



INSTITUTE FOR DEFENSE ANALYSES

**Institutionalization of Reduction of
Total Ownership Costs (R-TOC) Principles**
Part 1:
Lessons Learned from Special Interest Programs

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Executive Summary

The Reduction of Total Ownership Costs (R-TOC) program grew out of numerous reviews and discussions at Program Executive Officers'/Systems Command Commanders' conferences, the Defense Science Board, and others. It was officially established in May 1999 in response to longstanding concerns about the adverse impact of defense budgetary and operational trends on force structure and readiness. The purpose of R-TOC is to maintain or improve current readiness while reducing operations and support (O&S) costs. Thirty Pilot Programs were initially established to develop innovative new methods to achieve the R-TOC goal of reducing Fiscal Year (FY) 2005 O&S costs by 20 percent as compared to a FY 1999–FY 2000 baseline estimate.

In 2004, the R-TOC Pilot Programs were replaced by a set of fifteen Special Interest Programs (SIPs). The SIPs were established to institutionalize R-TOC principles and best practices and accelerate cost savings throughout the Department of Defense (DOD). On December 16, 2003 the Acting Under Secretary of Defense, Michael W. Wynne, issued a memorandum for the acquisition assistant secretaries of the Army, Navy, and Air Force on “Transformation through R-TOC.” According to the memo, the following vision was adopted “to further institutionalize R-TOC principles and accelerate progress:”

Through R-TOC principles, all defense systems will perform with increasing readiness and capability while avoiding increased operations and support resource costs and improving logistics footprint by institutionalizing the continuous implementation of innovative process and hardware improvements.

A new R-TOC goal was set for FY 2010—ALL programs should reduce inflation growth between FY 2005 and FY 2010 by 30 percent. Each SIP defined a set of projects/actions/initiatives or new processes/technologies to meet its goal. Potential areas included: 1) increasing the mean time between failures for critical parts; 2) eliminating obsolescence problems; 3) reducing part removals with no fault found; 4) incorporating new technologies; and 5) using Value Engineering trade studies to solve cost problems.

The Systems Engineering office in the Office of the Secretary of Defense (OSD) is responsible for managing the R-TOC program. The Systems Engineering office keeps abreast of the SIP progress toward reaching the goal of reducing O&S costs through R-TOC Forums. All SIPs were encouraged to attend all the R-TOC Forums which allow the SIPs to share their experiences and learn what has worked (or not worked) in other programs. This process was designed to help institutionalize R-TOC principles

throughout DOD by developing a set of lessons learned for other programs to use. Lessons learned are also documented in periodic progress reports.

While the cost reduction accomplishments by the SIPs are important, a more important SIP contribution is the potential influence that their advocacy and experiences can have on reducing ownership costs in hundreds of other DOD programs. The early life-cycle phases (requirements/concept development) are often the main determinants of fielded operating cost, but they have not been the main thrust of the R-TOC efforts. The main thrust is reducing the operating cost of fielded systems or systems about to be fielded. Fielded systems are the only ones for which operating costs are actually known and therefore the only systems where quantitative reduction targets can be established based on experience. R-TOC is also applicable to systems in design when there are O&S cost projections that can be used to evaluate emerging R-TOC proposals.

A framework for reducing total ownership costs in this context was developed from lessons learned from the experiences of the R-TOC SIPs and other information shared during the R-TOC Forums. It represents a methodical approach to institutionalizing R-TOC within program offices and programs that implement this framework will reduce costs. The size of the cost reduction, however, is a function of the extent and the effectiveness of its implementation.

The framework is designed to be structured, systematic, and inclusive, yet it can be tailored to be responsive to change. It takes into account human and cultural factors and facilitates continual improvement. The framework is both an integral part of all organizational processes and a key factor in decision making. Specific lessons learned for all elements of the framework are provided in this paper.

The framework begins with establishing an affordability culture throughout the program office. Once this happens, meaningful R-TOC goals and objectives are set. Then a careful, analytical approach is used to develop cost reduction concepts from both a managerial and a technical perspective. Then procedures are put in place to determine cost drivers from a managerial point of view. A technical analysis is needed to determine appropriate ways to reduce their cost.

Once cost reduction concepts (or ideas) have been identified, they become finalized through an iterative process of interacting with the relevant stakeholders, building the business case, and developing budgets to fund the upfront investments necessary for implementation. After projects are approved, their execution is monitored to verify that the intended results are achieved. This verification step, not only enables corrective action, but it also contributes to achieving R-TOC goals and objectives, establishes a basis for revising them, and provides experiences to support the formulation of new projects to attack remaining cost drivers.

Recommendations for institutionalizing R-TOC have been developed based on SIP experiences. *Service Headquarters and OSD should expand their role in championing the institutionalization of cost reduction activities.* Changes should be made to OSD's Selected Acquisition Reports, Acquisition Program Baselines (APBs), and Defense Acquisition Executive Summary (DAES) reports to capture cost baselines, cost reduction goals, and the plans to achieve them. DAES meetings should include these subjects in their agendas. R-TOC should be established as a parameter that must be included in the APB and then monitored over time.

The 2009 "DOD Weapon System Acquisition Reform: Product Support Assessment" also included three recommendations to strengthen the management and governance of program O&S costs:

- Strengthen guidance and policy so that sustainment factors are sufficiently addressed and governed at key life-cycle management decision points.
- Issue DOD policy to require the Components to conduct an independent logistics assessment (ILA) prior to Milestone B, Milestone C, and Full Rate Production, and provide the ILA report to Deputy Under Secretary of Defense for Logistics and Materiel Readiness (DUSD(L&MR)) thirty days before the milestone decision.
- Create a post-Initial Operational Capability review led by DUSD(L&MR) and the respective Service(s) responsible for life-cycle management.

Each of these reviews should address program status in achieving R-TOC objectives.

R-TOC must become embedded in systems engineering processes and be considered in all engineering design trades. To incorporate the management focus of the R-TOC principles, resources must be available and checkpoints must be established at all acquisition decision points. A set of systems engineering questions on R-TOC should be prepared and become part of every program and technical review and each milestone decision point.

The ownership cost reduction framework described in Section 2 should be augmented with new data and an associated maturity model to identify progress in the adoption of key activities. Additional lessons learned should be generated to give programs additional ideas and approaches to reduce cost. New Forums for sharing information should be established and emphasized by upper level management to generate participation by organizations that are in a position to spread the word about the importance of R-TOC efforts. Case studies should be performed to develop a stronger basis for spreading R-TOC principles to other programs.

The barriers that strongly discourage the Services from making investments to reduce ownership costs in the future must be overcome. Until these barriers are

eliminated, very few meaningful cost reduction projects will be funded because insufficient resources will be available.

To help overcome these barriers, there should be increased communication of the service-wide total ownership cost reduction objectives. *All programs should be required to implement the R-TOC framework.* A program's ability to achieve cost savings/avoidance using the framework is a function of the number of people assigned to the job and the amount of resources that can be made available to make the necessary upfront non-recurring investments that will lead to a substantial return on investment in the future.

Furthermore, *all DOD programs should be required to prepare annual cost reduction plans to be reviewed by the Program Executive Office (PEO) and Service Headquarters.* Success stories could be circulated throughout DOD to stimulate applications and cross-pollinate ideas. Future R-TOC Forums might then be drawn from each Service's outstanding achievers so that attendance at a meeting would represent formal recognition of program achievement. Such a selection process could, in effect, make every DOD program a potential R-TOC success story. Service Headquarters and OSD may also be able to help overcome regulatory and policy obstacles to R-TOC.

Individual program cost reduction goals should be tailored to the specific circumstances of that program. There is no reason to apply the same cost reduction goal to every program. Savings are dependent on where the program is in its life cycle—programs in development or production have the opportunity to make larger cost reductions. Savings are also dependent on the availability of resources to invest as well as the number of platforms that can be affected. Finally, savings potential in the future is dependent on the extent to which effective cost reduction efforts have been employed in the past. A program that has had aggressive cost reduction efforts should not be given the same goal as a program that has not paid any attention to cost reduction

Programs should assign the appropriate number of people to the R-TOC function regardless of the amount of investment funding available to implement cost reduction initiatives. In addition, *greater use should be made of program offices that focus solely on common support equipment.* These types of program offices are designed to reduce the ownership cost of the equipment they manage. These issues may get very little attention when they are managed by the weapon system program office.

Improved analytic methods are needed to track and assess overall program O&S costs, as well as individual ownership cost reduction projects. The most significant weakness is O&S cost baselines are neither well documented nor well understood. *The Services should issue rigorous guidance for establishing and updating cost baselines for overall program savings and individual project savings.* The guidance should explain what to include in measuring current costs as well as future costs, both with and without a

change being implemented. This also implies that the data collection and databases from which the baselines are drawn must be adequate. Any assumptions made concerning the data and the baselines derived from them should be fully documented.

Improved baselines will also provide a basis for differentiating cost savings from cost avoidance. *Acquisition leadership in the Services should ensure that future budgets are not decremented inappropriately.* While numerous cost savings/avoidance initiatives have been implemented through either program or outside funding, reductions to out-year budget estimates should not be automatic. This practice has nothing to do with the validity of cost saving/avoidance or with the estimated impact on current average costs. There are other factors involved such as uncontrollable variables, increases not factored into future budgets, and reducing the time spent on O&S functions by organic personnel.

Nevertheless, bad behavior should not be rewarded. Program Managers (PMs) who are not effective in reducing costs should not benefit from the efforts of PMs who do. Instead, *PMs should be incentivized to practice cost reduction.* One way of incentivizing program managers is to allow some reinvestment of savings. For example, allowing the PM to receive some or all of the resultant savings through direct budget transfers would reward proactive management and create a revolving account within each program to support future savings initiatives. In addition, such a scenario would guarantee that only those PMs maintaining active O&S cost reduction programs would benefit and provide a self-monitoring system wherein money becomes available only to those PMs producing results.

In summary, the use of R-TOC principles can be effective in reducing/avoiding O&S costs in the future. To be successful however, there must be emphasis on the subject at all levels of management. PMs must enforce the discipline necessary to identify projects. PEOs and service leadership must ensure resources are available to implement those projects. Finally, OSD must reinforce the importance of these efforts to ensure that all elements of the process improve continuously.

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1. Introduction

A. Background

The Reduction of Total Ownership Costs (R-TOC) program grew out of numerous reviews and discussions at Program Executive Officers'/Systems Command (PEO/SYSCOM) Commanders' conferences, the Defense Science Board, and others.¹ It was established in response to longstanding concerns about the adverse impact of defense budgetary and operational trends on force structure and readiness. Declining procurement funds due to rising operations and support (O&S) costs had resulted in a rapidly aging (and potentially inefficient and unsupportable) inventory.

The R-TOC program was officially established on May 10, 1999 by a memorandum from the Under Secretary of Defense for Acquisition, Technology and Logistics (USD(AT&L)).² The memorandum stressed that the purpose of the R-TOC program was to maintain or improve current readiness while reducing O&S costs. The memo instructed the Services to focus on three general R-TOC approaches:

- Reliability, maintainability and supportability improvements;
- Reduction of supply chain response time and reduction of logistics footprint; and
- Competitive product support.

New technologies and management practices provide significant opportunities to improve readiness and reduce ownership costs. World-class suppliers achieve cost reductions while making major improvements in customer support. Some Department of Defense (DOD) programs have achieved similar successes by adopting private sector improvements in logistics and supply chain management. The R-TOC program was initiated to capture the knowledge from successful programs and activities both within DOD and from the commercial world. It seeks to transfer this knowledge between programs and across the Services.

Thirty Pilot Programs,³ ten from each Service, were established to develop innovative new methods to achieve R-TOC goals and objectives. The thirty Pilot

¹ R-TOC Newsletter, September 1, 2005, 02/05.

² See USD(AT&L) Memorandum, *Future Readiness*, May 10, 1999, <http://rtoc.ida.org/rtoc/open/gansler051099.pdf>.

³ The list of Pilot Programs can be found at <http://rtoc.ida.org/rtoc/open/pilotprogram.html>.

Programs were instructed to develop an R-TOC implementation plan. These plans were submitted in October 1999. The thirty R-TOC Pilot Programs were all given a single cost reduction goal. They were challenged to reduce Fiscal Year (FY) 2005 O&S costs by 20 percent as compared to a FY 1999–FY 2000 O&S baseline estimate. This aggressive goal was designed to encourage the Pilot Programs to develop innovative cost reduction methods that could be disseminated to other programs.

Figure 1 depicts the self-reported savings/cost avoidances for the thirty R-TOC Pilot Programs as a percentage of their goal. The original pilot programs included a mix of programs in development, programs in production, and fielded systems. The reported savings/cost avoidances totaled \$1.8 billion in FY 2005 and \$69 billion over the life cycle of the Pilot Programs.⁴

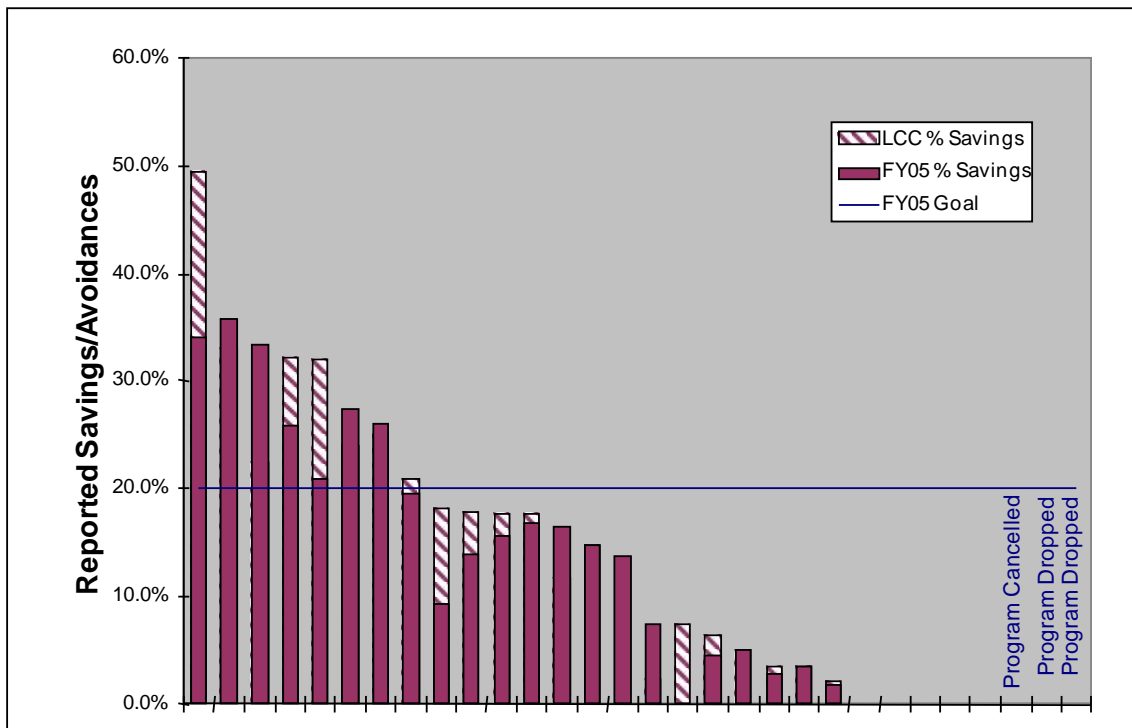


Figure 1. Self-reported Reduction of Total Ownership Costs (R-TOC) Pilot Program Cost Savings/Avoidances

⁴ They are constant dollars aggregated from various reports and in various years.

B. Establishment of Reduction of Total Ownership Costs (R-TOC) Special Interest Programs (SIPs)

In 2004, the R-TOC Pilot Programs were replaced by a new set of fifteen Special Interest Programs (SIPs). Twelve of the fifteen programs had substantial numbers fielded; the remaining three were in the Engineering and Manufacturing Development or the Production Phases of the acquisition life cycle. The SIPs were established by the USD(AT&L) to institutionalize R-TOC principles and best practices and accelerate cost savings throughout the Department of Defense.⁵

Accordingly, the USD(AT&L) set a new vision for R-TOC:

Through R-TOC principles, all defense systems will perform with increasing readiness and capability while avoiding increased operations and support resource costs and improving logistics footprint by institutionalizing the continuous implementation of innovative process and hardware improvements.⁶

Table 1 contains a list of the current SIPs.

Table 1. R-TOC Special Interest Programs

Army	Acquisition Activity	Navy	Acquisition Activity
Bradley A3 Upgrades	Sustainment	H-1 Upgrades	Acquisition/Sustainment
UH-60M Upgrade	Acquisition/Sustainment	V-22	Acquisition/Sustainment
Stryker	Acquisition	F/A-18E/F	Acquisition/Sustainment
Unmanned Aircraft Systems	Sustainment	Aviation Support Equipment	Sustainment
Guardrail		Common Ship	Sustainment
		H-60	Acquisition/Sustainment
Air Force		Joint	
Global Hawk	Acquisition	F-35 Joint Strike Fighter	Acquisition
Engines – F101 and F118	Sustainment		
F-16	Sustainment		

⁵ See USD(AT&L) Memorandum, *Transformation Through Reduction of Total Ownership Cost (R-TOC)*, December 16 2003, at <http://rtoc.ida.org/rtoc/open/SIP/Signed-Version-RTOC-Wynne-Ltr-16Dec03.pdf>.

⁶ The SIPs initially included the Army Future Combat System which was replaced with the UH60M Upgrade. Two Air Force Engine programs were combined into a single SIP. The Joint Unmanned Combat Air System was dropped from the original list.

A new challenge R-TOC goal was set for FY 2010—ALL programs should reduce inflation growth⁷ between FY 2005 and FY 2010 by 30 percent. Each SIP defined its individual goal, which was tracked and updated each year from FY 2005 through FY 2010, and also defined a set of projects/actions/initiatives or processes/new technologies to meet the goal. Potential areas could include: 1) increasing the mean time between failures for critical parts; 2) eliminating obsolescence problems; 3) reducing part removals with no fault found (NFF); 4) incorporating new technologies; and 5) using Value Engineering (VE) trade studies to solve cost problems.

VE, another systems engineering tool, is an initiative closely related to R-TOC. Value Engineering is an organized, structured approach to analyzing the functions of systems, equipment, facilities, services, and supplies to achieve the essential functions at the lowest life-cycle cost consistent with required performance, reliability, quality, and safety. Thus, VE approaches can be used to reduce ownership costs for a weapon system.

Figure 2 gives the latest self-reported results from the SIPs. They report O&S cost/avoidance savings of over 1.94 billion dollars and life-cycle savings/avoidances of over 100.7 billion dollars through their R-TOC efforts in 2010.⁸

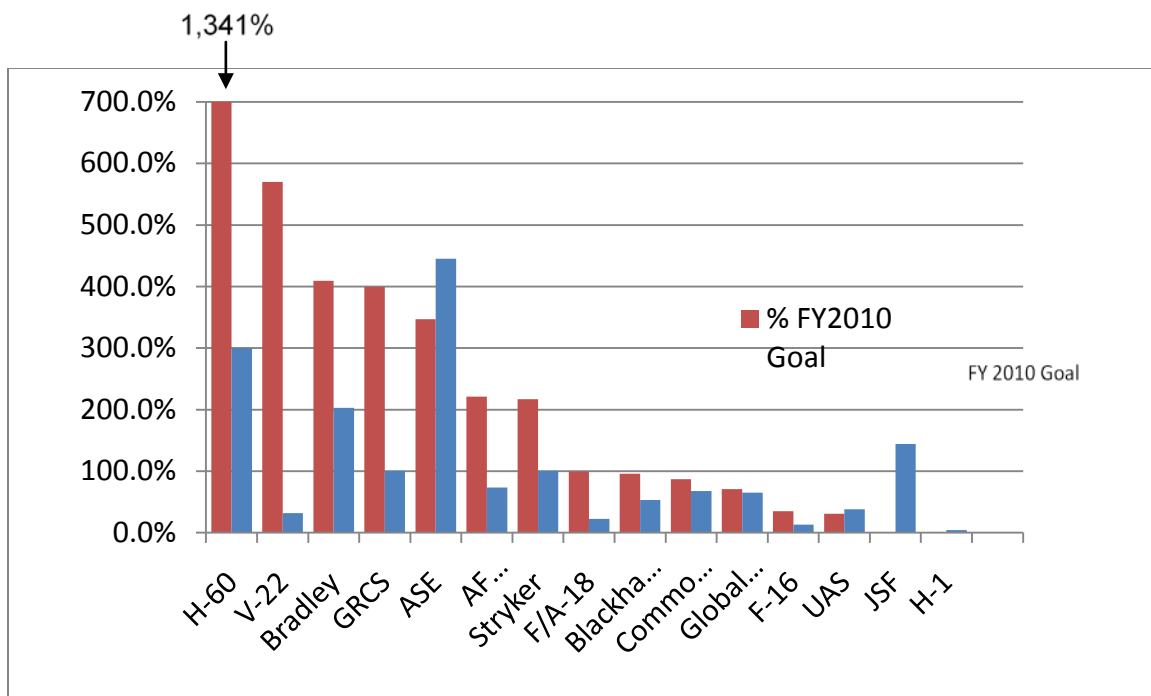


Figure 2. Self-reported R-TOC Special Interest Program Cost Savings/Avoidances

⁷ Inflation growth was defined as 2.5 percent per year for six years for a total of 15 percent. Thirty percent of inflation cost growth was calculated as 30 percent of 15 percent or 4.5 percent. Therefore, programs had to reduce O&S cost projections by a total of 4.5 percent over the six years.

⁸ They are constant dollars aggregated from various reports and thus in various years' constant dollars.

C. R-TOC Program Management

The Systems Engineering office under the USD(AT&L) is responsible for managing the R-TOC program. The SIPs were required to brief their initial plans for meeting their goals at a November 2005 meeting. Quarterly R-TOC Forums⁹ kept the Systems Engineering Office abreast of the progress of the SIPs while minimizing briefing demands.

SIPs were encouraged to attend all the Forums because they allow the SIPs to share their experiences and to learn what has worked (or not worked) in other programs. The Forums were designed to help institutionalize R-TOC principles throughout DOD by developing a set of lessons learned for other programs to use. Lessons Learned are also documented in periodic progress reports.

Another key aspect of R-TOC institutionalization was the establishment of R-TOC program element 0605017D8Z. This will be the subject of Part 2 of this paper.

D. Organization of this Paper

Section A of Chapter 2 introduces a framework for implementing improvements to R-TOC. Section B discusses management techniques for implementing an affordability culture and managing R-TOC projects. Section C discusses the technical approaches to R-TOC projects.

Chapter 3 makes recommendations for publicizing R-TOC programs, developing an affordability culture in the Department, and identifies tools such as Value Engineering that can be used to execute R-TOC projects.

Appendix A summarizes the lessons learned and results of the fifteen SIPs involved in this iteration of the R-TOC program. Appendix B reproduces a recent USD(AT&L) memorandum on Strengthened Sustainment Governance for Acquisition Program Reviews. Appendices B, C, and D contain the list of illustrations, references, and abbreviations respectively.

⁹ Forums began with the R-TOC Pilot Programs. Currently three Forums are held annually.

2. Framework for Reducing Ownership Costs in Programs Based on SIP Lessons Learned

A. Background

While the cost reduction accomplishments by the SIPs are important, a more important SIP contribution is the potential influence that their advocacy and experiences can have on reducing ownership costs in hundreds of other DOD programs. Experiences with the identification, implementation, and evaluation of R-TOC investments, along with management practices, barriers, and enablers from the SIPs, are summarized in Appendix B. They provide specific examples of R-TOC initiatives that have worked in a specific program and may work in similar programs.

The early life-cycle phases (requirements/concept development) are often the main determinants of fielded operating cost but have not been the main thrust of the R-TOC efforts. The main thrust is reducing the operating cost of fielded systems or systems about to be fielded. Fielded systems are the only ones for which operating costs are actually known and, therefore, the only systems where quantitative reduction targets can be established based on experience. R-TOC is also applicable to systems in design when there are O&S cost projections that can be used to evaluate emerging R-TOC proposals.¹⁰

Figure 3 shows a framework for reducing total ownership costs in this context based on lessons learned from the experiences of the R-TOC SIPs and other information shared during the R-TOC Forums. Many of the lessons learned represent consensus inputs from a number of R-TOC programs. Therefore the framework represents a methodical approach to institutionalizing R-TOC within program offices. Programs that implement this framework will reduce costs. The size of the cost reduction is a function of the extent and the effectiveness of its implementation.

The framework is designed to be structured, systematic, and inclusive, yet it can be tailored to be responsive to change. It takes into account human and cultural factors and facilitates continual improvement. The framework is both an integral part of all organizational processes and a key factor in decision making.

¹⁰ A design to total life-cycle cost perspective can be taken. For an industry perspective see James R. Hendricks, *Involving the Extended Value Chain in a Target Costing/Life Cycle Cost Process Model* (Austin, TX: The Consortium for Advanced Management International) 6 November 2009.

The framework begins with establishing an affordability culture throughout the program office. Once this happens, meaningful R-TOC goals and objectives are set. Then a careful, analytical approach is used to develop cost reduction concepts from both a managerial and from a technical perspective. From a managerial point of view, procedures must be put in place to determine cost drivers. A technical analysis is needed to determine appropriate ways to reduce their cost.

Once cost reduction concepts (or ideas) have been identified, they become finalized through an iterative process of interacting with the relevant stakeholders, building the business case, and developing budgets to fund the upfront investments necessary for implementation. After projects are approved, their execution is monitored to verify that the intended results are achieved. This verification step, not only enables corrective action, but it also contributes to achieving R-TOC goals and objectives, establishes a basis for revising them, and provides experiences to support the formulation of new projects to attack remaining cost drivers.

Section B of this chapter provides the lessons learned for each managerial element of the framework. The technical elements are described in Section C.

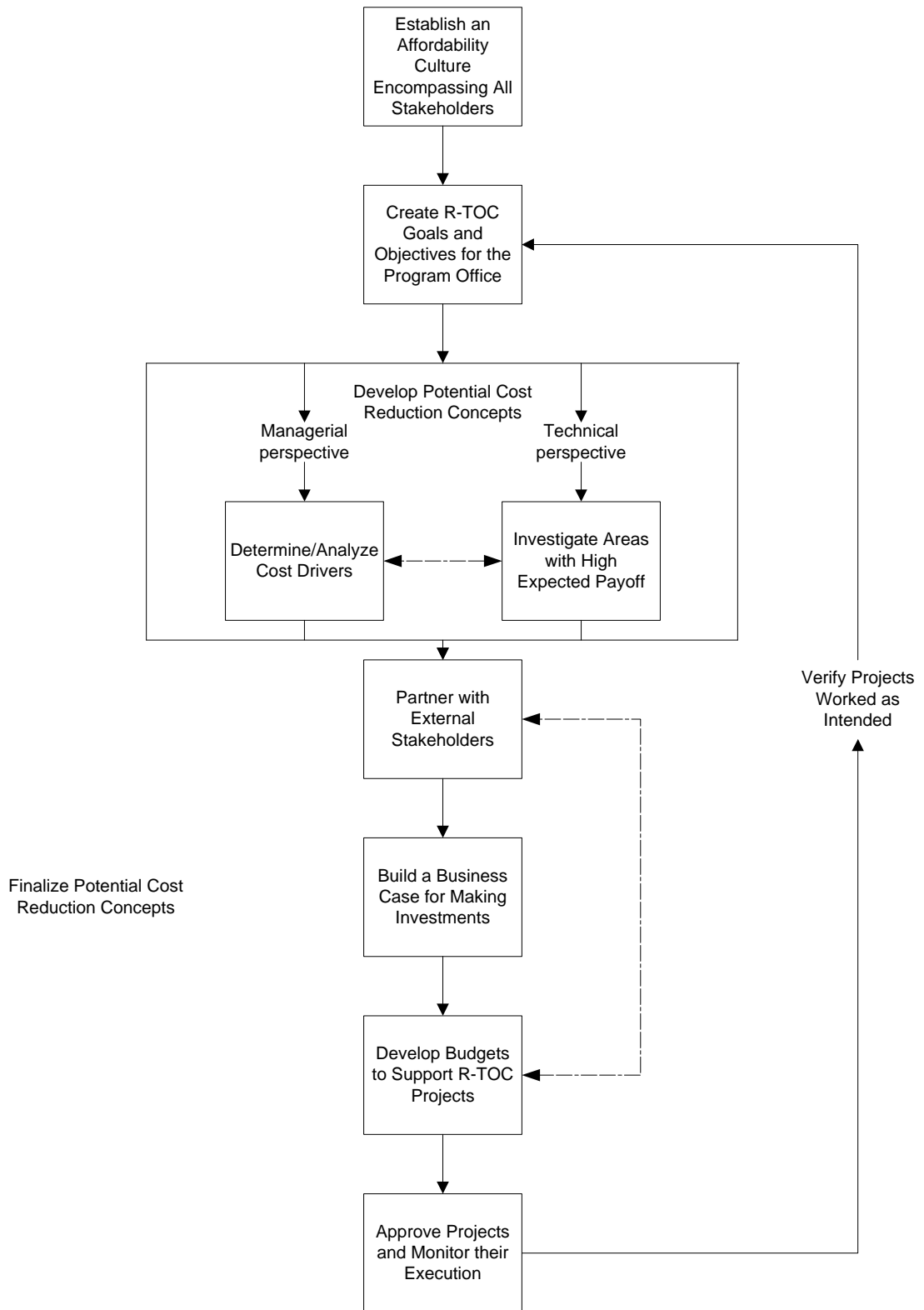


Figure 3. A Framework for Reducing Total Ownership Costs in Programs

B. Management Principles of the R-TOC Framework

1. Establish an Affordability Culture Encompassing All Stakeholders

To be successful in R-TOC, affordability concerns should be integral to the decision process for all stakeholders, not just the program office. R-TOC must be a “team” effort to succeed; every facet of the program must be focused on achieving cost savings. This starts by making R-TOC a high priority for the Program Manager (PM). It is equally important to keep all senior level leadership informed.

Every savings idea should be treated as a potential R-TOC initiative. For continued long-term success, personnel must be aligned and day-to-day processes must evolve in ways consistent with R-TOC principles. R-TOC initiatives should be integrated into corporate decision making processes.

A good example of how this can be implemented is the process used by the V-22 Special Interest Program. The PM ensures that all stakeholders in the weapons system are involved in R-TOC initiatives. Production and O&S cost reduction efforts are integrated at the program level to optimize investments toward an R-TOC goal. Establishing a balanced cost reduction program as a strategic objective and program goal has elevated R-TOC to a PM level of interest. The V-22 Director of Logistics has formed a cross-functional team specifically to look at potential R-TOC project candidates. This team consists of V-22 program logistics personnel, cost team analysts, and prime contractor representatives.

a. A Core R-TOC Implementation Team Should Be Established

While R-TOC should be an element of everyone’s job, a core R-TOC implementation team (i.e., a cost reduction integrated product team (IPT)) should be established to integrate all cost reduction activities in the program.¹¹ External stakeholders should be part of that team. The size of the core team will vary as a function of workload. R-TOC “champions” should be selected within each IPT to lead and facilitate the identification of cost-reduction initiatives. These champions should serve as the key IPT interface with the R-TOC core team.

There should also be an R-TOC component to all program reviews. This will facilitate improved coordination with the engineering community. R-TOC has been more effective when closely aligned with program execution and acquisition logistics, with every facet of the program aimed at cost savings.

¹¹ Many Special Interest Programs (SIPs) have made this office part of the Logistics Directorate.

b. Co-Location Can Enhance an Affordability Culture

The closer people's offices are to one another, the more they will communicate, collaborate, and share information. Program offices have benefitted from the co-location of their maintenance team, logistics personnel, and the contractor supportability team. To save time and money, co-locating the cost reduction IPT with the logistics division, supply chain management, acquisition division contracting officers, business management office, and/or the engineering office will enhance the affordability culture.

2. Create R-TOC Goals and Objectives for the Program Office

The F-16 Program Office is an example of how a mature system has organized itself to achieve maximum potential savings. The PM has integrated R-TOC into the Joint Multi-National Configuration Control Team to establish the goal of achieving a 10 percent reduction in O&S costs, facilitate cross coordination with the engineering community to accomplish this goal, and ultimately increase aircraft availability.

a. R-TOC Strategic Planning Should Be Conducted

It is important to make R-TOC a part of the program strategy so that decisions can take into account how to provide the best value for the warfighter. The establishment of an R-TOC vision, mission, goals, and objectives helps drive technical and programmatic decisions to properly balance warfighting capability and cost.

It is imperative that all stakeholders in the weapons system be involved in R-TOC strategic planning. All stakeholders should participate in periodic reviews of R-TOC concepts and initiatives.

R-TOC strategic planning concepts must flow down to the tactical level. Every segment of the program must take ownership and be responsible for integrating the R-TOC principles into their business processes. Production and O&S cost-reduction efforts must be integrated at the program level to optimize investments toward an R-TOC goal.

b. Realistic Cost Reduction Targets Should Be Established

There is ample experience in program offices to support the assertion that the absence of a formal goal does *not* lead to a best effort toward cost reduction. While it is easy to establish a goal of, for example, reducing total annual program O&S costs by 15 percent in five years, it is quite another matter to effect this reduction.

A focus solely on improvements to reliability and maintainability for fielded systems has limited potential gains. Substantial reliability improvements can be achieved only on a few of the thousands of system components in any given fiscal year and non-recurring engineering costs are the major driver of this type of change.

As an example, consider an aircraft where depot repairables comprise 20 percent of the total annual O&S costs and consumables 10 percent of the total O&S costs. Assume that resources were available to address a few major cost drivers that account for 5 percent of the total depot repairable costs and 5 percent of the total consumable costs. Assume, further, that depot repairables and consumable costs for these components are reduced to 50 percent of the annual historical cost. Less than 1 percent of total O&S costs would be affected.

Or consider the time needed to implement a major component upgrade. The assumption would be two to three years to develop the concept, build a prototype, and verify the solution; another one to two years to produce the kits for installation; and another three to five years to upgrade all systems on a non-interference basis. Thus it would take six to ten years from concept development through upgrade of the entire population.

Maintenance philosophy changes are subject to similar constraints. It is unlikely that the original maintenance philosophy would be seriously flawed considering the attention to maintenance procedures applied by government and contractor logisticians and engineers using Reliability Centered Maintenance (RCM) and similar techniques. Therefore, major O&S cost reductions would either be based on the likely assumption that the original maintenance procedures were faulty or inefficient or that a new, totally original philosophy has been created.

It is therefore important for cost reduction goals to be credible. Unrealistic goals may be subject to change and consequently may be ignored. A first step in this process is developing an awareness of both the controllable and uncontrollable aspects of total cost. Goals can be established only after there is buy-in from all elements of the program office and from external stakeholders.

3. Monitor Cost Drivers

Accurate and timely data are essential for identifying O&S cost drivers. Such data provide discipline, structure, and credibility to cost estimating and avoidance projections. Cost drivers may also include diminishing manufacturing sources and material shortages (DMSMS) and corrosion. For low density systems, processes such as cumbersome work practices are more likely to be cost drivers.

In some cases cost may be only one component used to prioritize problems to be addressed. Other factors that are correlated to cost may be more important. For example, availability constraints, mission criticality, maintenance turnaround time and cannibalization rates, and safety may also be significant considerations.

One approach used by the Stryker Program office is to identify and address field problems in a timely and efficient manner by isolating O&S cost drivers, applying a

logistic solution first, and then applying a technical solution to reduce O&S cost through the life cycle. The Navy H-60 Helicopter Program Office took another approach by focusing on aviation depot level repairable cost drivers at its monthly review of degraders/cost drivers/maintenance and supply issues.

a. Appropriate Cost Driver Data Sources Should Be Determined

The first step in monitoring cost drivers is determining where cost data can be found. To the extent possible, cost data should encompass the entire life cycle because that is the best perspective when making decisions on pursuing R-TOC initiatives. Efforts should also be made to identify sources of hidden costs.

It is, therefore vital, to identify the databases that will provide the required data, obtain access to these databases, understand how to use the data and its limitations, and identify persons that can assist in using these databases. Significant data and database integration shortfalls adversely impact analysis. In some cases, important data may reside with contractors. In such cases, it may be useful to add data collection to the contract to ensure coverage is efficient as well as effective.

Data quality is a related issue. There are situations where only limited data are collected, data are too aggregate, or data are based upon mixed operating tempos with individual effects that are not extricable. Predictive models should be considered to help improve data quality.

Data sources for DMSMS and corrosion are more complex. In these cases, understanding the bill of materials, proactive management, and forecasting all play an important part in predicting cost drivers.

b. Cost Baselines Should Be Established

For purposes of this paper, the term “baseline” is not intended to convey the establishment of a formal baseline as currently provided in the statute (Title 10, section 2435) for program acquisition costs, subject to Unit Cost Reporting and the Nunn-McCurdy (unit cost breach) provisions.¹² Rather, baseline is used in a more limited way to mean the O&S cost projection for a program, if no action taken by the program to reduce O&S costs.

An accurate baseline is vital to understanding cost drivers. It is, therefore, necessary to define the factors included in O&S costs. If the factors considered are not clearly defined and obtainable, stakeholders will arrive at vastly different O&S costs. Since it may not be feasible to obtain all the data required, O&S costs baselines must include

¹² See the *Defense Acquisition Guidebook* (dag.dau.mil), section 2.1.1 (Acquisition Program Baseline) and section 10.9.1.5 (Unit Cost Reports).

appropriate caveats to avoid misunderstandings. Early involvement of the command's cost analysis personnel adds discipline, structure, and credibility to cost estimating and avoidance projections.

Data quality issues should not be an excuse for failing to establish cost baselines. Baselines are vital to measuring improvement. Accuracy increases with the fidelity of the data.

c. Cost Drivers Should Be Periodically Reviewed

Periodic reviews of cost drivers, readiness degraders and maintenance and supply issues are important, especially in the highest dollar value expenditure areas. These reviews establish ground rules and assumptions to begin the dialog about what is driving O&S cost. They establish the basis for a baseline review to highlight and track potential risk areas. They also provide a good idea of problems that should be addressed most quickly. An effort should be made to work closely with Earned Value Management data to maintain an understanding of program risk and potential growth areas.

Addressing both O&S cost drivers and principal readiness inhibitors can yield the best results for R-TOC investments. In that way, initiatives can provide significant readiness improvements while also reducing TOC. Often, a single subsystem, component or practice is found to be a major driver of either O&S costs or readiness inhibition. Several R-TOC programs have achieved significant cost savings and readiness improvements by identifying such drivers early in the R-TOC process.

4. Partner with External Stakeholders

For example, the Aviation Support Equipment Special Interest Program has learned that partnering with maintenance providers can lead to significant benefit. Sixty-six percent of the total cost of all schedule maintenance tasks for Common Ground Support Equipment is driven by 20 percent of the items. In an effort to reduce scheduled maintenance requirements, the program office has performed RCM analyses for selected items. These analyses have been performed by fleet equipment experts (operators and maintainers) under the guidance of a trained facilitator. Analyses for twenty-one different support equipment items were performed. The Aviation Support Equipment Program reports significant reductions in scheduled maintenance requirements, reduced usage of consumables, and reduced disposal requirements for hazardous materials as a result of the RCM studies.

a. Establishing Cross-Functional Teams Can Improve Cost Reduction Efforts

Although the PM is typically responsible for identifying potential R-TOC activities, many other organizations should also be involved to keep all parties working toward a common goal. Participating organizations may include the buying command/PEO

structure, the user, organizations with logistics support responsibilities, organizations with budget development and approval authority, and the prime contractor/major subcontractors. A roster of all points of contact should be kept current.

In many cases, the PM may not be responsible for the funding necessary to implement an R-TOC initiative and may need to coordinate basic funding decisions with other organizations. A cross-functional IPT may be established for this purpose.

b. Aligning Initiatives to Meet User Needs Is Critical to Successful Implementation and to Realizing the Full Potential of Savings

R-TOC efforts will be hindered without user participation. User involvement is particularly important in building support for cost reduction initiatives for fielded systems where the user controls many of the funding sources. It is therefore important to work with users to help them understand the benefits of the initiatives, to incorporate their feedback, and to ensure that implementation funding is included in the budget.

In addition, user buy-in is critical to process changes necessary for evaluating new technologies. There may also be initiatives associated with operating procedures if the ability to perform the mission is not affected.

c. Partnering With Maintenance Personnel Can Improve the Acceptance of Initiatives

Maintainers also have a large role in how ownership costs associated with the system maintenance can be reduced. Increased coordination with maintenance management at the local levels can lead to efficiencies that will result in overall TOC reduction in O&S funding accounts. This is often accomplished by developing a working IPT to manage these efforts and track problem areas. Smaller IPTs should be established to research and devise solutions to issues in order to increase acceptance by the community. It is preferable for initiatives to be “pulled” rather than “pushed” to the field.

Such a partnership allows modernization and sustainment to work together with each organization concentrating on its specific expertise. It brings the PM and the sustainment community closer together to successfully support the warfighters in the field.

d. Engaging Prime Contractors and their Suppliers Can Lead to Additional Savings

Formation of the IPTs with industry to identify and overcome obstacles to cost reduction through requirement definition and risk mitigation is an effective approach. The program office should actively team with industry to overcome all obstacles in the earliest stage of development (i.e., testing, documentation, design, procedural/process

change) and couple proposed changes with system needs to develop a sound acquisition package and approval for implementation.

In addition, having the vendor independently analyze and adjust maintenance schedules may generate savings. Operators, maintainers, and the vendor jointly performing a subsequent RCM analysis and audit may provide additional maintenance savings.

Industry participation can be enhanced with effective business and financial incentives between DOD and its prime contractors and between the prime contractor and its suppliers. Such contractual incentives provide a profit-based motivation for industry to attack DOD's cost issues.

Finally, conferences and workshops with industry may prove valuable. These forums should be used to exchange ideas and provide information on issues that affect all parties.

e. New Cost Reduction Ideas Can Be Generated by Investigating What Other Programs Are Doing

There is no single source of good ideas. While detailed knowledge of the specific situation in a program is necessary, it is not always sufficient to generate and implement the most effective cost reduction initiatives. Obtaining a greater understanding of cost reduction efforts in other programs in a forum designed to share approaches and innovations has a number of potential benefits.

- It may instigate an idea that might have been overlooked.
- One program may have determined a way to overcome a barrier or a bureaucratic obstacle that another program is facing. The latter program may adapt similar tactics to overcome its problem.
- It may lead to cross-program and/or cross-service opportunities for savings.
- New funding sources applicable to the program (such as the Defense Logistics Agency (DLA) sustaining engineering initiative) may be discovered.
- Valuable points of contact can be identified.

Some ideas are directly transferable even when the components of the system are different. Process improvement, reliability enhancement, and technology refreshment all have broader application.¹³

¹³ Among the SIPs, the Army's light utility helicopter benefitted from UH-60 initiatives.

5. Build a Business Case for Making Investments

Classical business case analysis involves identifying non-recurring engineering investments and savings over time, determining the net present value of each, and calculating the return on investment (ROI) as the ratio of constant dollar savings to constant dollar cost over the entire life cycle. Savings is a function of the installation schedule, operational tempo, and the improvements of the new process or product relative to the old.

The approach should encompass developing and maintaining programmatic R-TOC baseline information as well as documentation on the newly proposed and replacement systems. Initiatives should only be considered when there are clear benefits from going to the new proposed system.

As an example, the Army's UH-60 Program Office has established a team to identify issues and develop proposals to present to the Board of Directors (Program Manager, Deputy and Assistants). The project is then prioritized for analysis and refined using the value engineering methodology. Finally, the team identifies funding program(s) and assigns responsibility for successful completion of the project.

a. Accurate Cost Estimates to Implement R-TOC Initiatives Should Be Made

The cost estimate needs to consider the amount of engineering work required to develop the change and the amount of testing to ensure that the change works as anticipated. Labor and material costs to install the new product or implement a new process are also included in the implementation costs used in calculating the ROI.

b. Savings Estimates from R-TOC Initiatives Should Be As Complete As Possible

It is very complicated to estimate the benefits of R-TOC initiatives. It involves understanding and using the databases and life-cycle cost models as well as benchmarking from other experiences. It also requires knowledge of the system to be analyzed. Therefore the estimation process should be performed by an experienced cost analyst.

The life-cycle cost model should tailor each platform's cost estimates as closely as possible to historical conditions so that, for example, retiring aircraft have fewer modifications and training costs in the last years before retirement while new aircraft have lower maintenance costs in the first years after introduction. All cost elements should be analyzed in this way to determine if they would vary at the time of introduction or retirement to more reliably model costs to be incurred for each fiscal year.

In practice, specific results have been difficult to document. Problems have included a lack of visibility within current database reporting and the number of variables affecting

each initiative. Currently it is impossible to track costs on a mission-by-mission basis. Without this visibility, it becomes difficult to document “before” and “after” costs relative to the initiative. Adding to the lack of visibility are the number of variables affecting the reported costs. As a result, it becomes impossible to tell whether a weight reduction initiative improved fuel consumption because specific mission operating weights are unknown as is the ability to measure fuel consumption differences between the continental United States (CONUS), Carrier, and Desert operations. That is why it is important to establish a well documented baseline cost using the best available data. In this example, the PM may chose the CONUS training mission operating weight as the baseline and compare initiatives against it.

c. Expanding the Business Case Beyond Cost Reduction Can Help Generate Project Support

The business case will be affected by delays in funding and unforeseen technical problems. Therefore risk should be addressed.

In addition, O&S cost reductions should be linked to mission capability rates whenever possible. O&S cost reduction metrics should be viewed in the context of the warfighters’ requirements for capability (e.g., sortie generation). Other benefits, including size reduction, weight reduction, or a smaller footprint, should also be considered.

6. Develop Budgets to Support R-TOC Projects

O&S cost avoidance cannot be achieved without committing to the initial capital investment required to develop, test, and install the changes. Capital investmenst needed for hardware improvements are often higher than the investment needs for process changes. For programs in development, such funding would normally come from the program itself. For programs in sustainment, the funding source is more likely to be external to the program. The availability of funding sources may be somewhat unpredictable, therefore a number of viable projects should be kept in the queue.

This is extremely difficult to accomplish because other more time sensitive needs almost always take precedence. Consequently, there is no example among the SIPs. However, there was one illustration of this in the original R-TOC pilot programs. The Air Force Airborne Warning and Control System (AWACS) Program Office includes R-TOC planning in every task it performs. R-TOC initiatives have been integrated into the AWACS corporate decision making processes (requirements generation, acquisition program baselines, planning, programming and budgeting system).

a. Planning for Programmatic Fluctuations and Variations in Funding Assists with Risk Reduction

Funding changes have a double impact: (1) even the strongest plan can die in execution because the resources allocated are not available and (2) the management attention required to appeal or develop alternatives detracts from improving the well-planned baseline. Savings cannot materialize without adequate and consistent investments. Therefore, variables such as programmatic delays, funding re-allocations, changes to deployment, depot maintenance, or modified/upgraded schedules, etc., all have major impacts on reaching projected savings.

b. Color of Money Constraints Should Be Considered in Developing Budgets

Research and Development (R&D), procurement, Operations and Maintenance (O&M) and working capital funds all contribute to R-TOC initiatives. Each source of funding has its own approval procedures, timing, and restrictions on what it can be used for (known as color of money constraints). For example, incrementally funded O&M dollars are only good for the current fiscal year. This prevents longer range actions to reduce O&S spending unless a different funding source is used. These procedures are a significant consideration in budgeting and executing R-TOC investments.

c. Leveraging Multiple Funding Sources Enhances the Likelihood of Success

While systems are still in development or production, most of the funds for the program are subject to the PM's control. Once the system is no longer in production, a more fragmented budgeting approach is employed. The Service Headquarters controls manpower funding and billet assignments; another element in the headquarters controls budgets for fuel, depot-level repairables, and consumable materials; another controls training budgets; and the operating headquarters controls budgets for depot maintenance. The PM controls only the budgets for program related logistics and engineering support, retrofit modifications, and technical manuals.

In many cases, the investment required is greater than the PM's ability to fund it.¹⁴ Therefore, a PM must "cobble together" the "up front" or "execution" funds required for an investment from various sources and "colors" of funding using procedures in place to permit this.¹⁵ Any recurring funding requirements also need to be in place to enable complete implementation.

¹⁴ Large system inventory drives higher investment costs and longer implementation time.

¹⁵ A system-wide perspective that includes the international business base may provide opportunities for cost sharing.

d. Value Engineering Change Proposals Should Be Considered a Source of Non-Recurring Investments

Value engineering programs are required by law. According to the authorizing statute, “Value engineering means an analysis of the functions of a program, project, system, product, item of equipment, building, facility, service, or supply of an executive agency, performed by qualified agency or contractor personnel, directed at improving performance, reliability, quality, safety, and life cycle costs.”¹⁶

A Value Engineering Change Proposal (VECP) is a proposal submitted to the Government by the contractor in accordance with the VE clause in the contract. A VECP proposes a change that, if accepted and implemented, provides an eventual, overall cost savings to the Government. The contractor receives a substantial share in the savings accrued as a result of implementation. The VECP provides a vehicle through which acquisition and operating costs can be reduced while the contractor’s rate of return is increased.

The VECP concept is a potential source of funding for cost reduction initiatives because the contractor typically pays for the upfront non-recurring investment. The contractor’s reimbursement is taken from the savings before the Government receives any share. VECPs provide contractors with an incentive for investing their own resources and using their best engineering talent to help reduce Government costs.

7. Approve Projects and Monitor their Execution

The Unmanned Aircraft Systems is a good example of the benefits of frequent monitoring of an approved project. It uses a robust data collection system as a check and balance system. The PM instituted a daily report to the unit commanders as a check on the accuracy of data the Field Services Representatives were entering into its data collection system. The accuracy of data has improved by at least 40 percent since the daily reports were implemented.

a. There Should Be a Standardized Project Approval Process

There should be a standardized, efficient, and transparent process for project approval. Elements may include:

- A recognized, formal decision making body;
- A project champion to present the case for approval;
- Well-defined requirements for the proposal that minimize paperwork and reduce the layers of management approval that are needed; and

¹⁶ National Defense Authorization Act for Fiscal Year 1996, Public Law 104-106, February 10, 1996.

- Well-defined responsibilities for project execution.

b. A Management Plan to Oversee Implementation Should Be Developed

Long-term follow-up is required to assure success. Therefore, a master schedule and implementation plan should be built for each initiative as early as possible. This will ensure sufficient time is available to budget, obtain funds, and procure hardware at the earliest possible date. Operational schedules may impact the installation of new technologies.

Periodic management teleconferences and meetings should track implementation progress. Overdue issues, decisions, and agreements should be documented and coordinated by all stakeholders. Progress against planned results should be continuously assessed and updated as needed. Follow-up audits on previously analyzed projects should be performed to re-validate that changes are still effective. Indicators for terminating projects should be established if it appears that projects will not succeed in reducing costs.

Lines of authority and responsibility for executing the projects should be clear. Effective, empowered, and accountable key leadership for the project should be established. All stakeholders should be apprised of the status of the efforts.

Resources allocated to the project should be monitored even if the initiative is not fully funded. It is better to begin execution as soon as possible to minimize delays in obtaining cost savings. In addition, a holistic approach should be applied to incorporate all initiatives for one weapon system, in order to take advantage of synergies in execution.

c. Metrics Should Be Established to Track Cost Savings

Metrics should be tracked wherever possible¹⁷ to provide a picture of net benefits accrued through all improvements made to the system. All participants must participate and agree when negotiating/determining R-TOC metrics. There must be ‘buy-in’ by all stakeholders including the warfighter, developer, and equipment manufacturers.

Development of accurate R-TOC metrics is difficult, especially when the R-TOC improvements are deployed across a diverse range of systems and platforms with

¹⁷ Some cost avoidance initiatives may be impossible to track. DMSMS and corrosion fall into this category because it is uncertain when the increased cost of doing nothing would be incurred. Similarly, the presence of external factors that affect cost measurement (e.g., an operational change) make it nearly impossible to track savings.

fluctuating baselines.¹⁸ Projected metrics developed prior to project initiation may not agree with actual data gathered after the initiative has been installed.

Lack of visibility into O&S costs at the system level can make it particularly difficult to identify the benefits of R-TOC activities. Consistency in tracking R-TOC metrics can also be hard because the use of conventional cost templates can generate erroneous aggregates for individual projects. Soft savings (manpower), cost avoidance, and actual cost savings must all be captured.

The proponents for R-TOC initiatives must, therefore, validate and verify the assumptions and methodologies used. Metrics must be reevaluated, the data collection system must be robust, and a check and balance system needs to be established. A cost analyst should be involved in the process. Actual R-TOC savings will not be known until the initiative has been implemented for several years and return costs can be measured.¹⁹

C. R-TOC Technical Approaches

Early in the program, the TOC emphasis is likely to be on “designing” in supportability, e.g., improved reliability and maintainability, and using an Integrated Product Data Environment to automate labor-intensive operations. As the program moves through the life cycle, the emphasis is likely to shift to a life-cycle support strategy based on a long-term partnership with industry, which has the potential to further reduce O&S costs. While specific R-TOC projects are context dependent and specific to the program’s cost drivers, this section identifies areas that have proven fruitful.

Several SIPs have found that having the authority to manage both “acquisition” and “legacy” requirements has advantages. It can result in improved synchronization of initiatives and avoid potential duplicative functionality.

For all of the areas described in the remainder of this section, value engineering can be an effective tool to determine which technical issues to examine as well as what to do about them. The function analysis phase of the value engineering methodology is designed to examine problems from a unique perspective that lends itself to innovative thinking about other ways to meet the requirements.

¹⁸ Several SIPs have found that traditional information systems do not provide the right information to track R-TOC baselines, investments, and cost savings.

¹⁹ In some sense, actual savings can never be known since the implementation of a project prevents measurement of what would have occurred if the changes were not made. The best that can be done is to measure savings against the cost estimate made prior to project completion.

1. Hardware-Oriented Areas

a. Life-cycle cost reduction during product design

The majority of a weapon system's future life-cycle costs are determined during concept exploration and design. Therefore, significant O&S savings can best be achieved when designed in or prior to production. Consequently, reliability, maintainability, and sustainability must be built into the system from its inception to maximize life-cycle cost savings.²⁰

Another important design consideration that reduces cost is commonality. The average cost of adding a new part into a system is \$27,500.²¹ The ability to take advantage of economies of scale is increased by commonality. Repair time is shorter because parts are more likely to be on hand thereby reducing the time between request and receipt. In addition, commonality improves logistics support because fewer parts must be stocked or transported.

The majority of solutions that arrive during in-service operations are after-the-fact patches that generally result in marginal O&S savings due to associated non-recurring engineering and material and installation costs. As upgrades and enhancements are made to any legacy system, the implication of any proposed changes for life-cycle cost should be a key consideration in evaluating these modifications. In fact, major modifications may provide the best opportunity to implement O&S cost reductions and readiness improvements in legacy systems while increasing capability.

b. Technology refreshment

Although redesign of systems through modernization/replacement is an effective way of achieving cost savings, it is not the most effective strategy for achieving life-cycle cost reductions in the near term. New technologies must also be integrated into legacy platforms. Incorporating improvements that occur naturally in the marketplace (commercial technologies, products, and processes) is one way to reduce O&S costs while increasing capability. New electronics technology typically reduces size, weight, and power consumption. New materials also reduce weight, wear slower, and resist corrosion. Maintaining awareness of new technological innovation from industry is helpful in identifying promising technologies for improving reliability, reducing maintenance cost, and increasing capability.

²⁰ Development of a technology demonstration prototype should not be confused with product design. Post-demonstration development must focus on systems engineering and sustainability as much as on capability enhancements.

²¹ *SDI9 Parts Management Guide*, Defense Standardization Program Office, September 2009.

Simply doing a demonstration of technology is not always enough. Efforts must occur to overcome all obstacles up front (i.e., testing, documentation, drawings, procedural/policy/guidance changes) and couple the technology with the actual system need in order to achieve a sound acquisition package and approval for installation. Formation of a Service-Industry IPT for the sole purpose of identifying and conquering those obstacles to acquisition through teaming and risk mitigation has assisted the process.

c. Reliability and maintainability (R&M) improvements

Reliability and maintainability (R&M) improvements not only affect cost but also improve system performance and readiness. Some of the readiness measures include:

- Reduction of failure rate or improved reliability in terms of mean time between failure;
- Reduction of mean time to repair;
- Reduction in maintenance man-hours;
- Reduction of spare part requisition fill response times;
- Reduction in deployable footprint/weight;
- Reduction in No Fault Found test call outs;
- Reduction of test equipment set up and warm up times; and
- Reduction of test program set end-to-end run times.

Maintaining commonality reduces overall support costs. This requires incorporation of hardware changes that may not be necessary to improve performance, durability, or reliability, but are necessary to improve maintainability and supportability. Therefore proposals in this area should also focus on integrating reliability, supportability, and capability to enhance the likelihood of adoption.

d. Equipment health monitoring systems

This area encompasses both diagnostics which measure when a system is not performing correctly and prognostics which predict when the system will not perform correctly before it happens. Many person years of effort are wasted when technicians are unable to reproduce problems detected in the field. When this happens, poor performing parts may be recycled again and again in the supply system. Greater use of effective intermittent electrical fault detection systems will help alleviate this problem. In addition, these detection systems help avoid serious failures that are far more expensive to correct. Health monitoring can also help to reduce equipment attrition by identifying unsafe situations. Equipment operated under such circumstances may fail catastrophically

resulting in either the complete destruction of the system or damage so extensive that it is not cost effective to repair.

e. DMSMS mitigation

Costs for Depot Level Repairables and consumables have been increasing annually beyond the effects of inflation. Some of these increases are due to attributable organic and commercial repair cost increases, component fatigue due to numerous rework events, and increasing technological sophistication. However, hardware obsolescence and the discontinuance of repair and/or replacement support by original equipment manufacturers for older components with low annual repair demand are also major contributors. Without a significant likelihood of return on the investment in a repair/manufacturing line, contractors are declining to compete with organic facilities for this workload. While in the long term, it might be more cost effective to replace the problem component with a newer item rather than continuing to organically reverse engineer repairs, this is rarely seen as a viable alternative. If a supplier actually stops making a part, costs will be incurred in the identification and qualification of a substitute. Proactive management leading to early identification of potential DMSMS situations will reduce both the time and cost of implementing a mitigation strategy.

f. Common support equipment

Focusing on support equipment that is common to multiple platforms enables economies of scale. There may be situations where a single program cannot realize an adequate ROI for initiating an improvement project however an effective business case may be possible if several programs are involved. Common support equipment projects typically involve safety, reliability, obsolescence issues, and cost reduction through component redesign.

2. Logistics-Oriented Areas

Pure logistics solutions are normally preferable to hardware changes since they can be implemented more quickly. There is less upfront cost and they can be undone more easily if the expected results do not materialize.

a. Reliability Centered Maintenance (RCM)

All programs should perform RCM-type analysis on equipment that has significant maintenance requirements. RCM analysis validates/optimizes equipment scheduled maintenance programs. RCM analyses have been shown to have a tremendous impact on reducing maintenance costs and man-hours, hazardous material purchasing, and disposal

costs.²² It is important to include the user maintainers in the analysis process, which helps ensure user buy-in and smooth adoption of equipment maintenance changes. It is also important to periodically reexamine the implemented changes to ensure that the changes are having the desired effect. Electronic Maintenance Aids, Interactive Electronic Technical Manuals and other electronic maintenance aids can reduce the time and cost of performing maintenance tasks, improve training of maintenance personnel, and accommodate changes easily and quickly.

b. Supply Chain Response Time/Footprint Reduction

R-TOC projects can achieve significant cost savings through the supply chain management process and efficiency improvements. These projects can be implemented without large upfront investments. R-TOC programs have implemented a wide range of projects to improve the management or efficiency of the system's supply chain. Strategic sourcing, direct vendor delivery contracts, corporate contracts, industrial prime vendor/virtual prime vendor arrangements, reductions in DLA cost-recovery rates, and other decision support systems that link into the supply chain can reduce logistics cycle time at the same time it reduces O&S costs.

c. Depot Initiatives

Significant O&S cost reductions can be achieved by extending depot maintenance cycles. By grouping depot maintenance activities differently and using actual experience with systems in the field, it may be possible to extend these cycles without impacting system performance or reliability. Savings/cost avoidance and decreased flow-days in depot maintenance, resulting from Lean Production initiatives, will result in increased availability.

3. Competitive Product Support

This technical area compares organic support to contractor support. There is a great deal of data that indicates significant cost savings can be achieved by competing work traditionally performed by the government. Because it takes time to build and coordinate an innovative product support strategy with all stakeholders, it is important to begin this planning early in the system's life cycle. The ability to implement competitive product support is limited for legacy systems. Major modifications and other major events provide an important opportunity to implement these arrangements. In addition to

²² One program expects to save 120,000 maintenance man hours per year and reduce system downtime by switching to this concept. Another program has a projected cost avoidance of \$202 million over the life of the program.

reducing costs, competitive product support arrangements can make substantial improvements in maintenance lead time, reliability, and readiness.

Incentives are key to any competitive support arrangement. Allowing the contractor to use savings to fund other cost saving initiatives offers appropriate incentive for effective implementation of R-TOC. Award fee and award term contracts, which increase the contractor's profits or the length of the contract, can also provide strong incentives to reduce TOC.

Some competitive product support agreements involve partnerships between the depots and private industry. These partnerships can provide a successful way to reduce TOC while taking advantage of the best available capabilities.

a. Contractor Logistics Support (CLS)

Contract Logistics Support (CLS) may entail a contractor completely sustaining a weapon system. It may also be an interim measure that is used during a system's initial period of operation before a permanent form of support is in place. CLS may also be contractor support for a specific sustainment task.

Even with CLS, the PM has the ultimate responsibility for customer satisfaction. Therefore, the program should consider "off-ramps" (e.g., provisions for re-competition or return to organic support) to maintain competitive pressure on the contractor and protect the government in case the arrangement is unsuccessful.

In order for CLS to be effective, there are several best practices to be followed:

- There should be early involvement and support in the proposed support concept from the user community.
- Changes to the way the soldier maintainer currently conducts his support mission should be minimized (e.g., retain standard information systems).
- Military force structure should not be impacted.
- Long-term funding issues should be resolved early in the process.
- Contractor-on-the-battlefield issues should be defined where applicable.

b. Performance-Based Logistics

Performance-Based Logistics (PBL) is a support strategy that places primary emphasis on optimizing weapon system support to meet the needs of the warfighter.²³

²³ The impact of each PBL is different and, while providing "best value" to the government, may or may not result in lower prices. Higher parts availability and/or improved reliability may be viewed as sufficient justification to entertain the award of a PBL contract despite a cost that is neutral or even higher than organic

PBL specifies outcome performance goals (and associated outcome-oriented metrics) for weapon systems, ensures that responsibilities are assigned, provides incentives for attaining these goals, and facilitates the overall life-cycle management of system reliability, supportability, and TOC. It is an integrated acquisition and logistics process for buying weapon system capability.

Another reason that PBL contracts may lower costs is the supply system cost recovery rates. These rates are added to the base costs of repairables and consumables to reimburse the military supply system for organic administrative costs. Under PBLs, the responsibility for these administrative costs frequently shifts, in whole or in part, to the PBL contractor. Thus, under the PBL, prices may be collectively lower than under a totally organic operation, even with no change in repair price, simply due to the lowering of cost recovery rates.

Some PBL initiatives are contracted with the Original Equipment Manufacturer (OEM) for a single commodity or family of parts. In this case, the contractor may guarantee increased reliability or availability since it has the most knowledge regarding the fabrication and repair of the parts it manufactures. This knowledge gives the OEM a competitive edge that benefits the contractor in guaranteed workload while the government benefits from lower operating costs. Since the number of “unknowns” is insignificant under this type of contract, and contractor risk is minimal, the contractor can propose leaner prices and fewer “conditions.”

Other PBL initiatives are negotiated with a contractor (not necessarily the OEM) for all or a large portion of the components of a weapon system. Under this type of PBL, the contractor must assume responsibility for potentially hundreds of subcontractors in terms of component cost, availability, reliability, and repair, and the smooth interface of government and commercial repair organizations. The contractor must also be able to negotiate a contract that allows the contractor to remain in control of its ability to successfully perform. A poor choice of performance metrics or the introduction of any “unknowns” with which contractors feel uncomfortable could result in contractors increasing their proposal price to cover risk factors. Such a scenario is counterproductive to producing greater efficiency of support. A contract that measures performance based on government actions may add both risk and cost.²⁴

support. The more complex the PBL contract, the longer it will take to assess the operational costs and determine the impact on historical costs.

²⁴ For example, Supply Material Availability may be a good performance metric since the contractor is responsible for making Ready For Issue parts available. Another metric, such as aircraft Ready for Tasking percentage, may be viewed as an added risk/cost factor if the PBL contractor is not responsible for aircraft repair. This type of metric may add unnecessary cost since the contractor must cover his risk that government maintenance may not be performed in a timely manner, resulting in a contract penalty.

PBL efforts require (1) a dedicated team of cost, logistics, and engineering personnel to support annual negotiations with industry and ensure equitably established prices, and (2) a good failure history to negotiate a fair fixed price. Key lessons learned include:

- The performance metrics should be clearly documented.
- Periodic PBL reviews or audits should be conducted by the Program Management Office (PMO) or an independent agency. These reviews/audits will determine the efficiency and effectiveness of the metrics and the accuracy of reported data.
- The contracting officer must thoroughly understand PBL or he/she may eliminate contractor incentives to reduce government costs. For example, contract length may incentivize long-term investments in availability/O&S cost reduction.
- The focus should be on creating a long term business arrangement that will be flexible in creating mutually beneficial outcomes.
- Funds traceability is important. The program must stay within the guidance of the Financial Management Regulation regarding investments and expenses.
- Funding sources should be resolved early.
- Coordination and communication are key. Lines of authority must be clearly understood by all stakeholders.

3. Recommendations

Service Headquarters and the Office of the Secretary of Defense (OSD) should expand their role in championing the institutionalization of cost reduction activities. From an OSD perspective, changes should be made to the Selected Acquisition Reports, Acquisition Program Baselines (APBs), and Defense Acquisition Executive Summary (DAES) reports to capture cost baselines, cost reduction goals, and the plans to achieve them. DAES meetings should include these subjects in their agendas. R-TOC should be established as a parameter that must be included in the APB and then monitored over time.

In addition, the 2009 “DOD Weapon System Acquisition Reform: Product Support Assessment”²⁵ included three recommendations to strengthen the management and governance of program O&S costs:

- Strengthen guidance and policy so that sustainment factors are sufficiently addressed and governed at key life-cycle management decision points. This recommendation was recently implemented in the April 2010 USD(AT&L) memorandum, *Strengthened Sustainment Governance for Acquisition Program Reviews*. This memorandum is provided in Appendix C.
- Issue DOD policy to require the Components to conduct an independent logistics assessment (ILA) prior to Milestone B, Milestone C, and Full Rate Production, and provide the ILA report to Deputy Under Secretary of Defense for Logistics and Materiel Readiness (DUSD(L&MR)) thirty days before the milestone decision.
- Create a post-Initial Operational Capability review led by DUSD(L&MR) and the respective Service(s) responsible for life-cycle management.

*Each of these reviews should address the program’s status in achieving R-TOC objectives.*²⁶

²⁵ See the DAU Acquisition Community Connection at <https://acc.dau.mil/CommunityBrowser.aspx?id=328610>.

²⁶ Additional discussion about these three reviews is provided in the forthcoming document by C. Vance Gordon, Lance Roark, *Management and Governance of Operating and Support Costs*, IDA Document D-4089, Alexandria, VA: Institute for Defense Analyses (forthcoming).

R-TOC must become embedded in systems engineering processes and be considered in all engineering design trades. To provide the management focus of the R-TOC principles, resources must be available and check points must be established at all acquisition decision points. A set of systems engineering questions on R-TOC should be prepared and become part of every program and technical review and each Milestone decision point.

The ownership cost reduction framework described in Section 2 should be augmented with new data and an associated maturity model to identify progress in the adoption of key activities. Additional lessons learned should be generated to give programs additional ideas and approaches to reduce cost. New Forums for sharing information should be established and emphasized by upper level management to generate participation by organizations that are in a position to spread the word about the importance of R-TOC efforts. Case studies should be performed to develop a stronger basis for spreading R-TOC principles to other programs.

The barriers that strongly discourage the Services from making investments to reduce ownership costs in the future must be overcome. This is based on:

- Budget constraints that create pressures to spend nearly every marginal dollar on paying current bills;
- The inability to spend resources earmarked for future cost reductions on their intended purpose when other problems inevitably emerge;
- Inadequate incentives for investing one organization's resources to reduce another organization's costs;
- The tendency to conduct engineering trades in a way that gives enormous weight to performance and schedule and little consideration to cost; and
- The fear that future budgets will be inappropriately decremented in an attempt by Comptrollers to take the savings.

Until these barriers are eliminated, very few meaningful cost reduction projects will be funded because insufficient resources will be available.

To help overcome the barriers, there should be increased communication of service-wide total ownership cost reduction objectives. *All programs should be required to implement the R-TOC framework* presented in Section 2. A program's ability to achieve cost savings/avoidance using that framework is a function of the number of people assigned to the job and the amount of resources that can be made available to make the necessary upfront non-recurring investments that will lead to substantial ROIs in the future.

Furthermore, *all DOD programs should be required to prepare annual cost reduction plans to be reviewed by the Program Executive Office (PEO) and Service Headquarters.* Success stories could be circulated throughout DOD to stimulate applications and cross-pollinate ideas. Presenters in future R-TOC Forums could be drawn from each Service's outstanding achievers so that attendance at a meeting would represent formal recognition of program achievement. Such a selection process could, in effect, make every DOD program a potential R-TOC success story. Service Headquarters and OSD may also be able to help overcome regulatory and policy obstacles to R-TOC.

Individual program cost reduction goals should be tailored to the specific circumstances of that program. There is no reason to apply the same cost reduction goal to every program. Savings are dependent on where the program is in its life cycle—programs in development or production have the opportunity to make larger cost reductions. Savings are also dependent on the availability of resources to invest as well as the number of platforms that can be affected. Finally, savings potential in the future is dependent on the extent to which effective cost reduction efforts have been employed in the past. A program that has had aggressive cost reduction efforts should not be given the same goal as a program that has not paid any attention to cost reduction.

Programs should assign the appropriate number of people to the R-TOC function regardless of the amount of investment funding available to implement cost reduction initiatives. Even if no investment funding is available, the following are some key duties that should be performed:

- Keep the program office and support contractors focused on reducing cost;
- Inform all IPTs and program leadership about the effects of decisions on ownership cost;
- Track high cost drivers while waiting for an opportunity to ameliorate them;
- Share lessons learned with other programs concerning high cost components;
- Encourage the use of lean six sigma to improve processes; and
- Encourage contractors to submit value engineering change proposals that do not require up front Government investment and share the savings with industry.

In addition, *greater use should be made of program offices that focus solely on common support equipment.* These program offices were created to reduce the ownership cost of the equipment they manage. common support equipment may get very little attention when it is managed by the weapon system program office.

Improved analytic methods are needed to track and assess overall program O&S costs, as well as individual ownership cost reduction projects. To establish meaningful baselines for program O&S costs, analytic methods should be used to adjust and update

baselines for external (“fact-of-life”) changes that could not reasonably have been predicted at the time that the original baseline was established, and that are not tied to the inherent supportability of the program. Examples of such external changes are:

- Changes to the quantity of systems being supported
- Changes in system operating tempo
- Changes in basing or active-reserve mix
- Changes in program unit design or employment concept

In addition, it may be necessary to revise baselines for accounting changes or definitional changes in O&S costs.²⁷

Improved analytical methods will lead to improved and clearer business cases and, as a result, greater acceptance by decision makers.²⁸ The most significant weakness is O&S cost baselines is that they are neither well documented nor well understood. *The Services should issue rigorous guidance for establishing and updating cost baselines for overall program savings and individual project savings.* The guidance should explain what to include in measuring current as well as future costs, both with and without a change being implemented. This also implies that the data collection and databases from which the baselines are drawn must be adequate. Any assumptions made concerning the data and the baselines derived from them should be fully documented.

Improved baselines will also provide a basis for differentiating cost savings from cost avoidance. *Acquisition leadership in the Services should ensure that future budgets are not decremented inappropriately.* While numerous cost savings/avoidance initiatives have been implemented through either program or outside funding, reductions to out-year budget estimates should not be automatic. This practice has nothing to do with the validity associated with the cost saving/avoidance or with the estimated impact on current average costs. There are other factors involved:

- It may be a function of the number of uncontrollable variables associated with cost drivers and the impact of the approved initiative. Uncontrollable variables include the changing mix of missions and variations in deployment schedules and locations. For example, an initiative may involve a configuration change that decreases operating weights to the point where a sizable decrease in fuel consumption is anticipated. But actual fuel consumption may remain unchanged

²⁷ Over time, the Office of the Secretary of Defense (OSD) guidance for terms and definitions associated with O&S costs have evolved and expanded. See the OSD *Operating and Support Cost-Estimating Guide* (<https://acc.dau.mil/CommunityBrowser.aspx?id=188404>) for the latest guidance.

²⁸ An example of the use of such analytic methods is provided in IDA Document D-4088, *Feasibility and Advisability of Establishing Baselines for O&S Costs: C-17 Case Study*, Lance Roark, Harold Balaban, Waynard C. Devers.

or even increase after the modification is incorporated due to the influence of other factors (e.g., pilots, missions, a change in operating theaters, differences in maintenance philosophy between commands). The effects of these factors are not normally considered in the budget development process. Thus, in this example, the weight reduction could still be justified on the basis that the increase in the rate of fuel consumption that would have otherwise been experienced was reduced or lessened by implementing the weight reduction even though there was no overall decrease in consumption.

- Another example is the cost of Depot Level Repairables and consumables. Costs for these elements have been increasing annually well beyond inflation. These increases are attributable to many factors, including hardware obsolescence, organic and commercial repair cost increases, component fatigue due to numerous rework events, and increasing technological sophistication. These increases are often not factored into budgets so initiatives to reduce such costs also should not automatically be used to decrement budgets.
- In a similar vein, reducing the time spent on O&S functions by organic personnel is another area where care should be taken before decrementing budgets. Such reductions can only be made if a person can be eliminated. Combining manpower saving initiatives to address the full workload of a single individual may result in the ability to cut manning levels.

As is to be expected, all SIPs believe that the savings generated from R-TOC initiatives should remain with the program. They make the following arguments:

- DOD is asking PMs to invest limited resources in the form of budgeted funding to reward another budgeting entity. This entity may choose to invest them in a totally different program to cover cost growth resulting from a lack of proactive PM initiative on that program.
- With a reduced budget, tasks for which the PM is responsible may go unfunded. Such a scenario certainly fails to increase the PM's ability to effectively provide oversight to life-cycle support.
- Allowing the PM to retain some or all of the initial savings generated by proactive initiatives (regardless of the budget from which they originate) and allocate these resources to achieve best value within the program (either to support underfunded areas or as "seed" money to support additional cost savings/avoidance initiatives) is the best way to incentivize and empower PMs to take a more dynamic role in O&S cost reductions.

This viewpoint is not consistent with DOD's continuous process improvement/lean six sigma (CPI/LSS) policy²⁹ which states: "It is DOD policy that ... DOD Components shall be permitted to retain savings and other financial benefits generated by CPI/LSS projects, unless explicitly directed to meet efficiency targets in accordance with DOD guidance." This policy leaves the disposition of savings at the discretion of the Component, not the individual organization generating the savings.

Nonetheless, bad behavior should not be rewarded. PMs who are not effective in reducing costs should not benefit from the efforts of PMs who are. Instead, *PMs should be incentivized to do a good job in cost reduction*. One way of incentivizing programs is to allow some reinvestment of savings. For example, allowing the PM to receive some or all of the resultant savings through direct budget transfers would reward proactive management and create a revolving account within each program to support future savings initiatives. Further, such a scenario would guarantee that only those PMs maintaining active O&S cost reduction programs would benefit and provide a self-monitoring system so that money becomes available only to those PMs producing results.

In summary, the use of R-TOC principles can be effective in reducing/avoiding O&S costs in the future. To be successful however, there must be emphasis on the subject at all levels of management. PMs must enforce the discipline necessary to identify projects. PEOs and service leadership must ensure resources are available to implement those projects. Finally, OSD must reinforce the importance of these efforts to ensure that all elements of the process improve continuously.

²⁹ Department of Defense Instruction 5010.43, Implementation and Management of the DoD-Wide Continuous Process Improvement/Lean Six Sigma (CPI/LSS) Program, July 17, 2009.

Appendix A

Special Interest Program Summaries

Appendix A is in a separate volume entitled *Institutionalization of Reduction of Total Ownership costs (R-TOC) Principles, Part I: Lessons Learned from Special Interest Programs, Appendix A: Special Interest Program Summaries*.

Appendix B
USD(AT&L) Memorandum: Strengthened
Sustainment Governance for Acquisition
Program Reviews



THE UNDER SECRETARY OF DEFENSE

3010 DEFENSE PENTAGON
WASHINGTON, DC 20301-3010

APR 05 2010

ACQUISITION,
TECHNOLOGY
AND LOGISTICS

MEMORANDUM FOR SECRETARIES OF THE MILITARY DEPARTMENTS

SUBJECT: Strengthened Sustainment Governance for Acquisition Program Reviews

As part of the Department's continuing effort to improve program life cycle management, I plan to strengthen sustainment governance by conducting detailed reviews of key elements of sustainment planning for all ACAT ID weapons system programs at decision and other review points in the acquisition process. Increasing visibility of sustainment factors is vital to ensuring we deliver a program that meets Warfighter materiel readiness objectives with long-term affordability consideration.

To facilitate a comprehensive review and provide the required information in a standardized format, program managers are to use the attached sustainment quad chart to report the status of sustainment planning at OIPT and Defense Acquisition Board reviews. Reporting begins at program initiation and continues through each subsequent milestone, the production decision, and at other reviews when directed.

I recommend you use the sustainment information provided in the chart for programs under your cognizance. Using it will enhance the acquisition governance process – one of the primary recommendations of the Weapon System Acquisition Reform Product Support Assessment report – which I endorsed November 12, 2009.

A chart template and instructions will be included in the Defense Acquisition Guidebook. Until then, please address questions regarding creation or formatting of the chart to Anthony Stampone, OASD(L&MR), at anthony.stampone@osd.mil or 703-614-3838.

Ashton B. Carter

cc:

DDR&E
Director, CAPE
Director, J-8, JS
Director, ARA
Director, DPAP
Director, PSA

SAMPLE PROGRAM: "ABC"

Date:

Product Support Strategy

Sustainment Approach

- Current (initial CLS covering total system)
- Future (sub-system based PBL contracts)

Issues

- Shortfall in O&M funding in FYDP
- Reliability and availability estimates are below goals
- LCSP requires update before DAB

Resolution

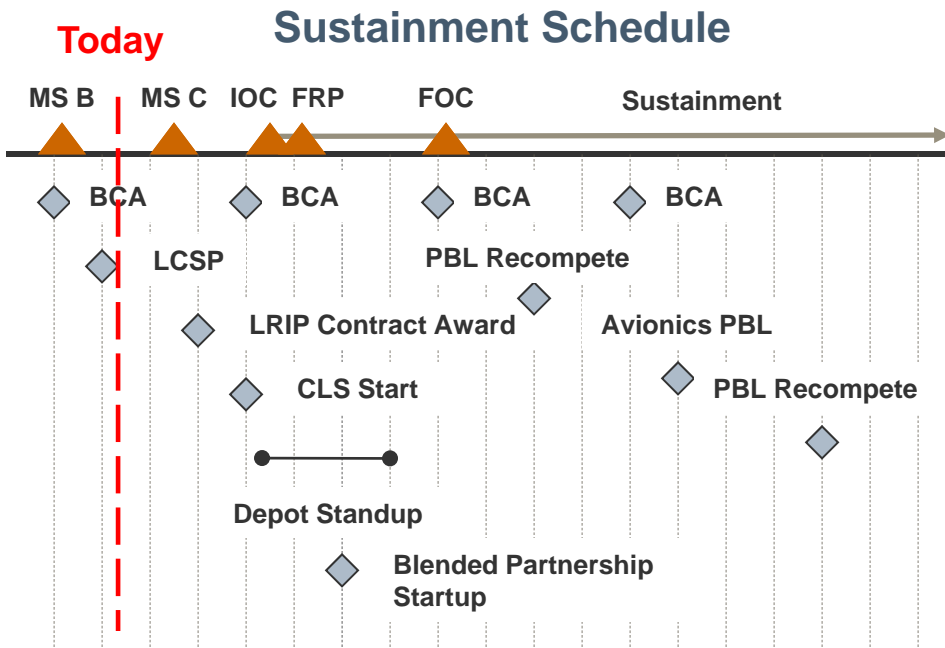
- POM request for O&M restoration submitted
- Reliability improvement plan with clear RAM goals up for final signature
- LCSP in draft

Metrics Data

Metric	Antecedent Actual	Original Goal	Current Goal	Current Estimate/ Actual
Materiel Availability	76%	80%	77%	71%
Materiel Reliability	37 hrs	50 hrs	50.5 hrs	48 hrs
Ownership Cost	245.6B	385.5B	395.1B	395.1B
Mean Down Time	12 hrs	20 hrs	18 hrs	15 hrs

* Test or fielding event data derived from _____

Notes:



O&S Data

Cost Element	Antecedent Cost	ABC Original Baseline	ABC Current Cost
1.0 Unit-Level Manpower	3.952	5.144	5.750
2.0 Unit Operations	6.052	6.851	6.852
3.0 Maintenance	0.739	0.605	0.688
4.0 Sustaining Support	2.298	2.401	2.401
5.0 Continuing System Improvements	0.129	0.025	0.035
6.0 Indirect Support	1.846	1.925	1.956
Total	15.046	16.951	17.682

Cost based on average annual cost per squadron

Total O&S Costs	Antecedent	ABC
Base Year \$M	102,995.2	184,011.9
Then Year \$M	245,665.3	395,147.2

ATTACHMENT

Sustainment Chart Instructions

Top Left Quad: Product Support Strategy

Purpose: Programs cite current sustainment philosophy and any future differences

Fields:

- **Sustainment Approach**
 - **Current:** State what the current planned or actual maintenance support strategy is (e.g.: Initial 4 year CLS period)
 - **Future:** State planned strategy for future if different than current strategy e.g.: Migrating to a Depot/Industry partnership)
- **Issues**
 - Cite any sustainment issues the program is currently experiencing or projected risks
- **Resolution**
 - Identify planned or potential resolutions to noted issues

Bottom Left Quad: Sustainment Schedule

Purpose: Display planned sustainment schedule milestones

Field:

- **Top Bar (Milestones)**
 - This field should begin from the present (or slightly earlier) through the expected service life of the system.
 - Major events such as Milestones, IOC, FOC, etc. should be displayed appropriately
 - Include a line for current date
- **Events**
 - Ensure important life cycle sustainment events are listed in the chart
 - Examples include but are not limited to: BCAs, PBL decisions, CLS periods, depot standup, sustainment recompetes
 - Use of existing program sustainment schedules in this field is acceptable

Top Right Quad: Metrics Data

Purpose: Display current estimates of sustainment metrics vs. goals and antecedents

Fields:

- **Metrics**
 - At a minimum, address the four metrics, Materiel Availability, Materiel Reliability, Ownership Costs and Mean Down Time as submitted by programs into DAMIR. These metrics are defined or derived from the Sustainment KPP and associated KSAs outlined in the Joint Capabilities Integration and Development System

- (JCIDS) Manual. The manual provides the process details for implementing CJCSI 3170.01G and can be found on intelink (<https://www.intelink.gov/wiki/JCIDS>).
- Programs can include additional metrics beyond the four listed above including: logistics footprint, customer wait time, etc.
 - **Antecedent Actual**
 - Evaluation of the four metrics on the preceding (antecedent) system (e.g. F-15 vs. F-22 or SSN 688 vs. SSN 774)
 - Antecedent is the system cited in Selected Acquisition Report (SAR) to Congress
 - **Original Goal**
 - Value for each metric according to the original baseline goal submitted for the first sustainment metrics transmittal
 - Can be set from an existing sustainment requirement or based on a goal cited in the first submission of the sustainment metrics
 - **Current Goal**
 - Value for each metric according to the current baseline goal for sustainment
 - **Current Estimate**
 - Program evaluation of system performance or projected performance (if still in development) for each metric
 - Color rating assigned by PM, based on estimate vs. goal
 - Green – At or exceeding goal
 - Yellow – Below goal by < 5%
 - Red – Below goal by > 5%
 - **Test or Fielding Event Data Derived From**
 - Cite the event (OPEVAL, IOT&E, etc.) or modeling and simulation tool that led to the current estimate
 - **Notes**
 - Any relevant or pertinent information concerning metrics definitions

Bottom Right Quad: O&S Data

Fields:

Fields are primarily pulled from the SAR O&S section:

- **Cost Element**
 - Refer to 2007 CAIG (now CAPE) Cost Estimating Guide for definitions of individual cost elements
 - These definitions should be consistent with what is submitted in the program's SAR O&S cost section (which should be based on identical definitions)
- **Antecedent Cost**
 - O&S cost of the existing program reported using the CAPE cost elements
 - O&S costs are based on average annual cost per hull, squadron, brigade, etc.
 - Use the SAR as the basis for determining the unit level and cite beneath first box what costs are based on
- **New Program Original Baseline**
 - New program O&S cost broken out over the CAPE cost elements, according to their original SAR submission.
 - Costs are based on average annual cost per hull, squadron, brigade, etc.

- **New Program Current Cost**
 - Current program cost broken out over the CAPE cost elements according to the most recent projections – not last SAR submission
 - Costs are based on average annual cost per hull, squadron, brigade, etc.
 - Color rating assigned by PM, based on increase since original baseline
 - Green – At or below original baseline or < 10% increase
 - Yellow – Increase > 10% but < 20% vs. original baseline
 - Red – Increase > 20%

- **Total O&S Costs**
 - Comparison of antecedent program cost vs. the new program's current cost presented in totals in both TY\$ and BY\$
 - For the new program, use the most recent estimate, not the most recent SAR values
 - O&S cost totals should be consistent with the CAPE estimate

Appendix C

Illustrations

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Appendix D

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Appendix E

Abbreviations

AC	Alternating Current
ACAT	Acquisition Category
ACTD	Advanced Concept Technology Demonstration
AF/CMS	Airframes/Critical Mission Systems
APB	Acquisition Program Baseline
ASE	Aviation Support Equipment
ATGM	Anti-Tank Guided Missile
AQL/RF	Advanced Quick Look/Radio Frequency
AWACS	Airborne Warning and Control System
BCA	Business Case Analysis
CBM	Condition Based Maintenance
CASS	Consolidated Automated Support System
CCA	Circuit Card Assembly
CCIU	Commercial Central Interface Unit
CECOM	Communications-Electronics Command
CGSE	Common Ground Support Equipment
CIFL	Capital Investment for Labor
CIP	Component Improvement Program
CITV	Commander's Independent Thermal Viewer
CIV	Commander's Independent Sight
CLS	Contractor Logistics Support
CNO	Chief of Naval Operations
COG	Cognizance Symbol
CONUS	Continental United States
COTL	Conventional Take-Off and Landing
CPI/LSS	Continuous Process Improvement/Lean Six Sigma
CRI	Cost Reduction Initiative
CRIP	Cost Reduction Integrated Product Team
CV	Carrier variant

CVN	Carrier Vessel Nuclear
CWRIIP	Cost Wise Readiness Integrated Improvement Program
DAES	Defense Acquisition Executive Summary
DLA	Defense Logistics Agency
DMSMS	Diminishing Manufacturing Sources and Material Shortages
DUSD(L&MR)	Deputy Under Secretary of Defense for Logistics and Materiel Readiness
DOD	Department of Defense
DOL	Director of Logistics
DVE	Driver's Vision Enhancer
ECP	Engineering Change Proposal
EMD	Engineering and Manufacturing Development
EPAF	European Participating Air Force
ERA	Explosive Reactive Armor
ETOC	Engine Total Ownership Cost
EW	Electronic Warfare
FRR&DP	Fleet Readiness Research and Development Program
FLIR	Forward Looking Infrared
FY	Fiscal Year
FYDP	Future Years Defense Program
GGB	Guardrail Ground Baseline
GDLS	General Dynamics Land Systems
GR/CS	Guardrail/Common Sensor
HBCT	Heavy Brigade Combat Team
IBAS	Improved Bradley Acquisition System
IC3	Integrated Combat Command and Control
ICS	Inventory Control System
ICV	Infantry carrier Vehicle
IFDIS	Intermittent Fault Detection and Isolation System
ILA	Independent Logistics Assessment
IPT	Implementation Team
IPT	Integrated Product Team
JAST	Joint Advanced Strike Technology
JSF	Joint Strike Fighter
LAV	Light Armored Vehicle

LCC	Life-Cycle Cost
LCMC	Life-Cycle Management Command
LO	Low Observable
LRU	Line Replaceable Unit
MC	Mortar Carrier
MFOM	Maintenance Figure of Merit
MGS	Mobile Gun System
MRIP	Material Readiness Improved Process
MWPWG	Maintenance Planning and Working Group
NAVAIR	Naval Aviation
NAVICP	Naval Inventory Control Point
NBC	Nuclear Biological and Chemical
NBCRV	Nuclear Biological and Chemical Reconnaissance Vehicle
NFF	No Fault Found
NSESA	Nose Section Equipment Support Assembly
OEF	Operation Enduring Freedom
OIF	Operation Iraqi Freedom
OEM	Original Equipment Manufacturer
OMA	Operations and Maintenance, Army
O&M	Operations and Maintenance
O&S	Operations and Support
PBtH	Power by the Hour
PBL	Performance Based Logistics
PE	Program Element
PEO	Program Executive Office
PEO/SYSCOM	Program Executive Officer/Systems Command
PET	Product Enterprise Team
PM	Program Manager
PMO	Program Management Office
PPBS	Planning, Programming, and Budgeting System
RADCOM	Radar Communications
RCM	Reliability Centered Maintenance
R&D	Research and Development
RLG	Ring Laser Gyro

R&O	Repair and Overhaul
RRAD	Red River Army Depot
R-TOC	Reduction of Total Ownership Costs
SBCT	Stryker Brigade Combat Team
SE	Support Equipment
SIP	Special Interest Program
SPO	System Program Office
TACOM	Tank and Automotive Command
TMA	Top Management Attention
TOC	Total Operating Cost
TOW	tube-launched, optically tracked, wire-guided
UAS	Unmanned Aircraft System
UAV	Unmanned Aerial Vehicle
USD(AT&L)	Under Secretary of Defense for Acquisition, Technology and Logistics
USS	United States Ship
VECP	Value Engineering Change Proposal
VE	Value Engineering

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