NAVAL POSTGRADUATE SCHOOL
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THESIS

THE PERFORMANCE OF REDUCTION OF TOTAL OWNERSHIP COST (R-TOC) PILOT PROGRAMS

by

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December 2002

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13. ABSTRACT ***(maximum 200 words)***

In April 1998, within the initiation of Section 912c studies (PM Oversight of Life Cycle Support), DoD expanded the responsibilities of Program Managers for designing and producing new weapon systems to include more accountability for the TOC of the systems, including O&S (Operation and Support) costs. At a December 1998 DSAC (Defense Systems Affordability Council), each service agreed to provide 10 program names for the 912c study. DoD would continue to track all 30 service pilot programs as R-TOC programs.

This thesis analyzes the utilization of Reduction of Total Ownership Costs (R-TOC) pilot programs in DoD Services. It identifies the lessons learned from the R-TOC pilot programs and the obstacles encountered to promote efficient reductions in the Total Ownership Costs of DoD weapon systems. It also makes recommendations for DoD leadership to establish a more efficient R-TOC environment.

The conclusion is that the performance of R-TOC is efficient because it forces PMs to consider TOC in their programs, and helps to identify obstacles, and encourages saving initiatives. Although further progress will be captured by blocking the inhibitors identified in Chapter IV, OSD should continue advocating R-TOC .

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THE PERFORMANCE OF REDUCTION OF TOTAL OWNERSHIP COST (R-TOC) PILOT PROGRAMS

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I. INTRODUCTION

A. BACKGROUND

Increased wear and tear on DoD weapon systems, due to the unprecedented high pace of deployments in recent years, has hurt readiness and raised maintenance costs. The services, so far, have covered the increased costs by shifting funds from their modernization accounts and delaying new procurement, thereby further increasing the burden on existing equipment. Dr. Jacques S. Gansler, former Under Secretary of Defense (Acquisition, Technology & Logistics), USD (AT&L), described this process as a "**vicious cycle.**"

DoD attacked the "**vicious cycle**" problem by implementing Reduction of Total Ownership (R-TOC) Pilot Programs to identify all TOC cost drivers and the necessary initiatives to reduce these drivers. In April 1998, within the initiation of Section 912c studies (PM Oversight of Life Cycle Support), DoD expanded the responsibilities of Program Managers for designing and producing new weapon systems to include more accountability for the TOC of the systems, including O&S (Operation and Support) costs. At a December 1998 DSAC (Defense Systems Affordability Council), each service agreed to provide 10 program names for the 912c study. DoD would continue to track all 30 service pilot programs as R-TOC programs [Ref. 1].

DoD initially planned to set and achieve Total Ownership Cost Reduction targets for R-TOC pilot programs and then to extend these targets to all programs and become increasingly more aggressive as lessons learned were applied across all systems.

The primary focus of the pilot programs is that industry, by assuming responsibility for O&S costs, would have incentives to modernize the equipment, and thereby make it more reliable and cheaper to maintain by having a stake in the savings.

The R-TOC Pilot Programs were established as the key players in implementing R-TOC throughout all DoD systems by:

- developing R-TOC strategies and sharing "lessons learned"
- identifying needed policy and legislative changes
- gaining visibility for the Operation & Support costs

In his "Into the 21st Century –A Strategy for Affordability" memorandum, January, 20, 1999, Dr. Jacques S. Gansler, Undersecretary of Defense, assigned two top-level objectives for the R-TOC Pilot Programs.

- New systems must incur at least 50% less TOC than the systems they replace
- For fielded systems, the O&S costs per weapon system per year compared to FY1997 baselines must be reduced as follows: 7% by FY2000, 10% by FY2001, and 20% by FY2005

B. OBJECTIVES

This thesis will analyze the overall efficiency of R-TOC pilot programs in DoD, whether or not R-TOC has thus far been a value-adding activity, and the performance of R-TOC pilot programs and whether they are falling short of or exceeding their goals. This thesis will also ascertain the needed areas in R-TOC efforts that should be considered higher priority, and what DoD leadership must do to promote R-TOC initiatives.

C. RESEARCH QUESTIONS

1. Primary Research Question

Are DoD R-TOC pilot programs achieving their objectives?

2. Subsidiary Research Questions

- Why is R-TOC important for DoD?
- What are the R-TOC pilot programs?
- How are the R-TOC pilot programs currently performing?
- What is needed from DoD leadership to enhance R-TOC efforts in DoD services?

D. SCOPE

This thesis analyzes the utilization of R-TOC pilot programs in DoD Services. It identifies the lessons learned from the R-TOC pilot programs and the obstacles encountered to promote efficient reductions in the Total Ownership Costs of DoD weapon systems. It also makes recommendations for DoD leadership to establish a more efficient R-TOC environment.

This thesis does not contain any individual discussions of each of the 30 R-TOC pilot programs. The metrics for efficiency of R-TOC pilot programs are derived from

GAO reports, program briefings, congressional hearings, budget reviews and the results from interviews with the government and contractor personnel affiliated with the R-TOC pilot programs.

E. METHODOLOGY

The methodology used in this thesis consists of the following:

- Conduct a literature review of books, professional journals, magazine articles, web-based materials, pilot programs' websites, GAO reports, and other library information sources
- Survey active R-TOC Pilot Programs via the internet and phone interviews with key contractor and government personnel involved in R-TOC programs

F. ORGANIZATION OF THE THESIS

This thesis is divided into five chapters. Chapter I introduces the topic and provides background information on the R-TOC concept.

Chapter II presents the development of the R-TOC pilot programs and the need for establishing them. It also defines the types of initiatives identified by the pilot programs.

Chapter III outlines the general research strategy, and presents the researcher's findings on R-TOC.

Chapter IV analyzes the data highlighting the problems and successful approaches.

Chapter V summarizes the thesis conclusions and makes recommendations to improve R-TOC efforts in the Department of Defense.

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II. R-TOC PILOT PROGRAMS

A. INTRODUCTION

This chapter will discuss the importance of the R-TOC pilot program and will provide an introduction to the R-TOC pilot programs.

B. WHY IS R-TOC IMPORTANT FOR DOD?

The R-TOC pilot program was established in response to long-standing concerns about the adverse impact of defense budgetary and operational trends on force structure and readiness. Declining procurement funds have caused a rapidly aging inventory. Rising O&S costs consume larger amounts of the defense budget, and therefore, even less is available for modernization [Ref. 2].

On July 16, 2001, Secretary of Defense Donald Rumsfeld, testifying before the House Appropriations Committee on the DoD budget, stated, "The U.S. Armed Services have been under-funded over a sustained period of years." He concluded by stating that "The shortfalls are considerably worse than I had previously imagined" [Ref. 3].

Historical DoD budget data can be used to observe trends in the size and the composition of DoD's budget. Table 1 illustrates the DoD Budget Authority (051) [1] between 1987-2002. The first column indicates that the DoD budget has increased by a factor of 1.2 since 1987. This figure is a misleading indicator of growth in the DoD budget for the following reasons:

- The inflation factor. The value of the dollar has decreased during this era. Column 2 is the value of each year's budget in terms of 2002 constant dollars. The real value of DoD's budget between 1987-2002 has gradually shrunk by 24 percent.
- Comparison of DoD's budget with the federal budget and the GDP helps in assessing of trends in the size of DoD's budget. If the government budget and the GDP are following different trends, the contraction of DoD's budget may be relatively more drastic. Table 1 illustrates that the share of DoD's budget from both GDP and federal outlays has been gradually decreasing since 1987.

[1] DoD Budget Authority (051) includes funding for Desert/Storm and allied Gulf War contribution.

	DoD Budget Authority (051) Current Year Dollars	DoD Budget Authority (051) in 2002 Constant Dollars	GDP Current Year Dollars	% of DoD Budget in GDP	Federal Outlays Current Year Dollars	% of DoD Budget in Federal Outlays
1987	274	434.92	4647	5.89	1004.1	27.29
1988	283.2	431.71	5014.7	5.65	1064.5	26.60
1989	290.8	422.67	5405.5	5.38	1143.7	25.43
1990	293	404.13	5735.6	5.11	1253.2	23.38
1991	287.5	380.72	5930.4	4.85	1324.4	21.70
1992	282	362.46	6218.6	4.53	1381.7	20.41
1993	267.2	333.58	6558.4	4.07	1409.4	18.96
1994	251.4	305.83	6944.6	3.62	1461.7	17.20
1995	255.7	302.29	7324	3.49	1515.7	16.87
1996	254.4	292.41	7694.6	3.31	1560.5	16.30
1997	258	289.88	8185.2	3.15	1601.2	16.11
1998	258.6	286.06	8663.9	2.98	1652.6	15.65
1999	278.6	301.51	9124.3	3.05	1701.9	16.37
2000	290.5	304.18	9744.3	2.98	1788.8	16.24
2001	309.9	315.58	10150.5	3.05	1863.9	16.63
2002	329.9	329.9	10361.6	3.18	2052.3	16.07

Table 1. DoD Budget for 1987-2002 (in Billions of Dollars)[2].

Table 2 shows a break down of DoD's budget by component and is converted into 2002 constant dollars. The main components of DoD's budget are Military Personnel, Operation and Maintenance (O&M), Procurement, and Research, Development, Test and Evaluation (RDT&E).

The following information from Table 2 is noteworthy for our research:

- Military Personal Expenditures consume a large part of DoD's budget. Table 2 illustrates that both Military Personnel funding and Budget Authority have decreased. Figure 1 shows Military Personnel funding as a percentage of DoD Budget Authority.

[2] Source: Based on OMB Data.

	Military Personnel	O&M	Procurement	R&D	Other	Total Budget Authority (051)
1987	114.29	120.95	128.1	53.33	15.85	434.92
1988	116.01	123.02	123.48	55.95	13.25	431.71
1989	113.96	124.41	116.28	55.52	12.5	422.67
1990	108.83	121.93	112.28	50.34	10.75	404.13
1991	104.5	114.17	104.77	47.02	10.26	380.72
1992	104.37	120.57	80.98	47.04	9.5	362.46
1993	94.88	111.36	65.92	45.57	15.85	333.58
1994	86.86	107.89	53.65	42.09	15.34	305.83
1995	84.73	111.01	51.6	40.83	14.12	302.29
1996	80.23	107.7	48.74	40.23	15.51	292.41
1997	78.99	103.82	48.31	40.9	17.86	289.88
1998	77.21	107.52	49.56	41.04	10.73	286.06
1999	76.4	113.64	55.3	41.45	14.72	301.51
2000	77.27	113.93	57.6	40.52	14.86	304.18
2001	78.31	117.92	63.75	42.36	13.24	315.58
2002	82	127.7	61.1	48.4	10.71	329.91

Table 2. DoD Budget Composition for 1987-2002 Expressed in 2002 Constant Dollars.

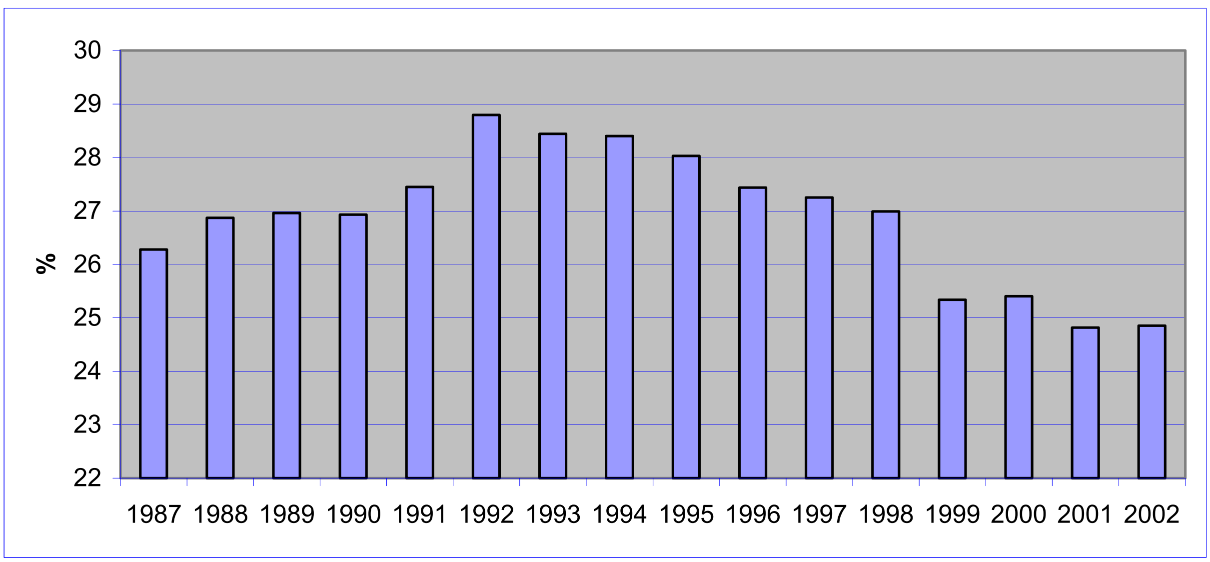

Figure 1. Military Personnel Funding as a Percentage of DoD's Budget.

The increasing trend until 1993 indicates transfers from the modernization account (Procurement) to Military Personnel funding. The percentage level of 1987 and below was not reached again until 1999. However, this decline can be attributed to the downsizing of the DoD personnel. During 1987-1998 Total DoD active-duty personnel decreased from 2,200,000 to 1,400,000, a 36 % drop in the number of personnel [Ref. 4].

O&M expenditures consume the largest portion of the DoD budget. The O&M account funds a wide range of activities, from the fuel used in the fighter planes to health care for DoD personnel and their dependents. From 1990 to 1997, in real dollar terms, there was a slight decrease in the amount of O&M funding. From 1998 to 2002, O&M has trended up slightly. Figure 2 shows O&M funding as a percentage of DoD's Budget Authority.

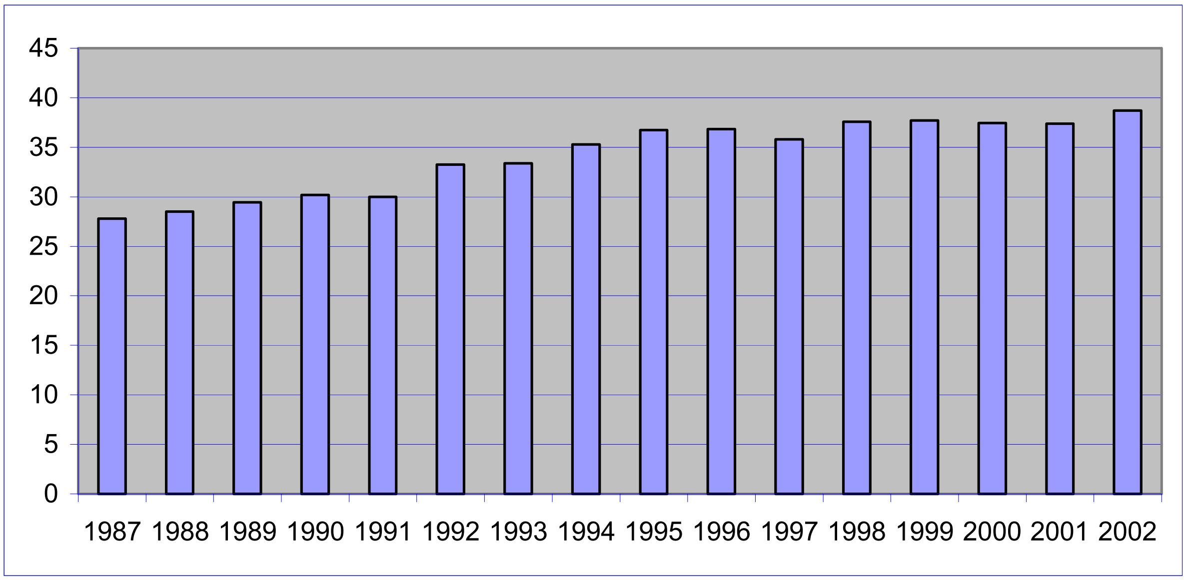

Figure 2. O&M Funding as a Percentage of DoD's Budget.

Figure 2 indicates that the percentage of O&M funding is gradually increasing. The foremost reason for this increase is aging equipment. DoD weapons get older and cost more as a result of decreased spare part availability and increased maintenance costs.

In Table 2, the downward trend in the real value of O&M partially reflects reduced procurement in the 1990s. After the collapse of the Soviet Communist Regime, the threat, which provided the principal reason to sustain the large budgets of the 1980s, no longer existed.

Figure 3 indicates that, in terms of percentages, transfers have been made from procurement to overhead accounts (Military Personnel and O&M accounts). The percentage of procurement funding in 1987 was 29.5% of DoD's budget. However, between 1993-2002, procurement funding was below 20%. The real dollar value of procurement funding in 2002 is less than one half of 1987's funding.

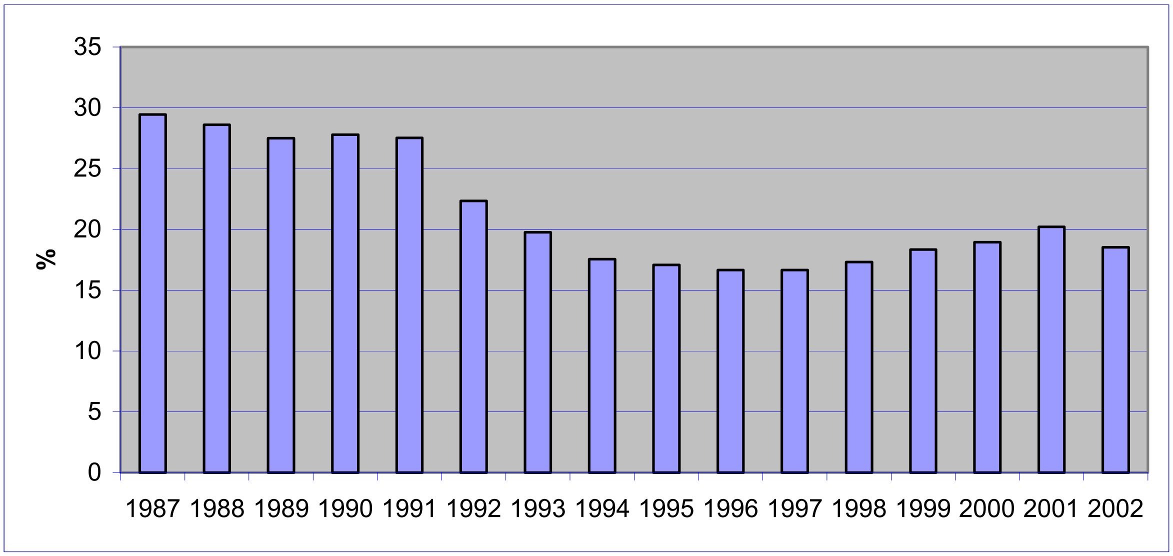

Figure 3. Procurement Funding as a Percentage of DoD's Budget.

R&D also experienced a downward trend in real dollar values. However, unlike procurement, R&D increased as a percentage of DoD's budget, when compared to its 12% level in 1987 (Figure 4). It can be stated that the decreasing procurement share in the composition also compensates for the increasing share of R&D in DoD's budget.

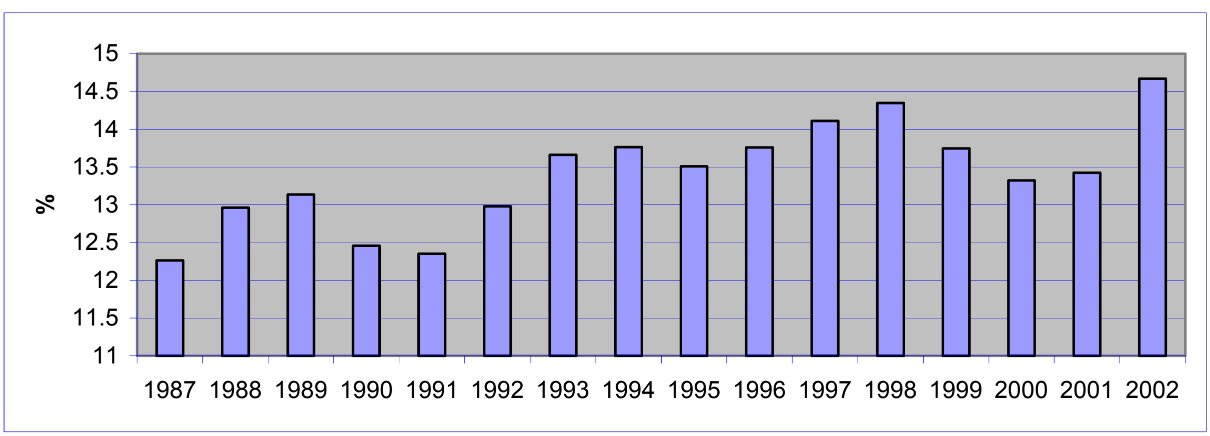

Figure 4. R&D Funding as a Percentage of DoD's Budget.

The overall picture shown in the aforementioned tables and figures indicates a "Death Cycle" within DoD. Shifting funds from procurement to cover the increasing maintenance costs of aging weapon systems is an adverse mechanism whereby decreasing procurement and modernization generate increased maintenance costs.

Aging has been a major O&S cost driver over the past decade. An August 2001 regression analysis by the Congressional Budget Office states that O&S costs increased by one percent for each additional year of average age for the Air Force aircraft, and 2.4 percent for Navy aircraft [Ref. 5].

Between 1980 and 2000, the average age of Navy aircraft rose from 11 to 16 years, the age of Air Force aircraft increased from 13 to 20 years, and the average age of the Army's helicopter fleet increased by 70 percent during this period [Ref. 6]. Bob Ernst, Head of the Naval Air Systems Command, said [Ref. 7]:

> The average age of our in-flight refueling and maritime surveillance aircraft is about 29 years. If they were cars in Maryland, they would qualify for historic license plates.

The most efficient way to fight the Death Cycle to prevent a possible catastrophe in the future is to increase procurement funding substantially. This must be done through Congressional appropriations or by devising strategies to relieve O&S cost pressures. DoD established the R-TOC pilot programs to identify methods to shift funding from O&S to procurement.

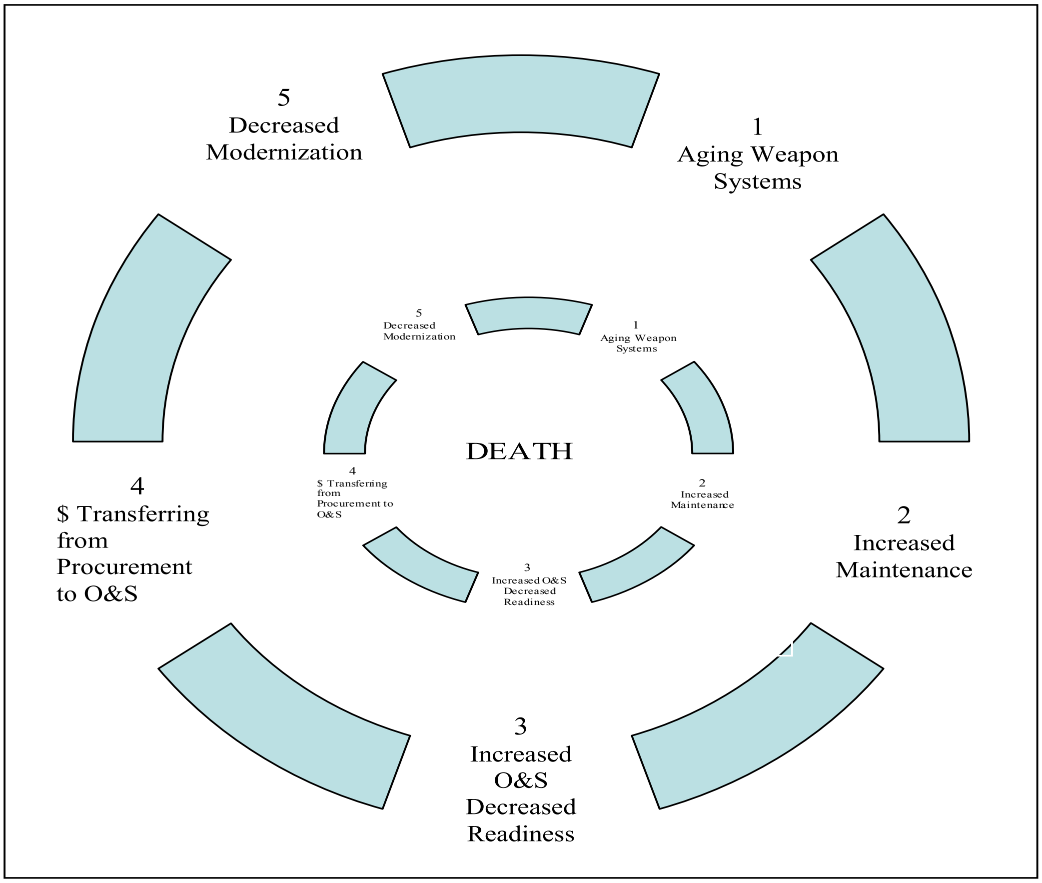

Figure 5. Death Cycle.

C. WHAT ARE R-TOC PILOT PROGRAMS?

The concept of R-TOC was already in place long before the R-TOC pilot programs were established. Cost As an Independent Variable (CAIV) followed by Section 912 c studies both emphasized reducing the total ownership cost of DoD weapon systems. Section 816 of the National Defense Authorization Act for FY1998 provided the final outcome of Section 912c studies, in which OSD was required to submit an action plan to Congress to streamline DoD acquisition.

Section 816 required DoD to designate 10 major weapon programs to collect and report data on O&S costs and to figure out appropriate ways to increase product reliability and readiness. To broaden these efforts at controlling O&S costs and increasing the reliability and readiness of weapon systems, DoD designated 10 programs from each service, a total of 30 programs. DoD would track these programs under the name of "R-TOC Pilot Programs." Out of these 30 R-TOC pilot programs, only 10 would be reported to Congress. However, all of these programs would participate in the Pilot Program Forums held on a quarterly basis.

The pilot program effort is used in three phases. In the first phase, the pilot programs prepared strategies, measures of effectiveness and their baselines. The second phase is implementation and testing of their strategies. The third phase will start at the beginning of FY2003 and finish at the end of FY 2005,and involves transferring these pilot strategies weapon systems strategies for the entire DoD. Figure 6 shows the datelines of the phases.

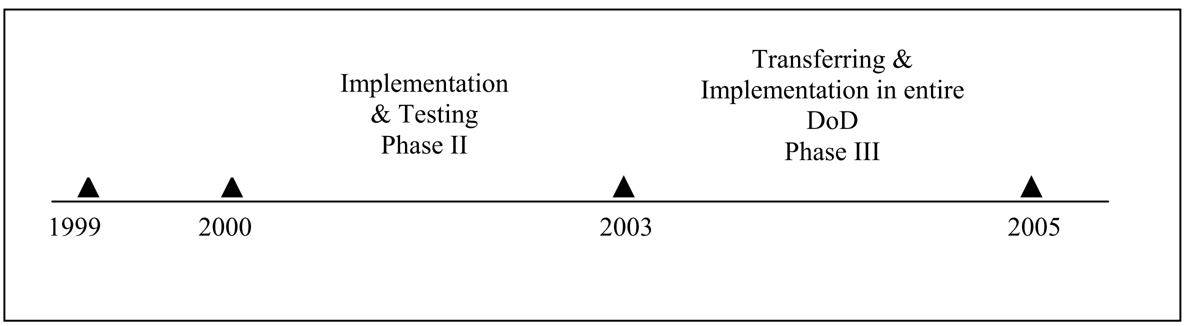

Figure 6. R-TOC Milestones.

Table 3 lists the DoD R-TOC programs. Section 816 programs are identified with an asterisk. These programs are in various phases of their life cycle. Some are fielded systems; some are in development or other stages of their life cycle. This diversity of phases has been created intentionally in order to exploit "lessons learned" from the pilot programs in every phase of a weapon's life cycle.

ARMY	NAVY/MARINE CORPS	AIR FORCE
Abrams*	AAAV	AWACS
CH-47	CG-47 Aegis Cruisers	C-5*
Comanche	Common Ship	C-17
Crusader	CVN-68	C/KC-135*
AFATDS*	EA-6B	Cheyenne Mountain
Guardrail	H-60 *	F-16*
HEMTT	LPD-17	F-117A
Precision Fires System of Systems (formerly HIMARS)	MTVR	JSTARS
TOW-ITAS	SLAM-ER*	B-1*
Apache*	ASE*	SBIRS

Table 3. R-TOC Pilot Programs.

A more detailed overview of each pilot program follows. The data is derived from program websites, GAO reports and various journals and hearings.

1. AH-64 Apache Helicopter

Life Cycle Phase: Fielded System

Strategy: Recapitilization

Service: Army

The Apache is the U.S. Army's main gunship/antitank helicopter whose life cycle is extending out to 2029. The original planned logistics sustainment of the Apache pilot program was Prime Vendor Support (PVS). PVS would have made the manufacturer, Boeing, responsible for sustaining and modernizing the aircraft by shifting the management of spare parts to them. PVS was based on the concept of "power by the hour," with the Army paying a flat fee for each helicopter flight hour. The plan had assumed savings of $2 billion over 20 years, under which the contractor team would assume responsibility for all repair and maintenance activities, which was then called "nose-to-tail" care for the entire Apache fleet. The goal of "nose-to-tail" was to upgrade the helicopter during periodical maintenance and repairs. However, the Army Working

Capital Fund, which used to manage the spare parts, stood to lose at least $50 million as a result of this plan. This would jeopardize other Army programs and, as a result, the Office of the Secretary of Defense (OSD) dropped the PVS approach, and did not turnover responsibility for spare parts from the Army Working Capital Fund [Ref. 8]. The Apache pilot program's current primary effort is directed towards focused recapitalization. Apache program's R-TOC solutions include material improvements, diagnostic enhancements, maintenance procedures, and training [Ref. 9].

2. M-1 Abrams Tank

Life Cycle Phase: Fielded System

Strategy: Contractor Logistic Support (CLS), Public/Private Partnering

Service: Army

M-1 Abrams is the U.S. Army's main battle tank. The Abram's engine and its mean time between failures has been a substantial concern influencing its readiness and a burdensome Operation and Support cost driver for the Army. The primary activities of this program are to improve reliability and decrease O&S costs through Performance Based Logistics Support. The Army plans four initiatives to improve reliability and maintainability:

- Partner with industry to overhaul engine components using contractor parts and technical support with Government labor and facilities.
- Reduce fuel consumption by 30 percent and increase reliability through an engine replacement program.
- Implement a technical support program to identify and replace obsolete parts, improve safety and provide post-deployment software support.
- Streamline the process for providing spare and repaired parts to the field through direct-vendor delivery, electronic data interchange and electronic commerce.

As part of this pilot program, Anniston Army Depot and General Dynamics have formed a partnership to rebuild the M1A1 and to extend its service life out to 30 years.

3. Comanche

Life Cycle Phase: Developmental

Strategy: Design for reduced O&S costs

Service: Army

The Comanche helicopter program started in 1983 and is still in the developmental phase. Full production is planned to start in 2006 and projected to continue up to 2028.

The R-TOC efforts of this program can be summarized as a design to reduce O&S costs. The Comanche will replace AH-64D aircraft, and it is projected to incur 53% less O&S LCC than the AH-64D [Ref. 10]. A June 21, 2001 GAO report states that the Comanche program faces significant risks related to cost overruns, scheduling delays, and degraded performance, and recommends that the program should make effective cost, schedule and performance trade-off decisions.

4. CH-47 Chinook Helicopter

Life Cycle Phase: Fielded system

Strategy: Reducing non-hardware cost drivers

Expected FY 2005 Cost Reduction:

The primary objective of this program is to develop an objective data system. The Army is refining a database to precisely measure operation and support costs and helicopter downtime by improved data collection and upgraded technical manuals and training [Ref.11].

5. Crusader

Life Cycle Phase: Developmental (Canceled in May 2002)

Strategy: Design for reduced O&S costs

Service: Army

The engine replacement program for the Abrams was also extended to the Crusader through the Abrams-Crusader Common Engine Program to reduce the O&S costs of both programs. The Crusader had been undergoing major restructuring to reduce the size and weight of the artillery system, and Secretary of Defense, Donald Rumsfeld officially canceled the program in May 2002.

6. Advanced Field Artillery Tactical Data System (AFATDS)

Life Cycle Phase: Fielded system with developmental components

Strategy: Reducing Personnel costs by consolidating in-use systems, CLS

Service: Army

AFATDS is a tactical data system for field artillery and provides integrated, automatic fire support for planning, coordinating, and controlling all fire support assets. The system also supports counter fire, interdiction, and suppression of enemy targets for close and deep operations [Ref. 12].

The primary R-TOC activity is to develop tactical management of both acquisition and legacy systems. The Army program team has been established to coordinate development of new systems with the support of the existing legacy systems to avoid duplication and to ensure interoperability between the new and legacy systems. The objective is to reduce operation and support costs by 20 percent by 2005 through increasing reliability and competitive sourcing of product support.

7. Guardrail Common Sensor

Life Cycle Phase: Fielded system

Strategy: Performance based arrangements

Service: Army

Guardrail is a corps-level, fixed wing airborne signals intelligence collection and target location system that provides real time targeting information to corps, division, and joint land force component commanders throughout the battlefield. The program will review all current contracts with support providers, including contractors, DLA inventory control points, and depots, to determine performance type and identify those appropriate for performance based contracting. Since Guardrail integrates many separately developed, technically sophisticated subsystems, it does not fit completely into the Army's traditional support structure for sustaining weapons. To provide better support for the systems and the forces that rely on them, the Army has established teams of stakeholders and established various agreements with these teams concerning the operational performance of the system.

8. Heavy Expanded Mobility Tactical Truck (HEMMT)

Life Cycle Phase: Fielded system

Strategy: Performance based contract partnership, Use of commercial products

Service: Army

The HEMMT program involves a family of 10-ton truck variants. It has been procured as a Non Developmental Item (NDI) since 1981. Ninety-five percent (95%) of

HEMMT parts are DLA managed .The primary R-TOC activity is to establish a Performance Based contract partnership between DLA and the Original Equipment Manufacturer (OEM). The Army intends to upgrade about 30% of its heavy truck fleet through an extended service program agreement between Oshkosh Truck Corporation and the Red River Army Depot. The program manager is applying an extended service program using commercial technologies to improve vehicle performance and reduce costs by the replacing high-failure-rate items. An award fee is being arranged with the contractor, covering operations and support performance. New interactive electronic technical manuals are being developed, and direct vendor delivery arrangements are being made with DLA to reduce inventories, achieve price reductions, and improve cycle times [Ref. 13].

9. HIMARS Multiple Launch Rocket System

Life Cycle Phase: Developmental system

Strategy: Total System Support Responsibility (TSPR), long-term contracts

Service: Army

The HIMARS multiple launch rocket system is still in development. The first EMD Launcher was delivered in November 2001.

The program is scheduled for fielding in 2005. The prime contractor is responsible for life cycle management. The Army is coordinating with the users as well as logistics support personnel to reduce total ownership costs and expects several initiatives to have a direct impact on the service's ability to control costs with the currently fielded multiple launch rocket systems [Ref 14].

10. Tube-launched Optically-Controlled Wire-Guided Improved Target Acquisition System (TOW ITAS)

Life Cycle Phase: In production

Strategy: CLS

Service: Army

The Army is managing a fixed-price support contract for supply and maintenance, which will tie the contractor's profit to the weapons' readiness level. The ITAS Contractor Logistic Support (CLS) is established to provide for wholesale supply and depot maintenance support for the system's life cycle. At the organizational and direct support levels, soldiers perform all maintenance and supply functions using standard Army processes and procedures. The ITAS program is expected to reduce total ownership costs of the TOW system by reducing the number of components to be supported and eliminating support equipment and scheduled maintenance [Ref. 15].

11. The Standoff Land Attack Missile - Expanded Response (SLAMM-ER)

Life Cycle Phase: Fielded System

Strategy: Commercial Off-the-shelf (COTS) Components

Service: Navy

The SLAMM-ER R-TOC effort is focused on reducing TOC primarily in the production phase, and secondly in operation and maintenance costs, which accounts for the majority of the system total ownership costs. By using commercial components, decreasing the number of parts, restructuring maintenance and establishing a commercial depot alongside the production facility, the Marine Corps plans to reduce annual operation and support costs [Ref. 16].

12. Aviation Support Equipment (ASE)

Life Cycle Phase: Mixture of fielded, developmental and production systems

Strategy: Performance Based Logistic support

Service: Navy

The Aviation Support Equipment (ASE) program is focused on performance based logistics support with incentives for improving O&S costs and reliability. The Navy is incorporating the best practices of many supply support programs into one. The program's goal is to improve reliability and to reduce supply chain response times while reducing overall costs [ref 17].

13. H-60 Helicopter

Life Cycle Phase: Fielded System with New Models in Development

Strategy: Virtual Prime Vendor Support, upgrading

Service: Navy

The H-60 pilot program is focused on reducing logistics requirements by consolidating makes and models. The Navy is reducing the logistics infrastructure for its fleet of helicopters by reducing the number of models from seven to one basic airframe with three variants. Under the overarching Helo Master Plan [Ref. 18], implemented by the H-60 program, the Navy will turn to Virtual Prime Vendor support for parts and material for all levels of maintenance as well as remanufacturing. By 2005, the Navy expects to cut operation and maintenance costs for the fleet by about 35 percent.

14. EA-6B Prowler

Life Cycle Phase: Fielded system

Strategy: Virtual Prime Vendor

Service: Navy

The key R-TOC activity can be defined as reliability centered maintenance and performance based support agreements. The Defense Logistics Agency is pursuing a virtual prime-vendor contract for engine parts. This program's main objective is to explore a Memorandum of Understanding (MOU) with fleet customers to identify responsibilities and agree upon aircraft inventory and readiness metrics. The MOU would provide increased insight into the factors degrading readiness [Ref. 19].

15. AAAV

Life Cycle Phase: Developmental system

Strategy: Contractor Logistics Support

Service: Marine Corps

The Advanced Assault Amphibious Vehicle (AAAV) is focused on up-front logistics investment and design for producibility efforts. The program is conducting design and supportability trade studies, and producibility assessments. Reducing the range and the depth of inventory is one of the main objectives. This program is still in the developmental phase, and savings estimates will not be available until 2004 [ref 20].

16. MTVR

Life Cycle Phase: In production

Strategy: Contractor Logistics Support

Service: Marine Corps

The Medium Tactical Vehicle Replacement (MTVR) program is currently in Low Rate Initial Production (LRIP), after awarding a five-year multi-year contract. The Marine Corps expects savings of about $30 million on repairs and reduced inventory through electronic commerce, electronic data interchange and direct vendor delivery agreements with the prime contractor [Ref. 21].

17. Common Ship

Life Cycle Phase: Fielded systems

Strategy: Technology insertion, reengineered maintenance to reduce manpower.

Service: Navy

The Common Ship program focuses on maintenance problem areas common to ships throughout the entire fleet, rather than those associated with only one particular ship class or type. The primary R-TOC effort is defined as the reduction of O&S costs while improving Quality of Life (QOL). This program includes initiatives designed to open product support to competition, and to modernize ships by upgrading spare parts and components. As of April 2002, Common Ship initiatives impacted 217 ships and 27 new products have been introduced into the fleet, such as Anti-stain paints, magnetic couplings for shipboard alignments, and various hand tools [Ref. 22].

18. LPD-17

Life Cycle Phase: In production

Strategy: Contractor Logistic Support

Service: Navy

The LPD-17 class carrier program is the planned functional replacement for four classes of amphibious ships. First ship delivery is expected at the end of 2003. LPD projects $4.5 billion (FY 1996 dollars) O&S Cost Avoidance through design initiatives. They are developing a PBL implementation plan, and expect to achieve savings totaling in billions of dollars for the entire program by contracting out most of the logistics support. The actual cost data incurred by this program will not be available until 2005, and anticipated savings have been removed from the program budget [Ref. 23].

19. CVN-68 Nimitz Class Aircraft Carrier

Life Cycle Phase: Fielded System

Strategy: Cost reduction through improving Quality of Life (QOL).

Service: Navy

The goal of the CVN-68 class ships program is to reduce TOC on aircraft carriers by reducing maintenance and improving reliability. The Navy anticipates substantial savings by using improved paints and coatings, zero maintenance composite vent screens, composite impellers, and split mechanical seals. The current program savings are not incorporated into the program budget.

20. AEGIS Cruiser

Life Cycle Phase: Fielded system

Strategy: Technology insertion, Virtual Prime Vendor Support

Service: Navy

The AEGIS R-TOC program was initiated to identify innovative SMARTSHIP technologies to reduce manpower requirements and equipment life cycle costs and, at the same time, increase ship performance and reliability. The Aegis Cruiser fleet's TOC baseline cost is estimated to be $72.9 billion over a 35-year service life (FY 2000 dollar). This program identified five initiatives, including: SMARTSHIP integrated ship controls; all-electric modification; stern flap; wireless technology; and advanced food service. These initiatives are projected to yield $57.6 million cost avoidance by FY2005 [Ref. 24].

21. F-16 Fighter Falcon

Life Cycle Phase: Fielded system

Strategy: Supplier performance agreements

Service: Air Force

The key R-TOC initiative of this program is a Combined Life-Time Support Concept. The program assumes a Firm Fixed Price (FPP) contract that provides incentives for the contractors to build more reliable components. The F-16 was one of four R-TOC Pilot Programs designated to experiment with performance agreements with users, performance agreements for support providers, and program-specific working capital funds. The F-16 program developed a Memorandum of Understanding MOU, which was signed between the System Program Office (SPO) and the Air Combat Command (ACC) on 26 June 01. The Air Force has established performance-based agreements with the suppliers and shifted responsibility for total logistics sustainment over certain avionics upgrades to the contractors. [Ref. 25]

22. Space Based Infrared System (SBIRS)

Life Cycle Phase: Developmental System with Fielded Components

Strategy: Cost As an Independent Variable (CAIV) analyzes, TSPR

Service: Air Force

The goals of the Space Based Infrared System are R-TOC savings and increased visibility of O&M costs by shifting the Total System Performance Responsibility (TSPR) to the contractor. The SBIRS program gives the contractor responsibility for virtually everything, except operating the system

The retirement and consolidation of old systems is the main concern for future O&M cost reductions [Ref. 26].

23. C-5 Galaxy

Life Cycle Phase: Fielded System

Strategy: Virtual Prime Vendor with DLA and prime contractor

Service: Air Force

The C-5 heavy transport aircraft program expects to improve aircraft reliability and reduce overall O&S costs by incorporating an Avionics Modernization Program (AMP) to upgrade avionics, and a re-engining program to use commercial off the shelf engines.

The program's objectives are to extend operational life to 2040, increase fleet availability and reduce Total Ownership Cost $53.9 million by FY 2005 [Ref. 27].

24. F-117A Nighthawk

Life Cycle Phase: Fielded system

Strategy: Contractor is given total system performance responsibility

Service: Air Force

The F-117A Nighthawk program uses a Total System Performance Responsibility (TSPR) contract. The contractor, Lockheed Martin Skunk Works, is completely responsible for supporting the F-117s. The TSPR contract is a Cost Plus Incentive Fee and Award Fee contract. Cost savings are shared 50/50 between the contractor and the Government, in case the savings are incurred from contractor–initiated actions. In FY01, the program had already generated $27.8 million in savings [Ref. 28].

25. K-135 Tanker Aircraft

Life Cycle Phase: Fielded System

Strategy: COTS electronics upgrade with 10-year warranty

Service: Air Force

The K-135 has a fleet size of 585 Aircraft in 40 worldwide bases with an average age of 41 years.

The key R-TOC activity of this program is to reduce the frequency of depot maintenance and to reduce the costs of Depot Level Reparables (DLRs) by replacing obsolete, low reliable equipment with Commercial-off-the-Shelf (COTS) equipment and prolonged warranties. The system TOC is estimated at $2.4 billion per year. The program assumes a cost reduction of $886 million by FY05.

The program has identified 27 initiatives to date, of which only eight have been funded by the Air Force [Ref. 29].

26. Cheyenne Mountain

Life Cycle Phase: Fielded system

Strategy: Total System Performance Responsibility

Service: Air Force

The Cheyenne Mountain Complex (CMC) consists of 24 communications, processing, and display systems. The CMC receives input from sensors located throughout the world to track air breathing and space borne vehicles and objects for decision-makers at both the National Command Authority and the Combatant Commander level. This program established a TSPR contract under the name of Integrated Space Command and Control Contract (ISC2) with the contractor, Lockheed Martin Mission Systems (LMMS). Under this contract, the Air Force transferred all logistics support to LMMS. The contractor integrates support for the complex in conjunction with Cheyenne's operations [Ref. 30].

27. C-17 Globemaster

Life Cycle Phase: In production

Strategy: Flexible Sustainment

Service: Air Force

The C-17 Cargo aircraft program has implemented the "Flexible Sustainment" contract on a trial basis. Flexible Sustainment is an interim support strategy utilizing a performance-based contract, measuring key system-level metrics. Goals include improved readiness through better data management; reduced operation and support costs through proactive management, based on reliability analysis and technology improvement; partnering between industry and the Government; and manufacturer performance warranties [Ref. 31].

28. Joint Surveillance and Target Attack Radar System (JSTARS)

Life Cycle Phase: Fielded system, in production

Strategy: Contractor Total System Support Responsibility (TSSR)

Service: Air Force

The Joint Surveillance Target Attack Radar System (JSTARS) program utilizes a sole-source system integration and support contract. The contractor, Northrop Grumman, is given total system support responsibility using a 6-year contract, with 22-year award term incentive. The contractor provides complete systems' logistics support. The Air Force, however, still maintains budgeting, contracting, requirements development and engineering authority. Northrop Grumman integrates all sustainment activities and has insight into those activities it does not directly manage, mostly using simulation models. JSTARS O&S Life Cycle Cost (LCC) was calculated as $9.114 billion, and the program projects a $2.278 billion (FY 1998 dollars) O&S LCC cost reduction [Ref. 32].

29. Airborne Warning and Control System (AWACS)

Life Cycle Phase: Fielded systems

Strategy: Replacement of low-reliability components and sub-systems

Service: Air Force

The AWACS Program has a relatively small fleet compared to the other Pilot Programs. It has a fleet of 32 operational aircraft.

This program identified two main initiatives:

- Diminishing Manufacturing Resources/Material Shortages (DMS/MS) Database
- Pinpoint II Tester

DMS/DM Database is an Oracle-based database tool to track, forecast and identify alternative part sources to mitigate DMS/DM problems.

Pinpoint II Tester diagnoses the faults in the circuit cards. It is more effective than the legacy tester, thereby increasing aircraft availability. [Ref. 33]

30. B-1 Lancer

Life Cycle Phase: Fielded system

Strategy: Wide range of cost-reduction initiatives

Service: Air Force

This program will update the B1-B long-range strategic bomber. As a part of the R-TOC efforts, a Cost Reduction Integrated Product Team (CRIPT) was established to identify, track, and document the champion cost reduction initiatives. The R-TOC approach consists of various cost-reduction initiatives. The Air Force is establishing service-level agreements (SLAs) with all organic supply-chain managers, which will yield metrics for the Air Force to define responsibilities and measure the program's performance. Under a long term partnering agreement, the Air Force expects to improve aircraft readiness and reduce operation and support costs through improved information and supply chain management [Ref. 34].

D. CHAPTER SUMMARY

This chapter presented the development of the R-TOC pilot programs and the need for establishing them. It also defined the strategies and initiatives identified by these programs.

The next chapter will outline the general research strategy, and present the researcher's findings on R-TOC.

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III. DATA PRESENTATION

A. INTRODUCTION

This chapter outlines the general research strategy used for this thesis as well as the researcher's findings. These findings are displayed in two subparts called GAO findings and survey results.

B. GENERAL RESEARCH STRATEGY

A comprehensive review of current literature was the principal research method used to answer the research questions, and focused on GAO reports, Pilot Program briefings and Quarterly Pilot Program Minutes.

In addition to the examination of current literature, the researcher also developed and administered a survey to a sample of Pilot Program officials. The Pilot Program officials responsible for the of total ownership cost reduction initiatives were targeted as the points of contacts when the survey was disseminated. Out of 25 requests, 13 addressed these R-TOC officials, eight addressed Deputy Program Managers and four addressed Program Managers. Of the 25 points of contacts receiving the survey, six participated. The response rate was 24%.

The participants were informed that this study would not address the performance of any individuals in the R-TOC Pilot Programs, but would ask questions concerning DoD overall. Therefore, the names of the participants would not be revealed, although their contact information will be kept in case it is necessary to contact them again.

C. RESEARCH DATA PRESENTATION

1. GAO Findings

A June 2000 GAO report, "Actions Needed to Enhance Success of Reengineering Initiatives," states that DoD will likely encounter problems in deriving benefits from the R-TOC pilot programs. The report points out that pilot programs have multiple program-specific objectives. Therefore, it will be very difficult to link the results into an overarching plan that integrates these individual efforts into a single department-wide implementation strategy. This report also emphasizes that the current R-TOC implementation schedule is overly optimistic. The report identifies the problem areas in implementing R-TOC as below: [Ref. 35]

- The transfer of inventory to contractors: the contractors will be reluctant to purchase overvalued DoD inventory
- Funding: These programs need significant up-front investment. However, DoD has not developed a budget plan to fund these investments. It is very likely that Program Managers will not receive the necessary funds. Moreover, Program Managers do not have complete control over the O&S costs. Some O&S funding should be transferred from Combat Commands to PMs.

In September 2000, GAO released a report, "Higher Priority needed for Army O&S Reduction Efforts," stating that the Army will likely not be able to significantly lower the high O&S costs that have reduced the amount of money available for modernizing its weapon systems. The report states that the "vicious cycle" will likely continue in the Army. Two deficient areas in the Army's R-TOC program are [Ref. 36]:

- The lack of assigned accountability and specific cost reduction goals for each system
- The lack of data. The Army was said not to be collecting data on all elements of the O&S costs of weapon systems

The Army responded that its efforts to track all O&S costs are still in the developmental stage, and as the lessons learned from their R-TOC initiatives are identified, a more accurate accountability of weapon systems O&S costs may result.

In October 2000, GAO released another report, "Risks in Operation and Maintenance and Procurement Programs," which states that DoD is unable to shift funds to Modernization and Readiness through infrastructure reductions, and warns that DoD may not produce the projected savings during the 2000-2005 timeframe, because the initiatives are long term efforts and require huge up-front investments. This report also states that DoD places higher priority on its current obligations, and therefore, procurement funding migrates to O&S costs [Ref. 37].

In May 2001, GAO issued another report entitled "Integrated Approach, Accountability, and Incentives are Keys to Effective Reform." This report stated that DoD's cost reduction effort lacks complete and accurate overall life cycle cost information for weapon systems, and therefore, it is impossible to determine the performance of these efforts [Ref. 38].

In September 2001, GAO issued another report entitled "Air Force Lacks Data to Assess Contractor Logistics Support Approaches." This report states that Air Force pilot programs are unlikely to provide the information needed to evaluate their cost effectiveness. The GAO's reasoning is that the Air Force did not perform a cost benefit analysis prior to its decision to use contractors to support their weapon systems. Therefore, the Air Force does not have sufficient data to determine whether or not the logistics support provided by the contractors achieved their cost and performance expectations [Ref. 39].

In February 2002, GAO issued another report, "Opportunities to Improve the Army's and the Navy's Decision Making Process for Weapon System Support," which states that R-TOC pilot programs are unlikely to provide the data needed to compare the initial expectations with the results. This report, as did the previous report on Air Force pilot programs, states that the Army and the Navy do not have sufficient data to assess the cost effectiveness of the proposed contractor support initiatives [Ref. 40].

2. Survey Results

Thirteen questions were asked to extract data for analysis. The questions, as well as the responses received, follow.

Question 1: What is your personal vision of the DoD R-TOC Pilot Programs and their future?

Response: Out of six participants, five stated that the R-TOC pilot efforts will be a winner. Only one respondent was neutral. A great deal of trust in future successes appeared to be the general trend. However, one respondent pointed out that these future successes are built on the hypothesis that OSD will continue advocating R-TOC. Some respondents stated that R-TOC is great because it forces PMs to consider TOC in their programs, helps to identify obstacles, and encourages cost saving initiatives. The one neutral respondent emphasized that it is not possible to see what will happen in the future, as these programs are pilots, and there is still insufficient data to favor or disfavor them. Five of the respondents stated that the R-TOC pilot program concept is beneficial and should be extended to all DoD programs.

Question 2: What are the advantages and disadvantages of being a R-TOC Pilot Program?

Response: The advantages and disadvantages are stated below:

- Advantages:
  - Increases program visibility to obtain funding for system specific initiatives
  - Provides a forum for identifying issues that adversely affect R-TOC efforts by voicing their problems and concerns to the officials most able to assist them
  - Provides an opportunity to prove a concept that may be beneficial to DoD as a whole
- Disadvantages
  - Additional workload developing and maintaining a R-TOC plan and cost data consumes the already insufficient resources
  - Being held accountable for all elements of a program that influence total ownership costs

Question 3: Is there a clear and concise DoD policy or tool showing how to format and start a TOC reduction initiative?

Response: All of the respondents agreed that there is no clear and concise DoD policy or tool. Each service has developed various different approaches to documenting R-TOC initiatives. The Army, Navy and Air Force have developed different formats for their PMs to use when submitting an R-TOC initiative for funding, and evaluation and prioritization of these various initiatives depends on the services' own sets of rules. One respondent stated:

> There are many different TOC programs available and all have their own unique format; likewise Value Engineering (VE); Reliability, Maintainability and Sustainability (RM&S); and Total Ownership Cost Reduction. Some of these formats stay constant. Some, like Total Ownership Cost Reductions, tend to change from year to year.

Question 4: How do you incentivize your staff to share their ideas and come up with cost saving ideas?

Response: The majority of the respondents were from R-TOC teams of the pilot programs. Since it is their job to develop R-TOC initiatives, they stated that they did not have motivational concerns. However, all of the respondents emphasized that for others in the Program Offices, it is very challenging to develop ideas that will achieve savings in their programs. One respondent stated that:

> In our program, some of our initiatives were to modernize, to improve readiness, and to fight obsolescence. These initiatives were also reducing ownership costs. We killed two birds with one stone.

Another respondent pointed out that participating/competing in the OSD PBD 721, which funds cost avoidance investment initiatives based on their ROI, is a good incentive.

The majority of the respondents emphasized that they are hosting an O&S seminar once or twice a year to discuss methods to reduce O&S costs.

Question 5: How many initiatives has your program identified so far; how many of these identified initiatives were funded?

Response: The respondents replied that among the initiatives that they had identified, many of them required no funding. One respondent pointed out that they are not submitting every initiative that they have identified. After analysis, some of them fail to meet the minimum requirements to be submitted.

One respondent stressed that although their initiatives have been funded once, subsequent budget decisions might reduce the scope of several of their initiatives.

Question 6: What are the metrics measuring the dollar effect of your TOC reduction initiatives?

Response: In all of the R-TOC programs, except those in the developmental phase, O&S savings in each year is measured against a constant Fiscal Year O&S baseline.

The respondents identified some other subordinate metrics to measure the dollar effect of their R-TOC initiatives:

- Reduction in cost per mile to operate
- Decrease in order/ship time
- Reduction in numbers of component failures (increase in MTBF)

- Comparison of costs for baseline programs to the costs for the initiatives

All the above metrics are measured over a long, specific period of time, usually 10 years or more.

Question 7: Does your R-TOC program have a gain-sharing policy among Government and the contractor? If yes, what is it based on?

Response: Out of six respondents, only one responded that there is a gain-sharing policy in place between the Government and the contractor. This respondent replied that that their Value Engineering program allows the contractor to share in any savings realized by incorporating a Value Engineering Change Proposal (VECP). In essence, the sharing of savings is the contractor's incentive to develop the VECP with his own funds. The gain-sharing ratio is decided in accordance with the incentive sharing rates stated in FAR Subpart 52.248.

Question 8: Do you have insight into the R-TOC practices of industry, or other foreign and domestic programs?

Response: All respondents replied that they only have insight into domestic DoD programs. One respondent stated that he also has a limited insight into the industry practices to reduce total ownership costs.

Question 9: Do you think that the current PPBS system is an obstacle to promote R-TOC?

Response: One respondent emphasized that it was not the PBBS, but the policy execution within PPBS that is the obstacle to promoting R-TOC efforts. The respondents stated several concerns:

- Single year appropriation makes long term commitment nearly impossible
- There are too many "colors of money"
- The services lack discipline in the Operation and Maintenance accounts
- PMs are held accountable for cost avoidance saving estimates without program stability for initiative investment

Question 10: Do you think that the PM turnover is an obstacle to promoting R-TOC initiatives?

Response: Only one respondent stated that PM turnover is an obstacle. The remainder felt that there were not any problems with PM turnover regarding O&S costs. One respondent pointed out that a civilian Deputy and staff that provide program continuity mitigate the issue of PM turnover.

Question 11: Do you believe that the TOC reduction of 10% for legacy and 20% for new systems until 2005 is a realistic goal?

Response: There were various responses to this question. One answered "no," two answered "it depends," and the remaining three answered "yes". Those answering "yes" pointed out that they had already realized these goals, assuming all of their cost projections are accurate. The two respondents answering, "it depends," pointed out that it depends on how you define your savings. One respondent stated: "It is probably realistic if measured on a saving per unit basis; but if measured in terms of overall fleet cost reduction, probably not."

One respondent pointed out that his PMO has a very large and aging fleet in the field, and hardware improvements reducing O&S costs can take a long time to show any effects. For example, O&S cost reductions can take over 10 years to really begin to make a difference from a fleet standpoint.

Question 12: Is your Program exceeding this goal or falling behind?

Response: Only two respondents stated they are falling behind while the remaining four stated that they are either on track or exceeding this goal.

Figure 7 is from an article by Dr. Spiros Pallas of the Strategic and Tactical Systems Office of the Under Secretary of Defense for Acquisition, Technology and Logistics (OUSD-AT&L). Dr. Pallas is the central R-TOC leader in the OSD. [Ref. 41]

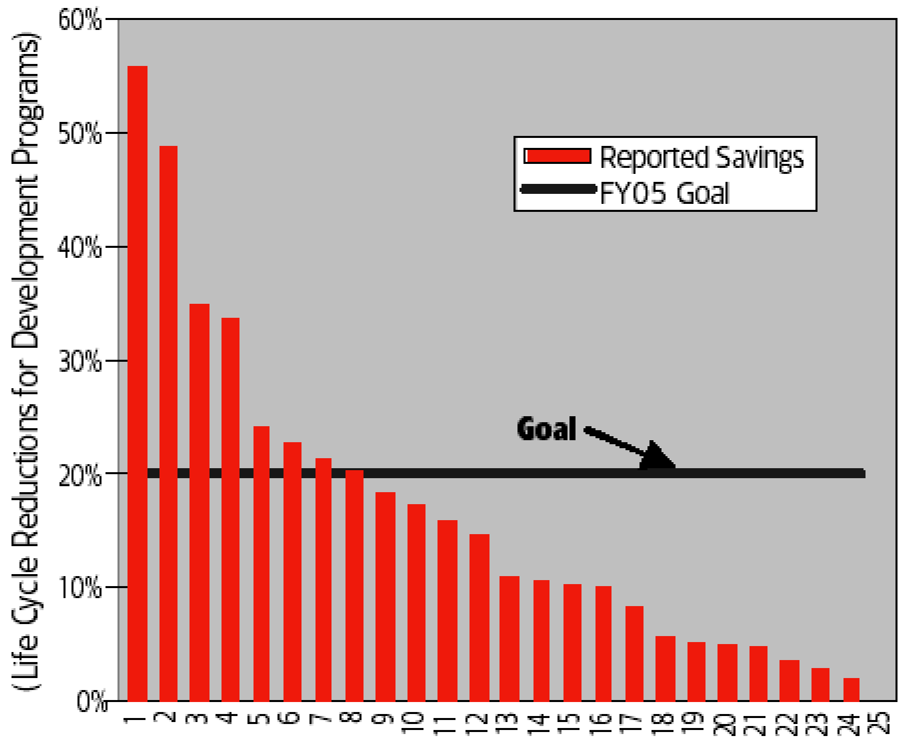

Figure 7. Projected Savings for Pilot Programs.

In Figure 7, five of the pilot programs were not reported because they are in the acquisition phase and excluded from calculations because they have no actual O&S costs.

Question 13: What are the main obstacles to promoting R-TOC in DoD services?

Response: The common problems of the respondents are listed below:

- Color of money and one year restrictions in O&M accounts
- Insufficient funding
- Lack of PM control over O&M accounts
- Difficulty of funding sustaining engineering analysis for systems once the system is out of production
- Concern that cost savings and cost avoidances will be removed from the budget before they have been validated or realized
- Complexity of tracking the actual cost of O&S
- Insufficient processes to measure savings and perform trade-offs

D. CHAPTER SUMMARY

This chapter outlined the general research strategy, and presented the researcher's findings on R-TOC.

Next chapter will analyze these data, and highlight the problems and successful approaches.

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IV. ANALYSIS

A. PROBLEMS

This chapter analyzes the problems hampering the efficiency of the R-TOC Pilot Programs in the following four areas:

- Concept development
- Budgeting
- Laws
- Tools

1. Concept Development

a. Milestones

R-TOC pilot programs were initiated to gather data to develop future department-wide strategies and policy changes by the end of 2005. DoD implementation was thus foreseen by the end of FY2002. The R-TOC test results from all programs will be evaluated and the results of successful implementations will be transferred to all DoD systems before the end of FY2005. However, only 25 of the pilot programs will have submitted their performance results when this thesis is finalized, as programs such as HIMARS, AAAV, SBIRS, and Comanche are still in their developmental phases and their R-TOC implementation plans either have not yet been developed or are subject to changes. Similarly, the Crusader program will not provide performance results, because the program has been cancelled.

Considering none of these five programs will be able to submit their savings estimates before FY2004, DoD will not have all the hoped-for information to meet its milestone to begin a department-wide R-TOC plan by the end of FY2002.

b. Too Much Diversification

Some of the pilot program initiatives are extremely program-specific and it will be impractical to transfer their results to a department-wide implementation plan. These programs seem to focus mainly on achieving cost savings, and not to develop cost savings concepts. Therefore, they may not provide meaningful results to develop a department-wide policy.

For example, some programs such as Abrams, the H-60, F-117 and SBIRS, are mixed efforts. Abrams involves both a public-private partnership and engine replacement. The H-60 involves both consolidating of various models and DVD supply contract efforts. The F-117 involves both implementing a Total System Performance Responsibility (TSPR) contract and other cost reduction initiatives, such as downsizing the program office. SBIRS involves both CAIV analyses and consolidating of old systems. However, these programs have not developed a methodology to differentiate each of their initiative's effects on cost savings.

Pilot Program	Increased Reliability	Decreased Response Time	Increased Supportability
Abrams	+	+	+
CH-47	+	+	
Comanche	+	+	+
Crusader	+		+
AFATDS	+		
Guardrail	+		+
HEMTT	+	+	+
HIMARS	+	+	+
TOW-ITAS			+
Apache	+		
AAAV	+	+	+
CG-47 Aegis Cruisers	+		
Common Ship	+	+	
CVN-68	+		
EA-6B	+	+	+
H-60	+	+	+
LPD-17	+	+	+
MTVR	+		+
SLAM-ER		+	
ASE	+	+	+
AWACS	+	+	+
C-5	+	+	
C-17	+	+	+
C/KC-135	+	+	+
Cheyenne Mountain	+		+
F-16	+	+	+
F-117A	+	+	+
JSTARS	+		+
B-1	+	+	+

Table 4. Composition of Pilot Program Approaches.

Table 4 shows the composition of different approaches to the R-TOC pilot programs. Most of the pilot programs are a mixture of improvements in supportability and reliability and maintenance. The more mixed a system, the more difficult to manage cost data because the responsibility for acquiring cost data shifts to a wide range of other services, such as maintenance depots, software support facilities and operational bases. Therefore, it becomes harder to evaluate the effectiveness of each individual initiative and to produce statistically validated concepts.

2. Funding

Funding is a real concern when evaluating the efficiency of pilot programs. The main funding concerns are listed below.

a. Lack of Program Manager Control in O&M Accounts

In the DoD Acquisition environment, the unit commanders control O&S funds while program managers traditionally control acquisition funds. This may be the most important problem hampering R-TOC efforts. The desired goals and objectives of the R-TOC efforts cannot be realized without giving PMs the responsibility and authority for the entire system related to O&S costs. Most R-TOC savings occur in the O&M account. However, program managers tend to focus on RDT&E and production phases of the life cycle and not sustainment. It is the latter area in which large O&S cost-savings usually occur.

Policy guidance directs that all pilot programs exclude Military Personnel and fuel costs from their baseline calculations. However, these accounts are the main cost drivers, and by not including them into the baseline calculations, pilot programs may not be addressing significant cost reductions.

Figure 8 shows a typical O&S baseline calculation prepared by the C-5 System Program Office (SPO), and presented at the 10th Quarterly Pilot Program Forum. This figure shows that SPO does not have direct control and authority for major areas of O&S costs. Although the weapon system is projected to incur an annual baseline O&S cost of $1.2 billion, the C-5 SPO only has direct influence over $549 million. Therefore, they used their directly controlled costs in establishing their baseline for the 20% OSD goal. The C-5 program's goal of a $109 million reduction in O&S costs by FY2005, in fact, only comprises 9% of the projected weapon system O&S costs.

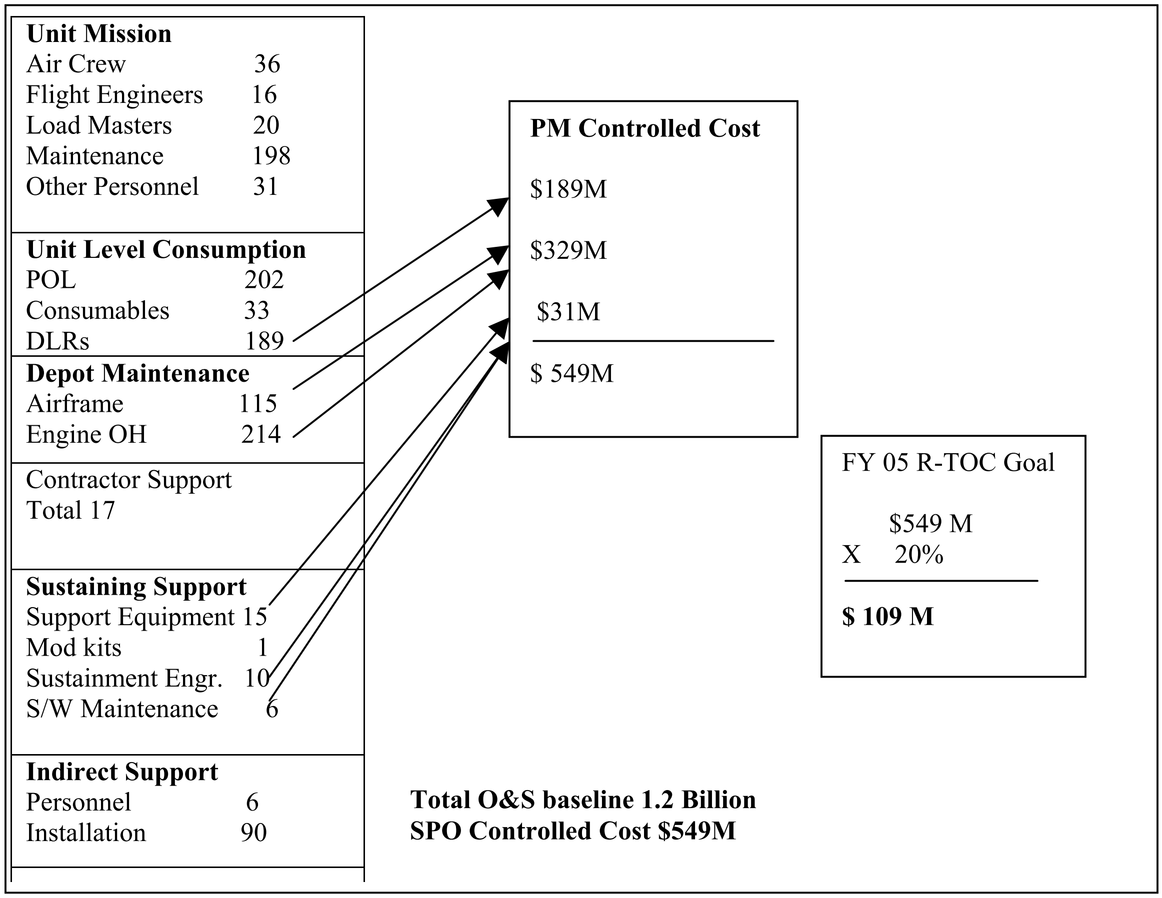

Figure 8. A Typical Baseline Calculation.

b. *PMs Do Not Get to Keep the Savings from R-TOC Initiatives*

There is no assurance that the PMs will be able to reinvest the R-TOC savings in their programs, which creates a disincentive for the PMs to dedicate all their resources to the R-TOC concepts. DoD has not issued any policy directing that at least some portion of these R-TOC savings will be reinvested by the PMs.

c. *Funding Instability and Lack of Funding*

Funding instability is, in fact, a common problem not only for the pilot programs but also for all DoD programs. There are various worthy R-TOC initiatives requiring a commitment of resources over the course of several years but funding is annually budgeted and may not continue to be funded over the required period.

Pilot programs being initiated to identify efficient methods to nullify the "Death Cycle" effect should have some sort of funding priority. OSD established additional funding under Program Budget Decision (PBD) 721 allocating $56M to fund the cost of economic and feasibility studies, environmental baselines and contractor support efforts. Although this funding provided incentives for the Pilot Programs, its effect is very limited. The $56 million comprises 0.04% of the O&M costs incurred in FY2002.

3. Legislation

There are various pilot programs such as F-117, C-17, and HIMARS, which are planned to test Total System Performance Responsibility approach. These programs are in place now and they didn’t report any legislative problems, though it is evident that there will be legislative issues when transferring the results of these initiatives into department-wide programs. The main legislative issues are listed below.

10 U.S.C 2464 requires that core logistics be performed by Government owned and operated facilities. However, the Secretary of Defense can waive the requirement and transfer the logistic support to the private sector in accordance with OMB Circular A-76.

10 U.S.C 2466 prohibits using more than 50-percent of funds in a fiscal year for depot-level maintenance and repair by non-Government personnel. The Secretary of Defense can waive this requirement for a single fiscal year because of National Security concerns.

10 U.S.C 2469 requires public-private competition before a depot-level activity is transferred to the private industry. However, this kind of competition is almost impossible, considering the lack of metrics and the resources that should be allocated.

An October 2002 GAO report, “Change in Reporting Practices and Requirements Could Enhance Congressional Oversight,” states that Air Force is already above the 50-percent public/private depot-level maintenance split ceiling. This report shows that Army and Navy are also very close to this ceiling. The percentages of private workload dollars in FY2001 were 46.8% for Army, 45.6% for Navy and 51.9% for Air Force [Ref. 42]. This data indicates that transferring R-TOC on a depart-wide basis faces major challenges remaining under the 50-percent ceiling, unless Congress increases the allowed percentage of private depot maintenance work.

4. Inefficient Tools

The GAO reports discussed in Chapter III mostly criticize R-TOC programs for not having complete and accurate overall life cycle cost information. However, this is only true for the R-TOC programs that are still in the acquisition pipeline. For fielded systems, the baseline calculations are pretty realistic with only small inaccuracies because of problems in getting data on the indirect costs of system operation and support (O&S) costs. Pilot programs use three main databases to find their cost drivers and track savings. These databases furnish historical data for the Pilot Programs. The Army uses the Operations and Support Management Information System (OSMIS), the Navy and the Marine Corps use the Visibility And Management of Operation and Support Costs (VAMOSC), and the Air Force uses the Air Force Total Ownership Cost (AFTOC). However, developmental programs don't have any actual O&S costs; therefore, they do not interface well with these information systems. For developmental systems, there aren't all encompassing estimating tools suitable for performing tradeoffs and measuring savings. The baselines for these systems comprise engineering projections only; therefore, their credibility is unknown.

B. PERFORMANCE IN TERMS OF ACHIEVING DSAC GOALS

The Defense System Affordability Council's original goal was for Pilot programs to reduce O&S costs, less military personnel and fuel, 7% by FY2000, 10% by FY2002 and 20% by FY2005, based on their FY1997 baselines. FY2001-2005 Defense Planning Guidance omitted intermediate-year results. All pilot programs are now required to achieve a 20% reduction in O&S costs by FY2005. However, some of these pilot programs are still in the developmental phase and they do not have any actual O&S costs, but only projections, and are therefore excluded from this calculation.

Figure 9 is prepared from the data presented by pilot program offices during Quarterly forums. It might be construed that some pilot programs are not working effectively. Although this can be misleading, as in the case of programs such as Abrams, which has a very large and aging fleet in the field; improvements that can reduce O&S costs may take longer than FY2005 to make an their projected impact.

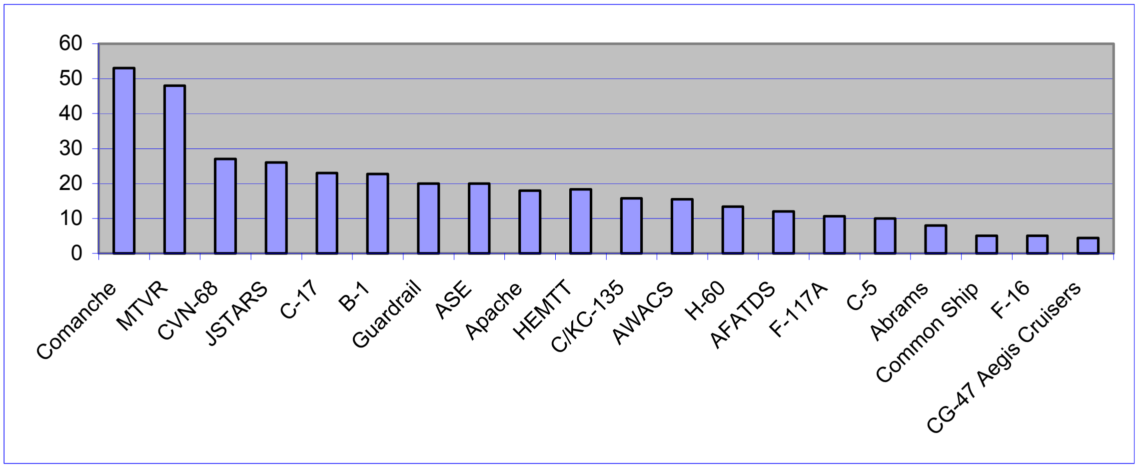

Figure 9. Projected Saving for Pilot Programs.

Table 5 shows the methodology used to prepare Figure 9. The program offices' projected cost savings are retrieved from their presentations delivered at Pilot Program Quarterly Forums, which are accessible via the Institute for Defense Analysis (IDA) homepage at http://rtoc.ida.org.

Program	%Savings by FY2005	Calculation Methodology
Comanche	53	(Estimated saving/FY2005 baseline)*100
MTVR	48	(Estimated saving in unit costs/baseline)*100
CVN-68	27	Estimated Reduction compared to the replaced legacy system
JSTARS	26	Program Office's projection
C-17	23	Program Office's projection
B-1	22.7	Program Office's projection
Guardrail	20	Program Office's projection
ASE	20	Program Office's projection
Apache	18	Program Office's projection
HEMTT	18.3	Program Office's projection
C/KC-135	15.8	Program Office's projection
AWACS	15.5	Program Office's projection
H-60	13.4	(Estimated saving/baseline)*100
AFATDS	12	Program Office's projection
F-117A	10.6	(Estimated saving/baseline)*100
C-5	10	Program Office's projection
Abrams	8	Program Office's projection
Common Ship	5	Program Office's projection
F-16	5	(Estimated saving/baseline)*100
CG-47 Aegis Cruisers	4.4	(Estimated saving/baseline)*100
CH-47	-	Unavailable
Crusader	-	Unavailable
HIMARS	-	Unavailable
TOW-ITAS	-	Unavailable
AAAV	-	Unavailable
EA-6B	-	Unavailable
LPD-17	-	Unavailable
SLAM-ER	-	Unavailable
Cheyenne Mountain	-	Unavailable
SBIRS	-	Unavailable

Table 5. Backup Table for Figure 9.

C. LESSONS LEARNED

The R-TOC pilot programs' successes depend on how efficiently they will transfer their experiences to the hundreds of other DoD programs. This sharing of "lessons learned" is now the highest priority for the R-TOC Working Group. Each pilot program presents their "lessons learned" in the quarterly Pilot Program Forums, which are accessible via the Internet. By creating a "lessons learned" database via the web, the R-TOC Working Group enables other PMs to conduct a broader range of cost saving analyses. Every PC user with military access can share these "lessons learned" captured by the Pilot Programs at http://rtoc.ida.org.

The lessons learned by the pilot programs will be reviewed using the same areas outlined in the beginning of this chapter.

- Concept development
- Funding
- Law
- Tools

1. Concept Development

a. Reliability and Maintenance (R&M) Improvements

To maximize R-TOC savings, reliability, maintainability, and availability must be incorporated into the system design from the beginning. When systems are in production or fielded, PMs have limited opportunity to improve reliability and maintenance, or reduce operation costs. For legacy systems, implementing major modifications may capture O&S cost reductions, but it is arduous and expensive.

Identifying and focusing on critical O&S cost drivers and readiness inhibitors may yield significant cost savings. For example, the LPD-17 program has identified the "Top 10 O&S Cost Avoidance Items." By incorporating improvements of these factors into the design, the program plans to reduce sailor workload and improve quality of life, while achieving better performance and reducing the O&S costs.

The installation of new sub-systems to increase capability may increase TOC in terms of training, maintenance, and hardware/software.

Low-density systems pose challenges such as poor economies of scale by distributing investment costs to a small number of weapon systems. Programs that have a larger fleet incur larger acquisition costs, but R-TOC savings are also greater and the payback period is smaller than the low-density weapon systems. For, example AWACS program has a fleet of 32 aircraft spread over a wide geographical area. The AWACS program faces challenges to target initiatives that demonstrate a large enough savings to justify investments [Ref. 43].

b. Supply Chain Improvements

Direct Vendor Delivery (DVD) contracts reduce logistics cycle time and O&S costs. For example,the HEMTT program awarded Oshkosh Truck Corporation a DVD contract in April 2000,which includes 1475 items. By August 2002, the price decreases on 1411 items added up to $3 million.The HEMTT program also cut the logistics cycle time by requiring Oshkosh Truck Corporation to deliver within 5 days via DVD.

c. Competitive Product Support

A gain-sharing policy for the contractor initiatives enhances R-TOC savings. For example, the F-117 program uses a 50/50 share between the Air Force and LM Aero for all savings beyond the 10% mandatory reduction in O&S costs required by the contract. The TSPR arrangement yielded under-runs of $3.9 million in 1999, $6.05 million in 2000 and $5 million in the first six months of 2001.

Adopting commercial products and procedures are effective in reducing O&S costs, where possible. For example, the ASE program uses a commercial maintenance agreement with Lockheed Martin Information Systems to support its Consolidated Automated Support System (CASS) systems, which requires 24-hour turn around time for high priority failures and 30-day turn-around time for routine transactions. This arrangement provides faster turn-around times for requisitions and reduced costs. The program also expects improved reliability via an incentive award fee.

2. Funding

Budget instability is a major inhibitor to enhancing the efficiency of R-TOC programs. When resources allocated are not available, PMs cannot be held accountable for execution of their cost savings estimates. For example, Abrams program will be reducing the original number of tanks for the AIM and PROSE initiatives due to instability in funding. This will also hamper Abrams program's saving projections and R-TOC plans.

Additional funding sources, such as PBD 721, create incentives for innovative initiatives and result in significant R-TOC savings. For example,the Air Force is projecting $94.8 million savings by an $11.6 million PBD 721 investment through FY2000-2007 [Ref. 44].

R-TOC goals are more difficult to achieve because of the tendency to take savings away from the program achieving them. Incentivizing PMOs through shared savings might strengthen R-TOC.

3. Law

To enhance the benefits of competitive product support throughout all DoD weapon systems, some relief from the 50:50 rule and a narrower core logistics definition are required. As stated earlier, the services are currently operating very close the 50-percent ceiling mandated in the law, and various R-TOC strategies like Total System Performance Responsibility (TSPR) and Public/Private partnering cannot be extended to other DoD programs within the limitation of this 50-percent ceiling.

4. Tools

The Visibility And Management of Operation and Support Costs (VAMOSC) databases have been converted into web-based data sources, so that program offices can perform R-TOC investment analysis and tradeoffs, and measure the impact of R-TOC savings via the Internet.

D. BEST PRACTICES

The best practices presented here have been chosen among many other best practices presented on the IDA website and pilot program briefings, because their impacts have been considered more significant.

1. Concept Development

a. Reliability and Maintenance (R&M) Improvements

Program: Abrams

Initiative: PROSE, AIM

PM Abrams has developed two initiatives to improve R&M. The first initiative makes innovative use of a partnership with PM Abrams/Anniston Army Depot/Honeywell to overhaul the existing AGT 1500 engine. This program is termed Partnership for Reduced O&S Costs, Engine (PROSE). Under PROSE, the Government is teamed with Honeywell to reengineer the production process and improve field support. Honeywell provides quality parts and expert technical support. Honeywell is responsible for project management and project engineering, customer support, supply chain management and quality assurance. Anniston Army Depot provides the skilled labor and facilities. Anniston Army Depot is responsible for repair and overhaul, testing failure analysis, and sustainment management. PROSE is expected to improve reliability by 30%. However, the greater potential for improved reliability and long term O&S cost reduction rests in replacing the AGT 1500 engine with a new engine. PROSE requires a $2.350 billion investment spread over 8 years from FY00-FY07. It is fully funded by the Army. PROSE projects potential savings of 13 billion over the remaining life of the tank by a 4 or 5-fold improvement in reliability, a 35% reduction in fuel consumption, a 42% reduction in the number of parts and significant improvement in vehicle mobility.

The second initiative for the improved R&M is the Abrams Integrated Management (AIM) program. The AIM process overhauls an old M1A1 tank to original factory standards, applying all applicable Maintenance Work Orders (MWO). The tanks will be like new, although it will still have the old technology of the1980s. The AIM tank project is estimated to result in 18% annual O&S cost savings.

Uncertainty in funding has reduced the scope of the PROSE and AIM initiatives. The number of PROSE engines and AIM tanks to be overhauled will likely be decreased significantly.

b. Supply Chain Improvements

Program: Heavy Expanded Mobility Truck (HEMMT)

Initiative: Direct Vendor Delivery (DVD)

DVD is a materiel acquisition and distribution method that requires supplier delivery directly to the customer. The DVD contract was signed between DLA and Oshkosh Truck Corporation (OTC). It captures 1811 items. Since the DVD contact has been in effect, actual savings of over $3 million for HEMMT unique materials have been reported. As a result of decreased inventories, contractor design changes are expected to increase reliability. Ninety-five percent of HEMTT parts are still managed by Defense Logistic Agency (DLA), and both DLA and OTC are seeking ways to expand the content of the DVD arrangement.

c. Competitive Product Support

Program: F-117

Initiative: Total System Performance Responsibility

Under F-117 TSPR, the contractor, LM Aero, assumes responsibility for system life-cycle management for the F-117 aircraft. The TSPR contract incorporates incentives for the contractor through a cost plus arrangement with award fee and incentive fee provisions. Additional costs and saving are shared 50/50 between the Air Force and LM Aero. The contract is based on an eight-year strategy with LM Aero committed to a 10% savings. The Air Force projects a savings of at least $170 million over eight years. The TSPR process has already enabled the Air Force to reduce the SPO size from 226 to 55 members, representing an eight- year savings of $82M in reduced personnel costs. The TSPR program has incurred under-runs from its start in 1999. The program office reinvested their share of TSPR under-runs in other initiatives, such as the engine sustainment program.

2. Funding

Program: C-17

Initiative: Multi-year Contracting

The C-17 Multi-year contracting is helpful in emphasizing the cost savings effects of budget stability. The C17's $14.2 billion seven-year multi-year contract for 80 airplanes is the longest and the largest multi-year contract ever entered into by the Government. In addition to previously negotiated annual savings of more than $4.4 billion realized from production efficiencies, streamlining and reform initiatives, the Air Force projects savings of over $1 billion through these long-term commitments.

The C-17 strategy incorporates innovative features, including performance based financing. For example, the contract states that future procurement depends upon a 25%

reduction in the C-17 average per-plane cost. This creates a good incentive for Boeing to manage the costs and work on proposals for additional aircraft.

3. Laws

The researcher could not find any best practices regarding laws and regulations to help block the inhibitors of R-TOC.

4. Tools

Program: JSTARS

Initiative: JSTARS Cost and Performance System (J-CAPS)

JCAPS is a set of analytical tools intended to perform the tasks stated below.

- Data warehousing of current financial and performance data to produce J-CAPS reports and tracks information and provides a single point data system for external reporting and information needs;
- Marginal analysis for assessing budget additions/cuts;
- Budget planning for POM exercises; and,
- Analysis of R-TOC proposals.

The above-intended functions are incorporated into the Statement of Objectives (SOO). Under the Total Systems Support Responsibility (TSSR) contract, Northrop Grumman is free and responsible for selecting system architecture, models and technology. The JCAPS will be instrumental in performing R-TOC analysis and aid in establishing annual contract performance targets.

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V. CONCLUSION AND RECOMMENDATION

A. INTRODUCTION

This thesis has examined how efficiently the pilot programs in DoD have tested the R-TOC concepts. The conclusions in this chapter respond to the subsidiary research questions presented in Chapter I and also answer the researcher's primary research question. This chapter also presents some recommendations for the DoD leadership to further enhance R-TOC initiatives and provides suggestions for further research topics.

B. CONCLUSIONS

The first subsidiary question asked "Why is R-TOC important for DoD?" As shown in the comparative figures in Chapter II, DoD established the R-TOC pilot programs in order to determine methods to shift funding needs from O&S to procurement. R-TOC initiatives were the most efficient way to fight the "Death Cycle" and prevent a future possible decline in equipment modernization. Overall, R-TOC is important in terms of devising strategies to relieve O&S cost pressures and increase procurement funding.

The second subsidiary question asked, "What are the R-TOC pilot programs?" A presentation of the R-TOC Pilot Programs presented in Chapter II provided an overview of each pilot program. It is important to recognize that these programs are in various phases of their life cycle: Twenty are fielded systems, five are in a developmental phase, and the remaining five are in production phases. This diversity of phases is intentional to exploit "lessons learned" from the pilot programs in every phase of a weapon's life cycle. The pilot programs are also testing diverse reengineering concepts, such as the Total System Performance Responsibility arrangement (TSPR), Virtual Prime Vendor support, Public/Private partnering, and Reliability and Maintainability (R&M) improvements.

Some programs, such as Abrams, H-60, F-117 and SBIRS, include mixed efforts. Abrams involves both public-private partnership and engine replacement efforts (R&M improvement). In such cases, it becomes more difficult for the pilot programs to evaluate the effectiveness of each individual initiative and to distill concepts or approaches that can be "carbon-copied." It is impractical to precisely analyze how much of the actual savings that should be attributed to each one of an array of initiatives.

The third subsidiary question was "How are the R-TOC pilot programs currently performing?" Chapter IV emphasizes that the Pilot Programs will not meet the FY2003 milestone to turn these pilot test results into an overarching depart-wide implementation plan. This is mostly because some of the systems that are still in the acquisition pipeline and can not provide credible cost projections. Chapter IV also presents the inhibitors for R-TOC performance, among which budget instability might be the most significant inhibitor. Without budget stability, the PM cannot be held accountable for cost reductions. There are various worthy R-TOC initiatives, but they require a commitment of resources over a period of several years against which the current one-year funding process works. The other inhibitors were identified as follows:

- Lack of Program Manager Control over O&M accounts
- Retention of savings from R-TOC initiatives
- Restrictive laws, such as the 50:50 rule and the "core logistics" definition

Chapter IV also illustrates the performance of pilot programs in accordance with DSAC's goal of 20% TOC reduction by FY2005. These programs are established on a basis of trial and error. Therefore, it is not logical to consider whether a R-TOC program is on track by just looking at the numbers. This thesis, rather than concentrating on the DSAC goal, regards the administration of the "lessons learned" process as a more important performance indicator. The performance of R-TOC is a step in the right direction, because it forces PMs to consider TOC in their programs, helps to identify obstacles, and encourages savings initiatives. Although maximum R-TOC progress will depend on changes in the law described in Chapter IV, OSD should continue to encourage R-TOC to achieve benefits such as have been demonstrated in the R-TOC pilot programs.

C. RECOMMENDATIONS

Based on the issues identified in this thesis, the following recommendations are made to help resolve the problems inhibiting the R-TOC initiatives and the continuity of the R-TOC process.

- Department-wide policies should be written with detailed instructions on how to formulate, and submit TOC initiatives. The R-TOC program should be extended to all DoD weapon systems as soon as possible. The developmental pilot programs may offer significant contributions and should be included as emerging results in the absence of complete savings data.
- Sustainment funding should be condensed into one single account for each program and placed under PM control. This would yield significant cost reductions by providing the PM with more flexibility to optimize Sustainment Support.
- DoD should establish a policy to reinvest the savings in the program realizing the savings. The removal or transfer of R-TOC savings is a disincentive hampering the effectiveness of the R-TOC process.
- More effective and user friendly tools should be established to make the complex R-TOC process easier for smaller programs which do not have the necessary analysis staff and that do not have the resources to manage R-TOC internally.
- A flexible budgeting process for managing R-TOC initiatives is necessary to get R-TOC initiatives approved and started. Funding needs to be structured in a manner that discourages arbitrary changes in approved funding levels.
- DoD should establish department-wide guidelines for the sharing of R-TOC savings between the Contractor and the Government. This is necessary to encourage contractor involvement. Without motivated contractors, R-TOC is unlikely to be a success.

D. SUGGESTIONS FOR FURTHER STUDY

Several areas for further research relating to R-TOC efforts are identified below:

- An analysis of the baseline calculation of R-TOC pilot programs and means to improve the existing cost databases such as VAMOSC, OSMIS and AFTOC.
- An action plan or a policy draft to extend R-TOC initiatives to all DoD weapon systems.
- A study to identify creative and promising logistic re-engineering processes.

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