

Project AIR FORCE

EFFECTIVE TREATMENT OF LOGISTICS RESOURCE ISSUES

**IN THE
AIR FORCE
PLANNING,
PROGRAMMING, AND
BUDGETING SYSTEM
(PPBS) PROCESS**

**FRANK CAMM
LESLIE LEWIS**

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MR-1611-AF

Prepared for the
UNITED STATES AIR FORCE

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20030328 433

The research reported here was sponsored by the United States Air Force under Contract F49642-01-C-0003. Further information may be obtained from the Strategic Planning Division, Directorate of Plans, Hq USAF.

Library of Congress Cataloging-in-Publication Data

Camm, Frank A., 1949–

Effective treatment of logistics resource issues in the Air Force planning, programming, and budgeting system (PPBS) process / Frank Camm, Leslie Lewis.
p. cm.

“MR-1611.”

Includes bibliographical references.

ISBN 0-8330-3284-4

1. United States. Air Force—Procurement. 2. Military planning—United States.
3. Program budgeting—United States. 4. United States. Air Force—Appropriations
and expenditures. I. Lewis, Leslie. II. Title.

UG1123 .C34 2003

358.4'16212'0973—dc21

2002152009

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Published 2003 by RAND

1700 Main Street, P.O. Box 2138, Santa Monica, CA 90407-2138

1200 South Hayes Street, Arlington, VA 22202-5050

201 North Craig Street, Suite 202, Pittsburgh, PA 15213-1516

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PREFACE

Given the resources it is willing to commit to logistics activities and how its logistics system actually performs, the Air Force currently tries to do more with its operational weapon systems than its logistics support budgets allow. At the beginning of FY 2001, the Air Force Director of Supply, AF/ILS, asked RAND's Project AIR FORCE (PAF) to address this problem by looking for ways to improve how the Air Force logistics community participates in the Air Force Planning, Programming, and Budgeting System (PPBS) process. As the Air Force Spares Campaign got under way in early 2001, under AF/ILS's leadership, AF/ILS also asked PAF, where possible, to link its ongoing analysis of the PPBS process to the Air Force's needs in the Spares Campaign. This report documents PAF's findings on the PPBS process. A complementary study¹ demonstrates how easy it is to use flying hours in the operational commands in any year to predict actual costs in the depots during that year for budgeting purposes.

This work should interest analysts and policymakers in defense organizations who coordinate resource management for a supply chain with scale economies that cut across several product lines. It gives particular attention to the scale economies associated with inventory management and to product lines that can usefully be associated with separate major operating commands. This becomes an important issue when several operating commands or customers rely on a common inventory management system. It becomes even

¹Edward G. Keating and Frank Camm, *How Should the U.S. Air Force Depot Maintenance Activity Group Be Funded? Insights from Expenditure and Flying Hour Data*, Santa Monica, Calif.: RAND, MR-1487-AF, 2002.

more challenging when the customers can control the resources made available to the common inventory management system.

This report documents several ways that the Air Force can improve its management of logistics resource issues in its PPBS process. The proposals presented here are best understood as elements of a broader, ongoing effort to improve Air Force performance. The report seeks to present them in that light and to suggest how to coordinate them with other proposals under consideration in early FY 2002.

PROJECT AIR FORCE

Project AIR FORCE, a division of RAND, is the Air Force federally funded research and development center (FFRDC) for studies and analysis. It provides the Air Force with independent analyses of policy alternatives affecting the development, employment, combat readiness, and support of current and future aerospace forces. Research is performed in four programs: Aerospace Force Development; Manpower, Personnel, and Training; Resource Management; and Strategy and Doctrine. This work was conducted in the Resource Management Program under the leadership of C. Robert Roll, Jr.

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SUMMARY

Reorganization of the Air Force after the Cold War has been challenging. Since 1991, the mission capable rates of the 13 weapon systems the leadership of the Air Force watches most closely have fallen. Unit costs of supporting these systems have risen. Difficulty predicting actual annual support costs and developing annual funding levels adequate to cover these costs have introduced turbulence into Air Force planning and operations. These difficulties appear to result from a new, less certain external environment; the challenges of downsizing to accommodate lower defense budgets; and problems caused by the process of change itself, which has continued at an unprecedented rate over a long period.

The Air Force logistics community is looking for systemic ways to deal with these changes. The Chief's Logistics Review, Logistics Transformation Program, Air Force Materiel Command (AFMC) Constraints Assessment Program, the Spares Requirements Review Board (SRRB), the Spares Campaign, and the Depot Maintenance Review Team (DMRT) all represent ongoing efforts to find and implement effective answers.

As part of this effort, the Air Force Director of Supply in the Office of the Deputy Chief of Staff for Installations and Logistics (AF/ILS), asked RAND's Project AIR FORCE (PAF) to look for ways to improve how the Air Force logistics community participates in the Air Force Planning, Programming, and Budgeting System (PPBS) process. As the Air Force Spares Campaign got under way, under AF/ILS's leadership, AF/ILS also asked PAF to support that campaign and, where possible, to link its ongoing analysis of the PPBS process to the Air

Force's needs in the Spares Campaign. This report documents the findings of PAF's work for AF/ILS on the PPBS process.

This report proceeds in four steps:

- It starts by explaining how the Air Force's treatment of depot-level-reparable (DLR) spares² in its PPBS process today aggravates problems that degrade Air Force-wide performance and cost levels.
- It identifies seven policy changes relevant to the Air Force PPBS process that, taken together, should improve Air Force management of DLR spares.
- It identifies three basic changes in policy, which the Air Force is already considering, that should make it easier to implement our proposed changes.
- It identifies fundamental elements of the Air Force culture that will complicate any effort to make the changes we suggest and that could easily defeat these changes unless the Air Force confronts these cultural issues directly.

HOW THE PPBS PROCESS ADDRESSES RESOURCE QUESTIONS RELEVANT TO DLR SPARES: POLICY ISSUES

Air Force treatment of DLR spares in its PPBS process today aggravates problems that degrade Air Force-wide performance and cost levels. The Air Force faces difficult challenges both in how it supports DLRs used in major end items (MEIs) and in how it plans, programs, and budgets for such support in its PPBS process.

The Air Force supply chain relevant to DLRs is extremely complex.³ It provides spare parts to multiple customers with varying require-

²DLRs are spare parts most cost-effectively repaired in depot-level facilities inside or outside the Air Force.

³A supply chain links a particular activity, such as DLR support, to all the activities, goods, and services that contribute to the execution of that activity. In effect, it comprises all the processes relevant to cost-effective provision of that activity. It can include logistics and nonlogistics activities, goods, and services inside and outside the Air Force.

ments. It delivers services to each of these customers associated with many different MEIs, from fighters and cruise missiles to ground radars and satellite ground stations. It buys or provides maintenance, supply, transportation, and planning services through multiple major commands (MAJCOMs), to support these MEIs. It does this at many locations in many organizations around the world. It is designed to support peacetime and wartime requirements as they arise.

Although the Air Force often does not understand how changes in one part of its DLR supply chain—say, base maintenance—affect performance elsewhere—say, in wholesale supply—the Air Force must maintain an accountability system good enough to manage the supply chain in uncertain times. It does this by breaking the supply chain into segments and developing well-defined ways to manage each segment. This segmentation makes it hard to develop and sustain a systemwide view of the supply chain. Segments, typically defined by functional (e.g., supply and transportation, maintenance) communities within MAJCOMs, identify their own goals and metrics and manage their performance against these various goals and metrics. For example, the operating commands emphasize weapon system mission capable rates, while the wholesale supply system emphasizes percentage of requests met within a day or the net operating result of the supply management working capital fund. The Air Force currently has no well-defined way to align these goals and metrics to serve the interests of the Air Force as a whole or of its individual customers.

The Air Force uses its PPBS process to define requirements for resources associated with spare parts (for example, maintenance of existing spares, purchases of new spares, and development efforts to improve the reliability of spares), develop funded programs relevant to spare parts, and then develop budgets to tell Congress what appropriations the Air Force needs to realize these programs.

The current Air Force approach to PPBS complicates problems that already exist in the DLR supply chain. It decentralizes decisionmaking on DLR issues that would often benefit from an integrated view. For example, inventory management displays large-scale economies that no single player in the PPBS process can recognize and optimize. These scale economies result from effective management of safety

stock and of shortfalls as they occur, among other steps. Centralized maintenance displays similar scale economies beyond the effective oversight and management of any party to the PPBS process. This is true despite the fact that any one PPBS cycle lasts at least three years and requires extensive interaction to build a budget. The length and complexity of the process make it difficult for the Air Force to shape its programs and budgets to the ever-changing contours of an increasingly uncertain external environment.

Air Force logistics organizations and personnel are not currently well prepared to participate effectively in the Air Force PPBS process. For example, officials responsible for managing logistics policy and resources have only limited training and experience in the PPBS process. Air Force analytic methods also offer only limited help to Air Force planners to deal with these challenges.

The SRRB is the principal improvement that the Air Force is pursuing in treating spares in the PPBS process. The SRRB uses a new, consensus-based process to identify spares requirements that the traditional requirements process has underestimated. Advocates hope that simply identifying requirements more completely will lead to better funding for spares. The observations above suggest that the SRRB will likely fail to provide the positive effects anticipated unless other enabling changes support it. The Spares Campaign, begun in early 2001 under Air Staff leadership to reengineer Air Force supply, takes a broader approach that touches on many issues raised here.

PROPOSED CHANGES IN STRATEGY AND POLICY

The segmentation of the DLR supply chain and the lack of coordination in the PPBS process, then, create systemwide problems in the Air Force. These problems help explain persistent low mission-capable rates. They point to the need for a broad set of changes in how the Air Force programs and budgets for DLR spares. The report identifies seven policy changes relevant to the Air Force PPBS process that, taken together, we think would improve Air Force management of DLR spares:

- Explicitly reframe all logistics issues relevant to DLRs in the PPBS process to represent a realistic level of readiness achievable within designated resource constraints.

- Have logisticians participate more actively in the planning segment of the Air Force PPBS process to promote the approach above and to ensure that logistics is assessed fairly in higher-level PPBS considerations.
- Define an Air Force Planning and Programming Guidance (APPG) process that uses a resource-constrained version of high-level strategic goals to provide effective oversight of MAJCOM program objective memorandum (POM) submissions.
- Define a Headquarters, Air Force (HAF), closed-loop process⁴ that monitors disconnects within the PPBS process itself and between logistics budgets and actual logistics needs relevant to DLRs identified during the year of execution.
- Strengthen the responsibility and authority of the AF/IL to integrate horizontally *all* logistics requirements associated with DLRs and represent these requirements in the PPBS process.
- Rebuild the human capital capability within the Air Force logistics community to participate effectively in the PPBS process.
- Build and sustain a credible analytic capability to support the efforts above.

The changes proposed in Figure S.1 comprise an integrated package similar in character to the logistics package proposed in the Air Force Spares Campaign. A logistics “proponent” would provide a single point within the Air Force that can integrate input from the many parties relevant to planning, programming, and budgeting to reflect Air Force-wide strategic goals.

The changes begin by seeking a way to think about logistics routinely as a force-multiplier rather than as a bill-payer in the PPBS process. They seek to bring logistics into a top-down Air Force strategic plan-

⁴A closed-loop system proposes an action, expecting the action to yield a particular result. It then takes the action and monitors the result. If the result is different from what is anticipated, the system assesses the shortfall and proposes a second action likely to achieve the result, takes the second action, and monitors the result. It continues this cycle until it achieves the desired result or determines why the result cannot be achieved.

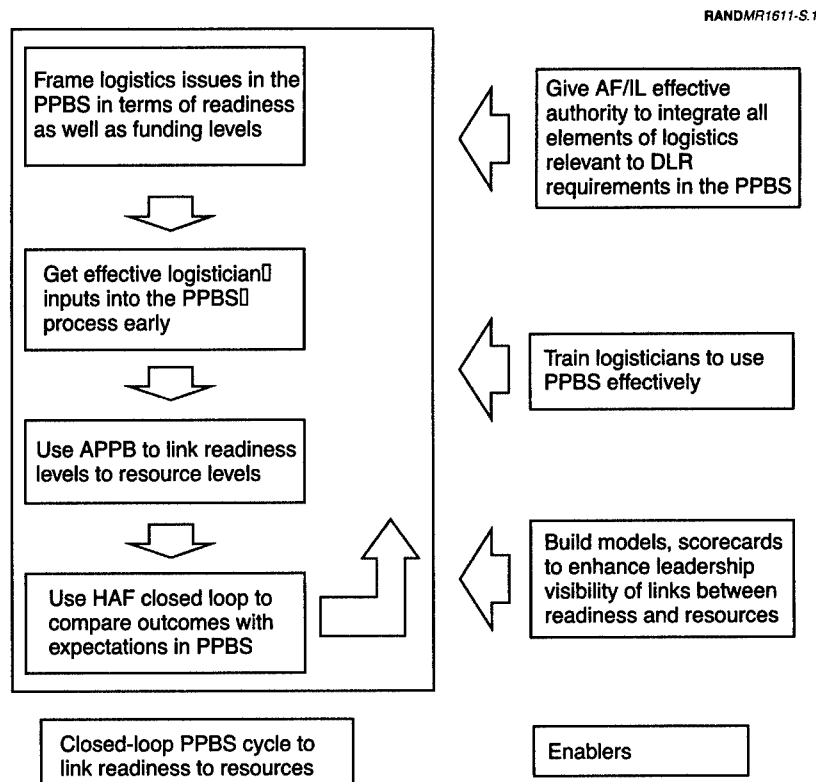


Figure S.1—Integrated Package of Proposed Changes

ning process that develops clear guidance on logistics resource decisions to the MAJCOMs. The APPG translates this guidance into specific, resource-constrained terms that the HAF can use to review MAJCOM inputs to the PPBS process and maintain an Air Force-wide view of logistics resource issues that places MAJCOM submissions in perspective as they move through the Corporate Structure. As an integral part of the PPBS process, the HAF monitors a set of closed-loop processes that compare plans with execution and help accelerate the Air Force's learning about how to adapt logistics resource policy to the dynamic threat and sourcing environments that it faces. AF/IL is the most logical focal point for these changes. The Chief of Staff and Secretary of the Air Force should clearly

endorse AF/IL as the champion for these changes, with the responsibility and authority required to implement them. To take on this responsibility, AF/IL will need logisticians better prepared to work in a PPBS environment and analytic methods, models, and data that link logistics resources as clearly as possible to high-level Air Force system metrics—readiness and total ownership costs. Such analytic methods will allow AF/IL to close the loop by demonstrating in the PPBS process exactly how logistics resources act as force-multipliers.

COMPLEMENTARY INITIATIVES THAT COULD FACILITATE EFFECTIVE CHANGE

The Air Force is already considering three basic changes in policy that should make it easier to implement our proposed changes.

The Spares Campaign is considering a way to centralize funding of spares to some degree. Its multipart pricing proposal would shift responsibility for about half the funding of DLR spares in the Air Force from the operating commands to AFMC. The DLR spares are those that benefit most from integrated management. This approach could reduce the problems caused by the current decentralized PPBS process. Properly implemented and integrated, it could enhance the value of the changes proposed above.

The Air Force Resource Allocation Process (AFRAP) could define a new capability construct to frame strategic decisions addressed throughout the Air Force resource-planning process. This construct seeks explicitly to link specific capabilities relevant to the senior leadership of the Air Force to the resources required to produce these capabilities. These resources would include relevant logistics resources. Such an approach could heighten the leadership's understanding of how logistics resources affect readiness, thereby increasing the priority given to these resources. Such an approach must be implemented carefully to ensure that it reflects the scale economies relevant to logistics resources. Implemented properly, it would complement the changes proposed above.

A balanced scorecard is a proven commercial method used to

- develop a clear consensus among senior leaders about strategic goals and how their organization works,

- develop metrics relevant to these views on goals and organizational behavior that the leadership can monitor on a regular basis, and
- employ these metrics to drive continuous improvement and effective response to surprises in the external environment.

The Air Force Logistics Transformation Team is developing a prototype balanced scorecard for the operation and support of the F-16 fleet. Such a scorecard necessarily captures relationships important to the supply chain for F-16 DLRs. Properly extended and implemented, such a scorecard could complement the changes proposed above.

The more effectively such changes as these are coordinated with the changes proposed above, the more value all of these changes, taken together, can bring the Air Force.

GENERAL ORGANIZATIONAL BARRIERS TO EFFECTIVE CHANGE

Fundamental elements of the Air Force culture will complicate any effort to make the changes we suggest and could easily defeat these changes unless the Air Force confronts these cultural issues directly. How the Air Force treats logistics resources in its PPBS process today is not an accident. It reflects deep-rooted traditions that color the Air Force's treatment of many issues, not just those addressed here. The Air Force tends not to follow up policy changes to verify that they have proceeded as planned. The Air Force prefers to organize itself around functions, such as supply and maintenance, and MAJCOMs, not integrated processes, such as supply chains. Although the Air Force has initiated many changes over the past 15 years, it has not made systematic and continuing change an integral part of how it manages its decisionmaking. Each policy or process change occurs in an isolated manner, not as part of a long-term, integrated strategy. The leadership of the Air Force has traditionally focused more on issues of modernization than on those of support.

The changes proposed here challenge many of these traditions fairly directly. The changes proposed here must occur within the bounds of the existing Department of Defense (DoD) PPBS process, which, as

flexible as it is, imposes significant requirements that absorb significant Air Force resources and management focus, simply to comply with the procedural requirements.

So the changes proposed here face significant barriers. In all likelihood, these barriers will slow the rate at which effective changes can occur. The kinds of changes proposed here will probably take time for the Air Force leadership to implement. In all likelihood, the Air Force leadership will need to see evidence that changes of this kind are worthwhile. Those promoting such change should be prepared to implement the changes incrementally to allow them to demonstrate improvement over time. Each improvement needs to build on the prior case for change, thereby implementing a series of interrelated, incremental changes over a period of several years. This type of change management is difficult because it typically requires a stable, long-term leadership team to maintain, over the long term, a strategic perspective of how the pieces are interrelated and build on one another. The Air Force leadership changes approximately every two years with the Air Force Chief of Staff changing every four years. The changes proposed here could easily take longer than Air Force senior leaders stay in particular positions.

The proposed general approach to resource management emphasizes the importance of using a monitoring cycle that is empirically well informed to proceed systematically against realistic, clearly stated goals. So it is natural to understand that this report would recommend a similarly realistic, systematic approach to change itself.

ACKNOWLEDGMENTS

This work would not have been possible without data and insights from many people in Headquarters Air Force and the major commands. We give special thanks to Brigadier General Robert E. Mansfield, Jr., AF/ILS, for sponsoring this work and for helping us refine our arguments. We thank Ed Koenig, SAF/FMBM, who led the Spares Campaign Programming and Financial Management (P&FM) Team where we initially aired many of the ideas presented here. Dennis Dutton, PACAF/XP; Lieutenant Colonel Brad Gentry, AF/XPPE; and members of the P&FM Team all provided great assistance. Curt Neumann, HQ AFMC/XPS, and his staff and Randy King and Ginny Mattern of the Logistics Management Institute provided deep insight into current logistics analytic capabilities in the Air Force.

Within RAND, Danielle Zink provided invaluable research assistance. Irv Blickstein, Chris Hanks, Gerry Kauver, Bob Roll, and Katharine Webb provided useful feedback on initial drafts. Roger Brown, Mary Chenoweth, Carl Dahlman, Greg Hildebrandt, Ed Keating, Jim Leftwich, Eric Peltz, Ray Pyles, Tim Ramey, Hy Shulman, and Bob Tripp all stimulated our thinking on this topic through the course of the work. Dan Sheehan ably edited the report.

We thank them all, but retain responsibility for any errors of fact or interpretation.

ACRONYMS

AAM	Aircraft Availability Model
ACC	Air Combat Command
AEF	Air expeditionary force
AETC	Air Education and Training Command
AFCAIG	Air Force Cost Analysis Improvement Group
AFLMA	Air Force Logistics Management Agency
AFMC	Air Force Materiel Command
AF/IL	Air Force Deputy Chief of Staff, Installations and Logistics
AF/ILS	AF/IL, Directorate of Supply
AF/PE	Air Force Deputy Chief of Staff, Program and Evaluation
AFRAP	Air Force Resource Allocation Process
AFSAA	Air Force Studies and Analyses Agency
AFSOC	Air Force Special Operations Command
AFSPC	Air Force Space Command
AFWCF	Air Force Working Capital Fund
AF/XO	Air Force Deputy Chief of Staff, Air and Space Operations
AF/XP	Air Force Deputy Chief of Staff, Planning and Programming
ALC	Air logistics center

AMC	Air Mobility Command
APOM	Amended Program Objective Memorandum
APPG	Air Force Planning and Programming Guidance
ASM	Aircraft Sustainability Model
BDA	Bomb-Damage Assessment
BES	Budget Estimate Submission
CIRF	Centralized intermediate repair facility
CLS	Contract logistics support
DCMA	Defense Contract Management Agency
DFAS	Defense Finance and Accounting Service
DISA	Defense Information Services Agency
DLA	Defense Logistics Agency
DLR	Depot-level reparable
DMAG	Depot Maintenance Activity Group
DMRD	Defense Management Reform Decision
DMRT	Depot Maintenance Review Team
DoD	Department of Defense
DPEM	Depot Purchased Equipment Maintenance
EAFF	Expeditionary Air Force
FOA	Field operating agency
FYDP	Future Years Defense Program
HAF	Headquarters, Air Force
LCOM	Logistics Composite Model
MAJCOM	Major command
MAJCOM/LG	Major command director of logistics
MDS	Mission Design Series (weapon system)
MEI	Major end item
MRRB	Maintenance Requirements Review Board
OSD	Office of the Secretary of Defense

P&FM	Programming and Financial Management (team on Spares Campaign)
PACAF	Pacific Air Forces
PAF	Project AIR FORCE
PDEP	Program Decision Package
PDM	Programmed depot maintenance
POM	Program objective memorandum
POS	Peacetime Operating Stock
PPBS	Planning, Programming, and Budgeting System
RSP	Readiness spares package
RSS	Regional supply squadron
SMAG	Supply Management Activity Group
SRRB	Spares Requirements Review Board
TNMCS	Total non-mission-capable rate caused by supply
TSSR	Total system support responsibility
USAFE	U.S. Air Forces in Europe
WCF	Working capital fund

Chapter One

INTRODUCTION

POLICY CONTEXT

Multiple reviews, over the past several years, agree that the logistics system that the Air Force uses to support its weapon systems does not work well in its current environment.¹ It needs to change to meet the needs of a force and processes different from those in place when the system was devised. Different reviews emphasize different sources of problems, but taken together, these reviews point to two kinds of problems:

- Given the resources it is willing to commit to logistics activities and how its logistics system actually performs, the Air Force *tries to do more with its operational weapon systems than its logistics support budgets allow*. Various observers argue the following:
 - Planned improvements are often programmed and budgeted before they are realized on the assumption that they can and will be realized. But improvements are typically smaller than expected.
 - Central planners often believe that depot-level logistics budgets can safely be cut because the depot-level logistics system has not downsized as fast as the rest of the Air Force,

¹See, for example, Air Force Materiel Command Reparable Spares Management Board (Frank Camm, chair), *Final Report*, Wright-Patterson AFB, Ohio, March 1998. The following General Accounting Office reports offer a variety of corroborating empirical evidence on the recent state of the Air Force depot management system: *Air Force Supply Management* (U.S. GAO, 1998); *Air Force Supply* (U.S. GAO, 1999a); *Air Force Depot Maintenance* (U.S. GAO, 1999b); *Air Force Depot Maintenance* (U.S. GAO, 2000).

suggesting that slack remains. In fact, further downsizing will cut performance unless significant process changes occur.

- Central planners often believe that cuts must lead improvements to motivate significant process change. Only pain will force the logistics system to learn and improve. Whether this is true or not, cuts without process change hurt performance. Process change in the Air Force has not caught up with the cuts.
- Recent budgetary increases for logistics activities, motivated by persistently poor performance, have not yet compensated for many years of underfunding. This is true in part because the Air Force has systematically underestimated its requirements for spare parts over time and in part because added funding for spare parts has done more to reduce the need for compensatory actions in base maintenance than to improve Air Force performance.
- Given the resources it is willing to commit to logistics activities, the Air Force could *improve its logistics system performance* if
 - Each depot-level reparable (DLR) supply chain were optimized to serve the goals of the Air Force as a whole and not its constituent parts.²
 - Logistics managers were better trained and sustained throughout their careers.
 - Data in official logistics data systems were more accurate and available on a more timely basis to all those who need them.
 - The DLR supply chain made better use of best practices by turning to the best sources of each logistics good or service required or emulating those sources.

²This report uses the term "supply chain" in the normal commercial sense. In particular, it covers more than only "supply-oriented" activities. A supply chain links a particular activity, such as DLR support, to all the activities, goods, and services that contribute to the execution of that activity. In effect, it comprises all the processes relevant to cost-effective provision of that activity. It can include logistics and nonlogistics activities, goods, and services inside and outside the Air Force.

- Individual problems were identified and resolved earlier, before they cascade into broader problems elsewhere in the supply chain.
- Individual problems were traced to root causes, which were then addressed broadly to prevent similar problems in the future.

The Air Force would likely benefit from efforts to resolve each of these problems, and efforts are under way to address several of them, particularly in the Chief's Logistics Review, Logistics Transformation Program, Air Force Materiel Command (AFMC) Constraints Assessment Program, the Spares Requirements Review Board (SRRB), the Spares Campaign, and the Depot Maintenance Review Team (DMRT).³

At the beginning of FY 2001, the Air Force Director of Supply, AF/ILS, asked RAND's Project AIR FORCE (PAF) to address the first problem above by looking for ways to improve how the Air Force logistics community participates in the Air Force Planning, Programming, and Budgeting System (PPBS) process. As the Air Force Spares Campaign got under way in early 2001, under AF/ILS's leadership, AF/ILS also asked PAF, where possible, to link its ongoing analysis of the PPBS process to the Air Force's needs in the Spares Campaign. This report documents PAF's findings on the PPBS process.

Programming and budgeting⁴ for Air Force DLR spare parts changed in two fundamental ways in the early 1990s.

First, in response to Defense Management Reform Decision (DMRD) 904 (U.S. DoD, 1989),⁵ the Air Force changed the administration of its

³The report provides some detail on several of these initiatives below.

⁴Programming and budgeting are two critical steps of the PPBS, the system that the Department of Defense (DoD) uses to develop programs and budgets for any future year of execution and for the years that follow as part of the Future Years Defense Program (FYDP).

⁵DMRD 904 attempted to introduce internal transfer prices to encourage cost awareness, reduce asset loss in the field, and encourage use of then-underutilized base maintenance manpower during peacetime. These new prices necessitated the creation of new working capital funds (WCFs). Many commentators in the Air Force speak of the activities associated with these new prices in AFMC as "WCF activities" and blame the WCF for problems that have resulted from DMRD 904. The funds and

funding for DLR repairs and hence the responsibility for preparing the program objective memorandum (POM) each year for this funding. Rather than giving AFMC funds to repair DLRs and having AFMC issue repaired DLRs for free to operating commands that requisition them, as in the past, the Air Force now gives the operating commands funds to, in effect, buy repaired DLRs from AFMC. Over the course of the next decade, this change in funding will move more and more responsibility for identifying and justifying the requirement for DLRs in the PPBS process from AFMC to the operating commands.

Second, in response to the Goldwater-Nichols Act of 1986,⁶ the Air Force reformed its PPBS process. The Air Force civilian and military leadership determined that it needed a highly decentralized process that empowered the individual major commands (MAJCOMs) to identify their requirements and then to argue for appropriate shares of resources. It pared the size and responsibility of Headquarters, Air Force (HAF), for building and managing Air Force resources. An initial reorganization in 1991 divested the Program and Evaluation Directorate (AF/PE) of many of its responsibilities in the PPBS process as the Air Force delegated most of its programming activities to the MAJCOMs. The Chief of Staff of the Air Force and the Secretary of the Air Force began to function as both the integrators of and the decisionmakers for Air Force resources. The operational MAJCOMs became the spokespersons for the operational Air Force's requirements and argued their resource needs before the leadership.

Since the 1991 reorganization, the leadership has taken several steps to develop a stronger integration function at the HAF to achieve a more balanced and executable program. In 1995, for example, the Chief of Staff reestablished the Corporate Structure; in 1996, he merged planning and programming in an attempt to restart strategic

their administration present technical problems of financial management, but they do not account for the problems we address here. We focus attention not on the WCF itself but on the more basic problems of separating the responsibility to program and budget for AFMC activities from AFMC and poorly structured transfers between AFMC and its customers that are not compatible with Air Force policy on AFMC customer support.

⁶This is the commonly used name for U.S. Congress, *Department of Defense Reorganization Act* of 1986 (Public Law 99-433); now U.S. Code, Title 10, Subtitle A, Part I, Chapter 5, Articles 151-155.

planning in the Air Force and to provide some centralized HAF ability to identify and adjudicate total Air Force resources. Because of continuous, congressionally directed staff downsizings, tightening of resources, and changes in the strategic environment, however, these initiatives have had only limited success.

Taken together, these two apparently unrelated changes altered how the PPBS process treated DLRs—from being a highly centralized process, dominated by AFMC, to a highly decentralized process, dominated by individual operating commands that cannot individually understand, much less realize, key scale economies associated with the management of DLRs. Scale economies exist whenever the unit cost of performing an activity falls as the scale of the activity increases. Scale economies exist for the management of DLRs for several closely related reasons:

- Central, depot-level repair of DLRs creates significant scale economies. The pipelines associated with depot-level repair—the inventories of DLRs that the Air Force must maintain simply to cover the fleet while reparable are in repair—also display scale economies.
- The safety stock for DLRs, their subindentured components, and other spares, which the Air Force maintains to compensate for uncertainties about demand rates at the flight line, shipment and processing times, and so on, creates significant scale economies.
- Total asset visibility, combined with central management of repair and distribution of DLRs, their subindentured components, and other spares to reflect priorities at the flight line, can create significant additional scale economies.
- Centrally managing DLRs and other spares needed in readiness spares packages (RSPs) can add still more scale economies, particularly with an Expeditionary Air Force (EAF) concept that continually rotates responsibility for the next deployment.⁷

⁷RSPs contain spares that the Air Force needs to support deployment but not normal peacetime operations. The new Air Force EAF concept makes most deployable Air Force assets available for deployment for a three-month period during each 15-month cycle.

It is much easier to identify and realize such scale economies in a centralized system than in a decentralized planning and programming environment. Quite unintentionally, the unrelated decisions to give operating commands responsibility for preparing POMs for DLRs and then to reduce the HAF's ability to integrate POM submissions from the operating commands have disrupted the Air Force's ability to identify the scale economies relevant to DLRs and hence to fully fund its ongoing requirement for the repair and replacement of DLRs.

A number of related initiatives to improve the performance of the Air Force logistics system as a whole offer an opportunity to revisit these decisions and correct their unintended consequences. The Logistics Transformation Program, begun in 1999, is developing a set of pilot initiatives that could give the Air Force new capabilities relevant to these decisions. The Spares Campaign, begun in early 2001, is promoting a perspective that aligns all activities in the supply chain. Full alignment will require the ability to view DLRs in a more systematic, unified way, and the Spares Campaign offers several alternatives. The Depot Maintenance Review Team, begun in the summer of 2001, is examining depot maintenance in much the same way that the Spares Campaign is examining the supply chain.

These ongoing efforts create an unusual opportunity for basic change. This report suggests a number of ways to take advantage of that opportunity to revisit how the Air Force PPBS process treats DLRs. It offers a number of suggestions that, taken together, could significantly improve the Air Force's ability to fund its true requirement for DLRs.

BACKGROUND ON AIR FORCE LOGISTICS AND PPBS PROCESSES

This report assumes a basic, high-level understanding of the Air Force logistics and PPBS processes. This section provides a primer for readers unfamiliar with either of these processes. Following sections build on this information, as needed, to discuss particular issues in greater depth.

Logistics

Broadly speaking, Air Force logistics activities provide physical support for major end items (MEIs). These activities occur in three fundamentally different settings inside the Air Force (see Figure 1.1). First, the “operational” MAJCOMs provide support for MEIs used for unit training during peacetime and in contingencies as needed. The operational MAJCOMs include Air Combat Command (ACC), Air Mobility Command (AMC), Air Education and Training Command (AETC), Air Force Space Command (AFSPC), Pacific Air Forces (PACAF), U.S. Air Forces in Europe (USAFE), and Air Force Special Operations Command (AFSOC). Second, AFMC is a MAJCOM that handles design, procurement, and depot-level management and maintenance of parts and systems relevant to the MEIs employed by the operational commands. Third, the HAF designs and maintains policy relevant to the first two logistics settings and their coordination. It also coordinates the Air Force PPBS process and the way the Air Force addresses logistics issues in that process.

The Air Force logistics system addresses maintenance, supply, transportation, and planning services relevant to the physical support of

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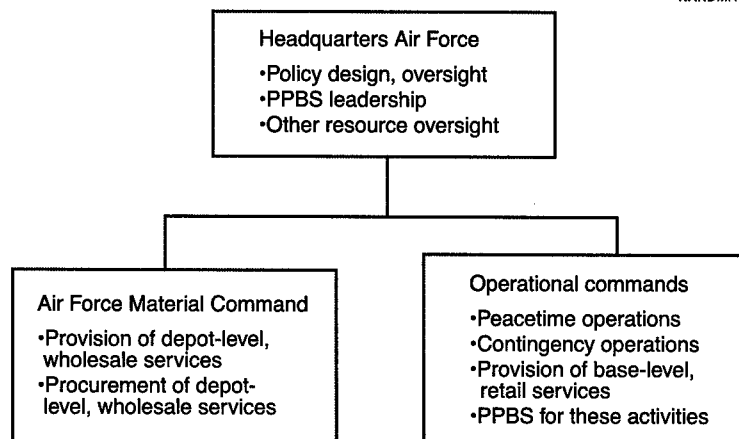


Figure 1.1—Formal Air Force Logistics Activities

MEIs in each of the three settings described above. These services consist of the principal "functional" activities associated with Air Force logistics. Broadly speaking, the maintenance function repairs and overhauls reparable parts in organically owned depots in AFMC and at repair facilities in each of the operational commands. Supply determines the requirements for DLR inventories, tracks where those parts are at any time, sets priorities for repair, and distributes serviceable DLRs to the highest-value locations. Transportation manages the details of moving parts from one place to another, including actual provision of transport services when contract transportation is inappropriate. Planning designs and maintains the operational architectures relevant to these other functions and their coordination.

A number of other Air Force functions support the logistics system in the operating commands, AFMC, and the HAF and across all the logistics functions. Broadly speaking, the financial management function manages the details of creating and maintaining internal transfer prices between functions and between MAJCOMs and associated working capital funds. It maintains data on operational metrics on logistics system cost and performance. The information services function provides hardware and software relevant to the maintenance and movement of logistics system information. The contracting function designs and oversees source selections and contracts associated with external sources of goods and services that the Air Force logistics community uses. The manpower function maintains data on the structure of the force and acts as a neutral broker in the competition among functions and MAJCOMs for internal and external labor resources.

The Air Force logistics system relies heavily on external sources for a variety of goods and services. Broadly speaking, the Defense Logistics Agency (DLA) buys most consumable spare parts for the Air Force (and the rest of the DoD) and sells them to AFMC. It also manages the central wholesale warehouses where Air Force spare parts are stored when not in repair or awaiting use on MEIs in the operating commands. The Defense Finance and Accounting Service (DFAS) designs and maintains the accounts that the Air Force uses to support its financial management function and disburses funds to contractors and personnel who work for Air Force logistics activities. Private companies and other parts of the government provide a wide

variety of maintenance, supply, transportation, and planning services through formal contracts and memoranda of agreement.

All these activities are relevant to the supply chains that the Air Force relies on to provide physical support to its MEIs. In this report, we are particularly interested in the supply chains to provide all the goods and services relevant to DLRs used in MEIs. Chapter Two explains in more detail how we think about these supply chains. For simplicity in this report, we will speak of a single “DLR supply chain” that comprises all activities, inside and outside the Air Force, relevant to all the DLRs used in the MEIs that the Air Force supports. In practice, it is typically useful to refine this notion into specific supply chains relevant to specific families of DLRs or even individual DLRs. For the purposes of this report, we do not need to pursue such a refinement.

Three kinds of spare parts are relevant to Air Force logistics: by definition, it is cost-effective to repair reparable; it is cost-effective to repair DLRs at organic or contract depot facilities; and it is not cost-effective to repair consumables—when they fail, the Air Force throws them out and replaces them with new items. The Air Force uses two maintenance concepts to manage reparable parts. The “two-level” concept removes items from an MEI at the “organizational level” and repairs them only in a depot-level shop at the “depot level.” The “three-level” concept removes items from an MEI and repairs them at an “intermediate-level” shop at the base. This intermediate shop may then remove subassemblies that can be repaired at a depot-level shop. These distinctions help illustrate the nature of the relationships that exist between bases in operational commands, the depot facilities in AFMC, and elsewhere.

PPBS

The Air Force PPBS process is one element in the larger DoD PPBS process. The Air Force PPBS in effect manages the submission of Air Force inputs to the DoD process. A PPBS cycle is effectively a series of carefully structured interactions that occur between the Office of the Secretary of Defense (OSD), the HAF, and the headquarters of the MAJCOMs over about a three-year period, using a fairly fixed set of

scheduled milestones, preceding any year of execution.⁸ These levels of command in DoD recursively exchange information to develop various kinds of guidance, plans, programs, internal transfer prices, and cost factors and finally a budget, which the President can submit to Congress. Congress routinely adjusts this budget in its authorization and appropriation acts for the year of execution. The Air Force and the rest of DoD then execute the budget passed by Congress.

The process is designed around a cycle that is supposed to be completed once every two years. In practice, the cycle is annual. The cycle converts a broadly stated *plan* into a specific *program* that extends over the course of the FYDP—two years in the current biennial *budget* plus five out-years. The cycle then converts this program into a budget stated in appropriation categories relevant to Congress. In alternate years, the cycle either (1) creates a two-year budget or (2) updates the two-year budget created in the previous year. In practice, the updates are so extensive that the process effectively generates a new one-year budget every year.

One cycle takes a long time to complete:

- OSD develops specific defense planning guidance from long-term defense plans during the first calendar year of the cycle.
- By the late fall of that year, the HAF, drawing on inputs from all parts of the Air Force, uses this planning guidance as a basis for its Air Force Planning and Programming Guidance (APPG), which tells the MAJCOMs how they should develop their inputs to the process that develops the Air Force POM.
- By early winter of the second year, OSD typically provides Defense Fiscal Guidance, which further defines the fiscal constraints to be used in developing the POM.
- The MAJCOMs bring their POM inputs to the HAF in late winter. The HAF uses a set of panels to review these inputs. Most inputs relevant to DLR spares come to the Agile Combat Support Panel. Because ACC has primary responsibility for agile combat support in the Air Force, it frames the review process in this panel from

⁸For a useful description, see U.S. Air Force (2000a) for a list of references that provide details on each part of the process.

an operator's perspective. Inputs relevant to DLR spares could in principle also flow to the Logistics Panel, where logisticians dominate; in practice, this has not occurred recently. These and a set of other panels, each oriented to a key mission in the Air Force, scrub inputs and begin a hierarchical review process in the Air Force Corporate Structure that resolves increasingly difficult issues at higher and higher levels.

- This process yields a fully coordinated Air Force POM by late spring of year two in the cycle. The Air Force sends this POM to OSD, which reviews it and asks for clarifications on specific issues. The Air Force fields these requests.
- In the meantime, the Air Force refines its POM into a budget document and adjusts this document as needed in response to continuing guidance from OSD. This budgeting phase provides opportunities to update pricing factors relevant to budgets, to revisit earlier programming decisions and update them in response to external changes, and to negotiate with OSD. These activities again yield inputs from the MAJCOMs. The panels in the HAF review the inputs and bring them into the Corporate Structure. The Corporate Structure once again resolves problems hierarchically, yielding a fully coordinated Air Force Budget Estimate Submission (BES) by late summer in year two.
- OSD reviews the BES and raises issues for the Air Force to address. Negotiation continues until OSD has completed a final budget, which it submits for final presidential approval in late fall. In January of year three, the White House sends the approved presidential budget for the Air Force and the rest of DoD to Congress.
- A variety of congressional committees review this budget, typically with accompanying hearings. The Air Force participates in this review process, continuing to respond to congressional queries.
- Usually, by early fall of year three, Congress approves a defense budget, allowing the Air Force to begin executing the program it has developed during this cycle. Execution continues through the "year of execution," which extends from October of calendar year three through September of calendar year four in the cycle.

- The summer of year four typically brings a reassessment of the monies that the Air Force and the rest of DoD need to execute their programs successfully. In recent years, they have required supplemental funding from Congress to complete the year of execution. This funding represents an additional infusion of money that supplements the funds included in the defense budget approved at the end of calendar year three.

In this process, OSD gives the HAF guidance, the HAF gives the MAJCOMs guidance, the MAJCOMs develop the details of programs and budgets, the HAF resolves conflicts in the inputs from the MAJCOMs and submits the final result to OSD, OSD reviews this input and works with the Air Force to refine it and ultimately submits a proposal to Congress, and Congress uses this proposal as a starting point for its final budget.

Three facets of this process inside the Air Force are particularly important to the management of DLRs:

- The operational commands develop both the aggregate levels of and details about the programs and budgets that pay for the DLRs and DLR services that the Air Force will acquire or produce during the year of execution. AFMC will acquire and produce most of these DLRs and DLR services for the Air Force.
- As part of a logistics planning activity that operates in the background, behind the PPBS planning process, all the MAJCOMs participate in the Air Force Cost Analysis Improvement Group (AFCAIG) process (named for the Air Force organization that coordinates the process). This process seeks to define the Air Force-wide "fully funded requirement" for DLRs (and some other important expenditures) during the year of execution. This process is entirely advisory and can influence actual funding proposals for DLRs, made in the operational commands, only by providing informational input. The "fully funded requirement" does not address what DLRs will cost the Air Force as a whole during the year of execution, but rather what the operating commands will pay AFMC to get these DLRs during the year of execution.
- During the Air Force POM submission, AFMC has no direct influence on the actual levels included for the DLRs and DLR services

it will acquire or provide in the year of execution. It can influence the proposed submission primarily through its participation on the Agile Combat Panel in the HAF review process.

- Once the total Air Force program is stated, AFMC can significantly affect the budget that the Air Force associates with that program when it updates the prices for DLR-related activities that the Air Force will use to develop the BES.

This is roughly how the current PPBS process works in the Air Force. It has changed each year in recent years and is likely to change in the future. One advantage of the PPBS process is that the Air Force has a great deal of flexibility to adjust how it responds to the guidance and deadlines it receives from OSD.

That said, when a cycle that lasts almost four years begins anew every year, at any point, four overlapping cycles are in play simultaneously. The Air Force must ensure that these overlapping cycles remain in sync with the others as each of them adjusts to ensure that future funding for DLR spares meets the Air Force's future needs.

THE SCOPE OF THIS REPORT

This report emphasizes the processes that the Air Force uses to define its program and budget for the acquisition and provision of goods and services relevant to the provision of DLRs and DLR maintenance during the year of execution. Relevant goods and services can include anything that contributes to successful provision of DLRs to end-users in the operating commands. With that in mind, we speak of a supply chain for DLRs that starts with the customers of the operating commands and walks back through each of the activities that support the use of DLRs in this process. So, although we focus on DLR spare parts, we are interested in all the maintenance, supply, transportation, and planning activities in the Air Force logistics system, as well as the other Air Force functional processes and external sources of goods and services that play a role in supporting these DLR spare parts.

Viewed this way, our definition of a DLR supply chain includes more than just the Air Force logistics system because it includes nonlogistics functions inside the Air Force and many activities outside the Air

Force. It does not include all of Air Force logistics because not all Air Force logistics support DLRs. Similarly, this definition is not constrained to spare parts that are DLRs. It includes consumable items and reparable parts that are important to the support of DLRs. It does not, however, include all spares, because not all spare parts support DLRs.

The report discusses a number of Air Force initiatives that have a very different focus. The Spares Campaign and Spares Requirements Review Board, discussed in detail Chapter Two, for example, consider all spare parts but do not consider all parts of the Air Force logistics system relevant to DLRs or large portions of nonlogistics functions inside and outside the Air Force. When these initiatives refer to a supply chain, they typically envision a set of processes traditionally aligned with the Air Force supply function.

So the definitions of terms like “spares” and “supply chain” can vary in the discussion below. We have attempted to be as clear as possible in particular contexts about the meanings we intend.

CONTENTS OF THE REPORT

This report proceeds in four steps:

- It starts by explaining how the Air Force’s treatment of DLRs in its PPBS process today aggravates problems that degrade Air Force-wide performance and increase costs.
- It identifies seven policy changes relevant to the Air Force PPBS process that, taken together, we think would improve Air Force management of DLR spares.
- It identifies three basic changes in policy, which the Air Force is already considering, that should ease implementation of our proposed changes.
- It identifies fundamental elements of the Air Force culture that will complicate any effort to make the changes we suggest and that could easily defeat these changes unless the Air Force confronts these cultural issues directly.

Chapter Two explains how the treatment of DLRs in its PPBS process today aggravates problems that degrade Air Force-wide performance and increase costs. It briefly explains how the Air Force has broken down its complex DLR supply chain into manageable segments and found effective ways to manage each segment. This segmentation limits the Air Force's ability to integrate the supply chain into a coherent whole, particularly in the current uncertain environment. The problems created by a decentralized PPBS process, described above, are one manifestation of this broader segmentation of the supply chain. The primary innovation under way to overcome segmentation of the Air Force PPBS process to define spares requirements, the SRRB, will address only some of the problems that prevent effective integration of the PPBS process.

Chapter Three identifies the seven policy changes relevant to the Air Force PPBS process that would improve Air Force management of DLR spares. That chapter explains that the Air Force should:

- Explicitly reframe all logistics issues relevant to DLRs in the PPBS process to represent a realistic level of readiness (e.g., sorties available or mission capability) achievable within designated logistics resource constraints.
- Have logisticians participate more actively in the planning segment of the Air Force PPBS process to promote the approach above and ensure that logistics is fairly assessed in higher-level PPBS considerations.
- Define an APPG process that uses a resource-constrained version of high-level strategic goals to provide effective oversight of MAJCOM POM submissions.
- Define a HAF closed-loop process that monitors disconnects within the PPBS process itself and between logistics budgets and actual logistics needs relevant to DLRs identified during the year of execution.
- Strengthen the responsibility and authority of the Deputy Chief of Staff of Installations and Logistics (AF/IL) to integrate, horizontally, the totality of logistics requirements associated with DLRs and represent these requirements in the PPBS process.

- Rebuild a human capital capability within the Air Force logistics community to participate effectively in the PPBS process.
- Build and sustain an analytic capability to support the efforts above.

We offer this package as an integral package. Each change increases the likelihood that other parts of the package will succeed.

Chapter Four identifies three basic changes in policy, which the Air Force is already considering, that should make it easier to implement the changes proposed in Chapter Three. First, multipart pricing of DLRs, part of the ongoing Spares Campaign, could promote integration by helping centralize the funding of spares. Second, a version of the Air Force Resource Allocation Process (AFRAP) now under development, with a capability defined to reflect sustainability of existing MEIs directly, could simplify effective inclusion of sustainment resource issues in the PPBS trade-space. Third, the balanced scorecard, under development in the Logistics Transformation Program, provides another way to link readiness-related outcomes to logistics resources. Ongoing Air Force efforts could yield a scorecard that substitutes for or complements available analytic models and databases.

Chapter Five identifies fundamental elements of the Air Force culture that will complicate any effort to make the changes we suggest and that could easily defeat these changes unless the Air Force confronts these cultural issues directly. Today, the Air Force does not sustain its strong organizational traditions of balancing resources and readiness realistically and “closing the loop” on plans to verify the balance; viewing the DLR supply chain as an integrated process and assigning effective, clear responsibility and accountability for and authority over the total supply chain to ensure its integration; or managing organizational transformation aggressively. Historically, the senior leadership of the Air Force has favored modernization and operational performance relative to other goals, including effective sustainment of existing MEIs. In the 1970s and 1980s, the Air Force effectively managed this shortcoming by determining its resources through capability packages, in which sustainment issues were integrated into Program Decision Packages (PDEPs). This mechanism enabled the leadership to understand how sustainment resources

directly affected operational readiness. The Air Force reorganization in the 1990s resulted in abandonment of the PDEP structure in favor of a more decentralized resource management scheme, resulting in a breaking of the tenuous linkage between operational performance and sustainment. Currently, the highly decentralized structure of the Air Force's PPBS process limits the Air Force in addressing service-wide sustainment resource management issues effectively because each MAJCOM is responsible for ensuring that sustainment issues are sufficiently addressed in its respective program. None of the changes discussed in Chapter Three is likely to succeed unless the Air Force finds explicit ways to address these broader resource management issues.

Chapter Six concludes the report with a brief summary.

HOW THE PPBS PROCESS ADDRESSES RESOURCE QUESTIONS RELEVANT TO DLRs: POLICY ISSUES

In today's Air Force PPBS process, it is hard to assess high-level trade-offs among AFMC logistics resources, which support the operating commands, and other Air Force resources. This chapter identifies factors that contribute to this difficulty. Any policy recommendations seeking to improve the treatment of AFMC logistics resource issues in the PPBS must address these factors.

The chapter examines each of the following topics in turn:

- A brief overview of integrated supply chain management sets the stage for a discussion of DLR supply chain management in the Air Force.
- It examines the complexity of the Air Force supply chain relevant to DLRs.
- Even though the Air Force does not understand exactly how changes in one part of its DLR supply chain affect performance elsewhere, it must maintain an accountability system good enough to manage the supply chain in uncertain times. It does this by breaking the supply chain into segments and developing well-defined ways to manage each segment. The chapter explains how this occurs.
- This segmentation makes it hard to develop and sustain a systemwide view of the DLR supply chain. The chapter explains why.
- The chapter examines how the current Air Force approach to PPBS complicates these problems.

- The chapter explains why Air Force logistics organizations and personnel are not currently well prepared to participate effectively in the Air Force PPBS process.
- These observations suggest that the principal improvement that the Air Force is pursuing in how it treats DLRs in the PPBS process, the SRRB, will probably not have the positive effects anticipated unless other enabling changes support it. The chapter briefly reviews the SRRB and explains why.
- These observations are much more in tune with those of the ongoing Air Force Spares Campaign. The chapter summarizes the relevant findings of the Spares Campaign and relates these to the approach developed here.

INTEGRATED SUPPLY CHAIN MANAGEMENT

A supply chain is a network of production processes that work together to create the products demanded by its ultimate customers.¹ To understand a supply chain, one needs to know who these customers are and what they demand from the supply chain. What processes produce what they want? What processes support these processes?

For example, if the customers want available aircraft, one process at the base flight line removes and replaces bad parts. Another at the base repairs three-level items. Another provides parts to the base flight line and repair shops. Others repair parts and overhaul aircraft and engines at organic and contract maintenance facilities. Other processes provide parts to these facilities. Other processes move all these parts from place to place.

A bit in the background, still other processes support all of these processes by maintaining facilities, utilities, and equipment for these activities and acquiring, training, and maintaining the people who work at the facilities. Others generate, store, and move information. Other processes decide which parts to move where and which parts

¹Many excellent references are available on supply chain integration. For more details, for example, see Kuglin (1998). For useful insight into the integration of the AFMC DLR supply chain, see KPMG Consulting (2000).

to repair. Still others move financial assets from place to place and keep records on their status.

All of these activities are part of the supply chain relevant to the ultimate customers at the flight line.

Supply chain integration seeks to coordinate all these processes as seamlessly as possible so that they jointly pursue a common purpose. Together, they either minimize the total ownership cost of achieving given levels of flying hours, safety, and flexibility at the flight line or maximize the levels of flying hours, safety, and flexibility achievable from the standing network of processes and the resources they consume.

How does this happen?

- All of the key players in the supply chain view themselves as part of an integrated system with common goals.
- The key players organize themselves around the needs of the ultimate customers. These needs define the common goals of the supply chain.
- Key players in each segment of the supply chain are responsible and accountable for performance against metrics linked to the common goals of the supply chain as a whole.
- Players in each segment of the supply chain are rewarded when their behavior enhances the performance of the supply chain as a whole and penalized when it does not.
- Key players in these segments share information and experience to improve their performance over time.
- Someone is responsible and accountable for ensuring that all the aforementioned actions occur.

All elements of the supply chain need not be in one organization or report to a single authority to achieve the goals above. Quite the contrary. Successful supply chains act as networks whose parts work together over time to improve their joint performance and share the gains from such improvements. Different parts effectively “co-evolve” over time, each affecting how the other changes. But one of

the co-evolving parts must take responsibility for keeping score and tracking the degree of success in moving toward greater integration.

Sweetness and light typically do not prevail in these networks. They are full of hard bargaining and tough demands. In the end, however, they succeed only if the players in the network maintain mutual respect for and trust in one another. Supply chains succeed only if they understand themselves as fostering positive-sum games in which everyone can win over time. Finger-pointing is futile; mutual problem-solving prevails.

Building and sustaining an integrated supply chain is hard to do and harder still, the more complex the supply chain becomes. Integration is not a one-time event. It grows as individual parts of the supply chain find ways to bind themselves to common goals. It typically starts small. Demonstrated success encourages ever more ambitious integration among more players. Integration grows continuously, so long as the players continue to find more ways to build mutual gains together. No one has found a logical end to this process, the point where no further integration is worth considering.

A COMPLEX DLR SUPPLY CHAIN

The simplified process map in Figure 2.1 conveys a sense of how complex the Air Force supply chain relevant to DLRs is. The Air Force DLR supply chain primarily delivers services to its own wings, which in turn can deliver services to combatant commanders and other high-level commanders as needed. It also provides support services to other U.S. armed forces, who in turn serve higher-level commanders, and to foreign customers. The DLR supply chain relies on base-level, regional, and wholesale-level supply organizations and on base-level, depot-level, and contract sources of maintenance. These activities in turn rely on contractor parts providers, Air Force transportation and planning services (not shown, because they are pervasive), and a variety of defense agencies.

We could explode each of the simple nodes and arcs in Figure 2.1 to reveal far more complex relationships. Doing so would show that many different Air Force functional communities interact in each of

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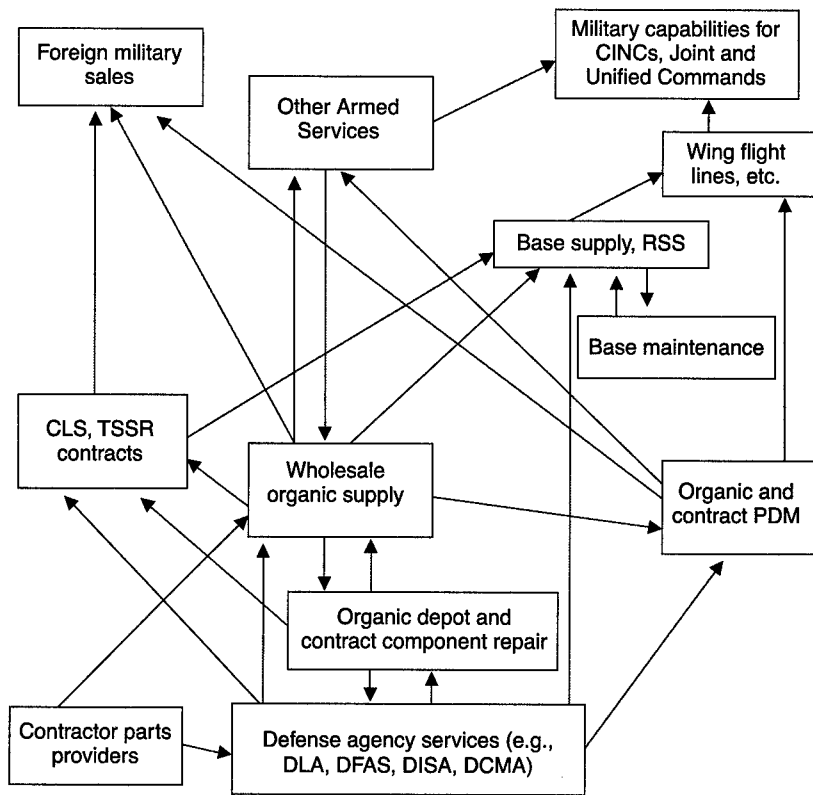


Figure 2.1—Simplified Overview of the Air Force DLR Supply Chain

these nodes and often in the arcs as well. It would also show that different MAJCOMs are responsible for individual parts of this supply chain and, in the end, for finding ways to work together to keep all the parts synchronized.

A truly integrated supply chain would manage all of these elements to serve a common purpose—giving the Air Force DLR supply chain’s customers the best support available from existing resources. Such integration requires that the Air Force have a coherent and

internally consistent way to define priorities among different customers and have a clear way to link the value added by each element of the supply chain to the values of these customers.²

No one in the Air Force has this clear an understanding of how all the parts of the DLR supply chain fit together. Individuals understand each part of the system quite well. No one, however, understands the whole supply chain well enough to optimize it, no one has the effective authority to optimize it, and no one is held accountable to optimize it.

This is particularly important when considering two kinds of scale economies inherent in this kind of supply chain. The Air Force can realize these scale economies only by coordinating the players in the supply chain who must act together to create those economies.

First, key assets in the supply chain in effect provide common capabilities that are greater if players work together than if they work in isolation. For example, large portions of the DLR spares inventory serve all players in the Air Force that rely on these spare parts. Filling the pipeline for an F-16 part benefits not only ACC, but also PACAF, USAFE, and all other parts of the Air Force using this part. Providing safety stock has exactly the same effect. So does filling RSPs when squadrons deployed by any of several players might use them in the future. Similarly, many maintenance test stands can create large-scale economies that allow higher levels of production if they are collocated than if each stands alone. Operators who rely on these stands can realize these scale economies only if they work together to collocate the test stands and use them jointly.

Second, central management of key assets can ensure that they address the most important problems of operators when the assets are in short supply. A given inventory of parts allows higher military capability if it is managed together than if it is split up because, when

²Consider the challenge of defining and serving the priorities for two sets of Air Force customers—those flying in the continental United States (CONUS) and those deployed. Priorities would presumably seek to achieve different mission capable rates in these different locations. Today, the Air Force cannot even do this in an internally consistent way for one Mission Design Series (MDS), much less across all MDSs. Creating and serving priorities for foreign military sales and other parts of DoD present even more challenges.

managed centrally, the system can send parts to the places they are needed most throughout the Air Force, not just where they are needed in one portion of the Air Force. Similarly, a repair facility can add more value when information from the whole Air Force drives what parts to induct than when information from only a portion of the Air Force drives this decision. The Air Force can exploit such priorities centrally, of course, only if it can set clear priorities among different customers for the constrained support assets in question.

Important diseconomies of scale are present as well, of course, and they must be balanced against these types of scale economies. The larger an organization gets, the harder it is to manage to a central set of goals. Breaking up an organization can allow each part to run more effectively, even if some poor coordination between parts occurs. The improvement within parts makes up for any diseconomies resulting from poor coordination. In general, though, a falling cost of information and increasingly capable information systems make it easier and easier to coordinate large activities, favoring increased centralization of information about DLRs and of the exploitation of this information.

The Air Force's inability to explain, to itself and others, how all the segments of its DLR supply chain fit together presents two important kinds of difficulties.

When addressing itself, the Air Force has no common set of metrics it can apply to weigh investments in one segment of the supply chain against another, much less against an investment elsewhere in the Air Force. Therefore, it has difficulty articulating the value of investments in its DLR supply chain, even within its own house.

When addressing others, the Air Force cannot explain important facts that outsiders can easily observe. For example, while the Air Force was complaining that it was short of DLRs in the air war over Serbia, the Air Force performed reliably, with high aircraft availability rates. How could it perform so well if the contentions about DLR shortages were true? The Air Force could not explain effectively that compensatory actions made up for the claimed shortages and that these compensatory actions probably could not have been sustained in a larger or longer conflict. The Air Force is still dealing with negative effects that working its maintenance troops hard had on reten-

tion and training activities, but it has difficulty clarifying the magnitude of these negative effects and their root causes in DLR shortages. Similarly, when Congress provides supplemental funds for DLRs, it has difficulty understanding why these funds do not appear to improve readiness much. They do take pressure off personnel in military maintenance activities and give the Air Force breathing room to rebuild its human maintenance capital. But Congress cannot see how such improvements relate to funds for DLRs.

SEGMENTING THE DLR SUPPLY CHAIN TO SUSTAIN ACCOUNTABILITY

Personnel in the Air Force know a great deal more about what happens within each segment of the DLR supply chain that they control than about how these segments work together. Supply personnel in ACC have a common understanding of their mission and use common language, goals, metrics, and data systems to pursue their mission. Maintenance personnel in AFMC have a common understanding of their mission and use common language, goals, metrics, and data systems to pursue their mission. So do inventory management personnel in AFMC. The same could be said of each functional community in each MAJCOM associated with the supply chain, from the traditional logistics functions of maintenance, supply, transportation, and planning to the financial management, manpower, personnel, contracting, and other functional communities that support them.

Each of these communities understands its situation well enough to sign up to specified performance targets and take responsibility for meeting these targets, so long as each community controls the factors relevant to the performance in question. Supply activities focus on targets relevant to the inventories they control directly; base maintenance focuses on activities that it controls, such as cannibalization rates;³ and so on. Each has a pretty good idea of which

³"Cannibalization" occurs when a base maintenance shop takes a part it needs for a particular repair off an MEI that it supports rather than getting the part from the supply system. This occurs only when the supply system cannot provide a part quickly, and waiting for a part would reduce the overall performance level of the activity that the maintenance shop supports. The base maintenance shop directly controls how much of this occurs.

resources are required, with current process arrangements, to meet any set of targets, again so long as they control all factors relevant to that performance. None of them is comfortable performing against a target, such as number of sorties available, more relevant to their immediate customer than to themselves. This is true, in part, because they control only some of the factors relevant to this performance and, in part, because they do not really understand the factors outside their own community relevant to such performance targets.

Under these circumstances, the Air Force has sought performance targets for each segment that meet these criteria. Depot-level maintenance personnel, for example, pursue efficiency targets, defined either in terms of efficiency in the utilization of the existing labor force or, increasingly, of the financial performance of the Depot Maintenance Activity Group (DMAG) fund. Similarly, wholesale supply personnel pursue MEI availability targets defined carefully to reflect only things they control. The dominant outcome metric in this community is the total non-mission-capable rate for an MEI caused by supply (TNMCS) or, even closer to the supply community, the stockage and issue effectiveness it achieves when it passes items to the next segment in the DLR supply chain.

CONSEQUENCES OF SEGMENTATION

Focusing on such goals and metrics has three important effects: First, it makes personnel in each segment comfortable enough to take responsibility for them. Second, it induces personnel in each segment—typically defined by a function and/or a MAJCOM—to think locally rather than globally. That is, it explicitly cuts off each segment from the broader supply-chain-wide picture, which is precisely the intent of such metrics because doing so allows each segment greater control over its own destiny. Third, it makes it most difficult for the senior leadership of the Air Force—which is much more interested in supply-chain-wide metrics that address military combat capability, safety of flight, and cost than it is in each bit of the chain itself—to understand the value of improving performance in any part of the DLR supply chain. In other words, choosing such goals and metrics breaks up the Air Force supply chain in ways that fundamentally separate most segments of the DLR supply chain from

the things the leadership values, such as mission capability and Air Force-wide costs. This, in turn, has two further consequences.

First, such segmentation amplifies the effects of a broader DoD effort to distinguish “tooth” from “tail”—military capability from support capability—and reduce resources in the tail to make them available to the tooth. This simple distinction views support almost entirely in terms of its cost, transforming it into a bill-payer for tooth. In the extreme version of this view, there is no recognition that cutting the size of the tail might reduce effective support to the tooth and thereby damage military capability.

Seen through the tooth-tail lens, the segments of the DLR supply chain outside the Air Force operating commands all fall into the tail and become natural bill-payers. Cost reduction is obviously a valid and important goal in these segments, but the tooth-tail lens transforms that goal into the dominant goal. The dominant guidance the senior leadership gives the AFMC portions of the DLR supply chain in the PPBS process is to reduce their cost to free up resources for modernization. The leadership supported lean logistics, now agile combat support, not primarily for its ability to reduce the mobility footprint or to make the supply chain more robust during a period of increased external uncertainty (both key attributes of lean logistics) but to cut requirements for inventory and thereby reduce cost. The senior leadership has repeatedly mandated performance improvements to achieve specified cost savings without first identifying how such improvements might occur. Because the Air Force has no compelling way to show how AFMC segments of the DLR supply chain contribute to the senior leadership’s military capability goals, AFMC has been unable to move the focus of the senior leadership from the cost of AFMC to the performance of the entire supply chain.

Second, almost everyone in the Air Force thinks primarily about making improvements within a segment rather than in the DLR supply chain as a whole. Even when cross-segment teams and initiatives form, it is easier for them to think about bundles of improvements in each of the segments represented than about improvement in the DLR supply chain as a whole. For example, initial efforts to implement two-level maintenance immediately ran into resistance in the operating commands, which did not want to give up the testing capability that had to be centralized to achieve a

significant portion of the improvements from two-level maintenance. Similarly, initial efforts to implement lean logistics very quickly broke into two efforts, one in AFMC and the other in the operating commands. Each interpreted lean logistics differently. Perpetuating local priorities reduced the benefits that a global implementation would have offered. Operating commands, for example, saw lean logistics primarily as a way to make AFMC more responsive to their needs. AFMC, on the other hand, used lean logistics to pursue initiatives that improved the internal performance of five specific AFMC processes, from AFMC's perspective. Because lean logistics in effect transferred resources from supply to maintenance, transportation, and planning functions—each normally evaluated separately—the Air Force had great difficulty reaching consensus on how to validate the success of the change. Repeated reductions in headquarters staffs that might take a broader view have eliminated a potential source of broader thinking.

Even in a headquarters where cross-functional thinking is occurring, the lack of common metrics to examine performance in all segments makes consensus-building difficult. For example, consider what happens when operations (AF/XO), plans and programs (AF/XP), and logistics (AF/IL) organizations in the HAF try to work out joint positions on DLR policies and resourcing. AF/XO wants to know how changes will affect its formal war plans and its ability to field sorties in unforeseen contingencies. AF/XP wants to know how changes will affect numbers of people and dollars required throughout the Air Force. AF/IL wants to know how changes will affect the resources at its disposal and its ability to use available logistics processes to meet its targets. Each organization depends on stovepiped organizations throughout the Air Force to feed it information and support negotiations. Each organization thinks in terms of different language, goals, metrics, and databases throughout its supporting stovepipes.

In the absence of a consensus on how the Air Force DLR supply chain as a whole works, negotiations lack facts and tend to become political. High-level negotiations in a large organization can never escape politics, but factual information on how the organization's processes work together can focus negotiations in ways more likely to produce light than heat. Without a common vision at the top, the Air Force, like any other large organization, will tend to rely on

agreements reached at lower levels, where local visions (within segments) are more complete and concrete. It will bundle tactical agreements from below to avoid the difficulty associated with reaching strategic agreements at the top.⁴

MANAGING UNCERTAINTY IN A SEGMENTED DLR SUPPLY CHAIN

Since the fall of the Soviet Union, the external threat to the United States and the Air Force's role in mitigating that threat have become more uncertain. At the same time, the private markets that the Air Force relies on for goods and services have become more dynamic. So, over the past 15 years, the Air Force has faced greater uncertainty in the nature of the mission it will be expected to perform and in the nature of the external sources it will rely on to perform that mission.

The Air Force has responded to this rise in uncertainty by changing key policies to make itself more agile. This has simultaneously improved the Air Force's ability to accommodate the increased external threat and increased the uncertainty that its own DLR supply chain, internal and external, must accommodate.

For example, the EAF concept is designed to allow the Air Force to deploy quickly to deal with unanticipated contingencies without causing undue turmoil in day-to-day operations in the Air Force. The Air Force hopes that, by demonstrating its ability to meet unanticipated contingencies quickly, it will actually deter such contingencies, thereby reducing the uncertainty it must contend with each year. To make this possible, it needs a supply chain that can reliably execute and sustain a wide variety of unanticipated contingencies. In fact, the EAF concept is meaningless without a new view of the DLR supply chain. The deployed supply chain must become lighter and more agile, and the supply chain at home must become more responsive to unanticipated demands. The supply chain must sustain this ability to deal with unanticipated demands, whether they

⁴Properly implemented, a balanced scorecard provides a disciplined method for framing strategic agreement at the top and driving it down through an organization. Chapter Four provides a brief discussion of ongoing Air Force efforts to implement a balanced scorecard to improve the performance of its logistics system.

materialize or not. By definition, individual segments of the supply chain cannot make such improvements without reference to a broader vision.

Similarly, matching depot repair actions to demand is an attempt to recognize that specific demands on the depot are so hard to predict that the depot should, to the full extent possible, wait until it is sure a demand will materialize before repairing a particular DLR. Matching repair actions to demands became even more important as uncertainty in the Air Force's external environment rose. Matching repair to demand can reduce costs by reducing the number of repairs performed and by reducing the safety stock required to cover demands when repair priorities depended on other factors, such as prenegotiated quarterly production rates. But it can also increase costs by moving resources from buying DLR spares to buying repair capacity that will be available to meet any demand. The Air Force needs a sophisticated view of its DLR supply chain to do this cost-effectively; it has had great difficulty justifying its move in this direction, choosing the right algorithm to use to predict actual demands, and choosing the degree of matching—between repair and demand—most appropriate for different kinds of DLRs.

Other Air Force policies have introduced uncertainties to the DLR supply chain that were not necessarily generated by an increasingly uncertain external environment. For example, the methods the Air Force uses to set internal transfer prices and cost factors for budgeting have led to repeated surprises when the cost factors do not generate enough money in an organization's budget to cover the internal transfer prices it must pay in the year of execution. This has occurred repeatedly for exchanges between the DMAG and the Supply Management Activity Group (SMAG) and for exchanges between AFMC and the operating commands. These surprises increase uncertainty for the buying organizations. Similarly, internal transfer prices between AFMC and the operating commands have led the operating commands to change their demand patterns for AFMC services in ways that reduce the level of services demanded and increase the cost to AFMC of each service provided from those that AFMC anticipated. These responses increase uncertainty in AFMC. All of these increases in uncertainty are direct consequences of segmentation in the Air Force DLR supply chain and a lack of understanding of how segments relate to one another.

Analytic models should help the Air Force manage such problems.⁵ The Air Force has maintained sophisticated logistics models to support resource planning in the PPBS process for many years. The Aircraft Availability Model (AAM) and Aircraft Sustainability Model (ASM) are of greatest importance to DLR spares planning.⁶ The Logistics Composite Model (LCOM) is the dominant model for base maintenance. Other models exist for other parts of the DLR supply chain.

They have major shortcomings, however.⁷ Even though current Air Force models often dominate analogous models in the commercial world in terms of sophistication, when faced with the challenge of linking readiness-related outcome measures to logistics resource level, these existing models face severe challenges. For example:

- The models break up the DLR supply chain and address each element of it in isolation, using simple assumptions about remaining portions of the supply chain. For example, LCOM focuses on detail on the base while using very simple assumptions about the performance of the supply system that supports the base. AAM, on the other hand, makes very simple assumptions about base maintenance and focuses on the details of the system that delivers DLR spares support to the base. No models are currently available to look at base-level maintenance and the supply system together to predict how they interact or support trade-offs between them. More generally, no models exist to portray the entire DLR supply chain.
- In each segment of the DLR supply chain, models link only a portion of all logistics resources to readiness-related outcomes. For example, AAM includes only DLR spare parts for which it can model a direct relationship between flying hours for the planning period and associated demand for spares. The Air Force has no

⁵Repeated discussions with Randy King and Ginny Mattern of the Logistics Management Institute helped us deepen our understanding of the current state of the analytic supply models that the Air Force relies on most heavily.

⁶For basic information on how these models work and what decisions they can support, see O'Malley (1983) and Slay et al. (1996).

⁷The summary statements here are based on Mary Chenoweth's unpublished analysis of several major supply-oriented Air Force models.

simple analytic way to link large portions of its expenditures on maintenance—for example, Programmed Depot Maintenance (PDM)—to readiness.

- The models used in each segment of the DLR supply chain do not match actual behavior well. For example, the basic functional forms in models like the AAM and ASM are not compatible with uncertainties associated with contingencies and other quantum changes in flying-hour programs. Also, although the evidence suggests that several factors often drive failures of reparable, Air Force models can only consider one at a time. This in effect increases the variability of outcomes around expectations, inducing the Air Force to invest in more safety stock and adaptability than is necessary. A third example is that current Air Force models cannot accommodate even simple constraints on repair capabilities. Finally, the optimization characteristics of most Air Force models are not consistent with the more ad hoc methods used to manage the real DLR supply chain. Therefore, the models cannot predict how the supply chain actually performs in practice. Perhaps ironically, as the Air Force learns to manage its supply chain in a more systematic way, simple models based on optimization assumptions will become more realistic and hence more useful.
- The models use unrealistic assumptions to simplify computations. For example, the models use simplifying assumptions about how bases differ, how activity levels change over time, how parameter values persist over time, and so on. Backward-looking models for estimating parameter values fail to capture likely increases in stress associated with upcoming contingencies. Even though analysts have long known that the negative binomial probability distribution does not capture state-of-the-world uncertainty in real Air Force settings, Air Force models continue to use this distribution. This assumption understates the real uncertainty the Air Force faces and discourages appropriate investments in DLR spares whose demand levels are likely to rise in a contingency.
- More perniciously, under pressure to provide support within severe resource constraints, the Air Force has often used over-optimistic assumptions to calibrate key parameters in the models. For example, the ASM assumes that major theater wars will

stress the Air Force less than objective modeling would suggest. The AAM assumes that pipeline segments will meet Air Force standards that remain significantly more demanding than current performance, despite recent improvements.

- The data used to feed parameter estimation remain incomplete, despite years of efforts to improve them. For example, LCOM offers such a detailed view of the maintenance process that it instills confidence, but the Air Force has been unable to provide the data required to keep such a detailed view up to date.⁸
- The Air Force has made only limited efforts to validate the models it uses in the PPBS process and, more broadly, in logistics resource management. It has not carefully tested and validated the AAM, for example, since 1978. That validation was reassuring.⁹ But even in this case, it focused only on the portion of the DLR supply chain that AAM modeled directly, not on all the resource decisions that the AAM might influence, because no other model is available.¹⁰ Experience in recent contingencies has revealed discrepancies between assumed and appropriate levels for many parameter values and more basically between the assumed and appropriate structures of the models used.¹¹

So, the Air Force has created and maintained extremely sophisticated models—models that no commercially available product has been

⁸For more information, see Dahlman, Kerchner, and Thaler (2002).

⁹The test collected observed parameter values from several Air Force data systems, calculated aircraft availability to be comparable to the definition used in AAM, and then compared the observed availability with the availability AAM estimated based on the observed parameter values. LMI found that the predicted level of availability tended to be lower than the actual, which one would expect because the Air Force can take management actions to enhance availability not reflected in the AAM. A simple regression would have allowed the Air Force to predict the actual availability rates from the estimated rates with an R-squared of 0.93. A less formal but more recent LMI assessment in 1997, using data from 1990 to 1996, found that the AAM did not perform as well in turbulent times, when full funding could not be relied on, as it did in the fairly stable period examined in the 1978 assessment (O'Malley, 1997).

¹⁰The validation focused on safety stock associated with the peacetime operating stock (POS) buy requirement for those items that have flying-hours demand drivers. To put this in perspective, Mary Chenoweth's analysis shows that, in September 2000, this portion of the POS buy requirement accounted for 14 percent of the total POS buy requirement.

¹¹See, for example, Pyles and Shulman (1995).

able to rival in the applications where they are used. Despite that, these models do not give the Air Force a strong analytic ability to link readiness-related outcomes meaningful to the Air Force leadership—and hence the PPBS process—to logistics resources. As a result, personnel in any particular segment of the DLR supply chain are unwilling to make commitments based on analyses and metrics that extend beyond their own segment—for example, commitments to the warfighter based on metrics of readiness on the flight line or in the fleet as a whole. And these problems reduce the general level of confidence that senior leaders have in analyses of the DLR supply chain in support of decisions that involve more than one segment—in particular, more than one command or function. Because the leadership cares most about military capability, shortfalls in models that link segments of the DLR supply chain to military capability present serious problems. Such shortfalls give the senior leadership more confidence in analyses conducted within a segment than in those that span segments. Cost is fairly easy to compute within a segment; effects on military capability are not. So shortfalls in Air Force models of its supply chain make it easier for the senior leadership to sustain its tooth-tail focus. This focus effectively induces the leadership to think about many segments of the supply chain, especially those in AFMC, more in terms of cost than in terms of readiness.

Closed-loop planning and execution could also help the Air Force manage the uncertainties relevant to its DLR supply chain. A closed-loop system proposes an action, expecting the action to yield a particular result. It then takes the action and monitors the result. If the result is different from what was anticipated, it assesses the shortfall and proposes a second action likely to achieve the result, takes the second action, and monitors the result. It continues this cycle until it achieves the desired result or determines why the result cannot be achieved.

For example, simple air-to-ground attack with a “dumb” bomb identifies a target, chooses settings to place a munition on the target, and fires, assuming the target will be hit. This is an open-loop system. A guided weapon identifies a target, chooses settings to begin a course toward the target, monitors progress relative to the target, and

continually adjusts settings until the target is hit. This is a closed-loop system.¹²

Closer to home, think about driving a car. A driver sees a squirrel dart across the road and decides not to hit it. An open-loop driver would quickly choose a path to steer in the road and then execute, shifting his attention to the next section of road. A closed-loop driver would choose a path to steer and then watch the squirrel to ensure that the car did not hit it. If the squirrel behaved as expected, the driver would execute his planned path and continue. If the squirrel jumped in front of the car, the driver would choose a new path to steer and look at the squirrel again. This would continue until driver and squirrel disengaged safely.

Such closed-loop systems must be able to make appropriate adjustments in a local area but do not need a systemwide model to choose settings once and for all to achieve success. By continually monitoring progress toward a target, they can learn from experience and update settings in a way that keeps a system on course. Such closed-loop planning and execution is especially useful when uncertainty makes complete understanding of a task impossible.

When making policy changes, the Air Force has a strong tendency to design a change, implement it, assume success, and then move on to the next change. It is reluctant to monitor the initial change relative to its goals and manage the change until it gets as close to the goal as possible. The most obvious example is when the Air Force implements such a change as lean logistics or a new working capital fund, takes the savings expected from the change and spends it elsewhere, and then assumes the change succeeded in future planning. The Air Force has done this repeatedly in changes relevant to the logistics system since the Cold War.

¹²Control loops can exist within control loops. For example, bomb-damage assessment (BDA) can be understood as a second way to close the loop on air-to-ground attack. The Air Force expects an outcome from an attack and uses BDA to monitor whether the outcome occurred. If it did not, this "outer" loop allows the Air Force to schedule a subsequent attack. The Air Force can apply this outer closed loop around an inner open-loop process using a dumb bomb or closed-loop process using a guided weapon. Loops within loops increase the reliability and hence the effectiveness of outcomes.

SOME EFFECTS OF THE CURRENT PPBS PROCESS

The PPBS process, by itself, complicates the consideration of high-level trade-offs among AFMC logistics resources used to support the operating commands and other government resources. This is true for several reasons.

Most obvious, it takes a long time to complete. Air Force planners must make decisions over three years before some of the resulting obligations of funds in the year of execution. Related expenditures can occur even later. That was a long time in the Cold War and is even a longer time in today's uncertain security and commercial environment.¹³ To manage uncertainty effectively, the Air Force must be prepared to update its decisions through the course of any cycle and use established milestones in the PPBS cycle to ensure that these updates shape the final product sent to the President.

Doing this in the context of the externally imposed PPBS schedule and coordinating updates across all overlapping PPBS cycles to ensure that they remain consistent among themselves are challenging enough. Simply coordinating input from all Air Force parties and interaction among all Air Force parties interested in the services that AFMC provides to the operating commands is a further challenge. Getting such mechanisms right can easily absorb Air Force attention and divert it from the substantive task at hand, which is developing the best program and budget possible for the year of execution.

OSD defines a few key dates in the PPBS process. The difficulties discussed below flow almost entirely from Air Force decisions on how to operate within the broad outlines of OSD policy on PPBS.

Updating its decisions through the course of any PPBS cycle becomes more complex and demanding as more players participate. If data must repeatedly flow from MAJCOMs to the HAF to OSD and back to complete an update, all players' inputs and responses must

¹³Uncertainty induced by the commercial environment is more important to the Air Force today than in the past for two reasons. First, global commercial competition has become more fierce, product life cycles have shortened, and process improvement has accelerated. Second, the Air Force has increased its dependence on external commercial providers as it has decreased in size, use of commercial standards has increased, and dependence on commercial sources has increased.

be coordinated in time and in intent. Suppose, for example, that several MAJCOMs participate to reflect the joint effects of a simple updated plan for a modification or RSP. The update affects the use of AFMC's resources, changing the mix of direct and indirect costs. This in turn affects AFMC's prices for different items. Because these price changes cannot be fully reflected in MAJCOM budgets today, the pricing change affects users unequally and typically in unpredictable ways. This happens if everything works as planned; no one makes any errors. Even without errors, the potential for misunderstandings and inconsistencies in databases or assumptions is significant. Errors simply compound these problems. By the time someone detects them, other changes have occurred, making it difficult to determine which databases should be corrected and how. The more players involved in a significant update, the more costly the update is likely to be and, hence, the less flexible the Air Force's use of its PPBS operating environment.

Through the 1990s, the Air Force decentralized this process internally, effectively giving the MAJCOMs more and more authority to frame the majority of the POM, which is the centerpiece of the programming effort and the critical starting point for developing a detailed budget in each cycle. The HAF relinquished more and more PPBS-related authority and resources to the MAJCOMs. This decentralization gives the final Air Force users of Air Force support services—the primary “customers” of the DLR supply chain—an exceptional opportunity to define the programs that they value most.

At the same time, the Air Force has removed effective authority from AFMC to influence the DLR-related programs that AFMC must execute to support the operating commands. The operating commands develop their own programs for DLRs. The HAF then reviews these command inputs in panels that focus on mission issues, not support issues. AFMC tends to give most attention to activities that it still programs in this process. Without effective input, AFMC has difficulty ensuring that the programs proposed by the operating commands can in fact give the operating commands the support they want. Today, the BES is the point at which the PPBS receives information on what resources AFMC believes will be required to support the POM developed earlier by the MAJCOMs and on the likely cost to AFMC (and hence the operating commands) of the program in the POM.

Planning for resources with significant scale economies becomes especially difficult in this decentralized setting. Because scale economies associated with spare parts inventories, test stands, central induction of parts for repair, central distribution of repaired parts, and so on often affect multiple MAJCOMs, these MAJCOMs must find a way to coordinate their actions to ensure that the Air Force realizes these economies. To date, the operating commands have not been able to do so. When short of funds to meet all of their high priorities, they are reluctant to pay for assets they effectively never see, such as pipeline and safety stock that sits primarily under AFMC control. They are even reluctant to pay for spares they value highly, such as RSPs, because the current logistics system does not guarantee that they have first call on these assets in a contingency. Any inventory control system that provided such an assurance would sacrifice scale economies in its RSP investments. When AFMC uses its models to argue the need for central pipeline and safety stock to support the operating command programs, the operating commands question the validity of AFMC's models.

In sum, placing programming primarily at the MAJCOM level makes the PPBS process feel like a zero-sum game. Each player looks for a way to extract whatever it can, from beyond its assigned budget constraint, to support its program. In such a setting, it is natural to expect an operating command to look for a free ride on the investments it hopes others will make in the common assets that build scale economies. Unfortunately, no one has an incentive to invest. It is natural for operating commands and AFMC to point fingers at each other, seeking to induce the other party to invest to improve its own performance. Unfortunately, neither side has an incentive to invest. The result is the Air Force has a great deal of difficulty achieving consensus on an internally consistent plan of PPBS roles and responsibilities for the MAJCOMs (including AFMC). Without agreement on such a consensus, the Air Force has difficulty funding investments with effects that extend across MAJCOM lines. Investments in spares, test stands, and central control mechanisms that could benefit many players simultaneously are particularly at risk.¹⁴

¹⁴Better visibility of the supply chain as a whole at the Air Staff level could help the Air Staff reduce and arbitrate disagreements among MAJCOMs in the interests of the Air Force as a whole. However, it would not resolve such disagreements effectively until

As responsibility for programming AFMC services for the operating commands has shifted more and more toward the operating commands, another problem has gained attention. When the operating commands program for AFMC support activities, the operating commands bear the full brunt of the resource constraint imposed by the PPBS process. They are forced to choose between getting AFMC support services and getting something else they value, such as MEI modifications or improvement of the quality of life on base. AFMC faces no similar budget constraint. Rather, preparing for the BES in each PPBS cycle, it calculates the costs it expects for particular maintenance and repair tasks and uses these to build cost-based prices that it will charge the MAJCOMs when they ask it to execute these tasks. If decisions made in the PPBS process constrain what the operating commands are willing to spend on AFMC services, and AFMC charges cost-based prices for these services, budget pressure in an operating command or loss of productivity in AFMC tends to reduce the level of service the operating commands can buy and presumably affects their performance. That is, constraints tend to bind and hurt the operating commands more than they hurt AFMC.

Such asymmetric treatment of AFMC and the operating commands in the PPBS process further angers those in the operating commands who believe AFMC has not downsized as aggressively as the operating commands have since the end of the Cold War. Anger increases when updated AFMC prices enter the PPBS schedule in the BES, through no fault of AFMC, after the operating commands have submitted their programs based on earlier prices. Because such updates generally increase prices, they automatically reduce the level of support to the operating commands. The resultant anger complicates efforts to sustain cooperation between AFMC and the operating commands it serves.

A critical element of coordination within the Air Force that might address such issues is the development of the APPG that sets the stage for writing the POM.¹⁵ With planning input from the MAJCOMs, the HAF develops the APPG early in the PPBS cycle. The guidance tells the MAJCOMs explicitly what the HAF expects to see in

the Air Staff demonstrated an ability and willingness to use this visibility to challenge specific MAJCOM assertions with broadly accepted analysis.

¹⁵See, for example, U.S. Air Force (2000b).

their POM submissions. It provides an opportunity to state specific roles and responsibilities for each player in the POM-development process and to define the metrics that will be used to justify proposals included in the POM. This element of the PPBS process presents three serious problems with regard to programming and budgeting AFMC support for the operating commands.

First, recent APPGs have framed guidance for AFMC support service primarily in dollar terms. Some guidance requires MAJCOMs to fund a certain percentage of established requirements for such line items as procurement of aircraft and missile initial spares, programmed depot maintenance and overhauls, total spares, and vehicles. Some guidance mandates reductions in operating cost and forward support footprint and requires MAJCOM investment in cost-reduction and cost-savings initiatives. None of these mentions potential effects on military capability or other measures of importance to the senior leadership. In all likelihood, lack of such metrics reflects the problems with segmentation stated above: no models are available to link AFMC activities to other metrics that interest the senior leadership more, such as mission capability; AFMC is unwilling to be held accountable for other metrics not entirely under its control; and, given its tooth-tail perspective, the leadership is content to view cost as the metric of primary relevance to AFMC. In all likelihood, the APPG cannot abandon this perspective until this broader context, in which the APPG operates as one statement of general Air Force policy, changes.

Second, the logistics community does not appear to have contributed effectively to the APPGs drafted in recent years, particularly the portions of these documents relevant to AFMC support services. ACC, as the MAJCOM with primary responsibility for framing agile combat support policy in the PPBS process, has primary responsibility for developing input from logisticians to the APPG process. Participants in the Logistics Panel have focused increasingly on topics of internal interest to AFMC only. Broader and better-coordinated input could provide a forum in which to pursue more effective integration of the MAJCOMs on DLR spares and other logistics policies in the PPBS process.

Third, the review of submissions from the MAJCOMs gives the HAF its primary opportunity to shape these submissions into an inte-

grated whole. With clear resource-constrained guidance, the MAJCOMs could more easily submit material that could contribute to an integrated program. Using the APPG as the first step toward effective HAF review could provide a powerful tool in support of central integration. Today, the APPG is not resource-constrained and hence cannot be used directly to review POM submissions from the MAJCOMs. Now that almost all Air Force resources have been distributed to the MAJCOMs for programming—the HAF retains less than \$1 billion for its own discretionary use—it makes sense for the APPG to be resource-constrained. As noted above, such a change is likely to be most valuable for resources with benefits and costs that flow across MAJCOMs, such as spares, test equipment, and centralized control mechanism for logistics support activities.

As the PPBS process works today, the guidance used in the Air Force has not prevented the AFMC logistics community from spending significantly more than was budgeted in most recent years. Some argue that this is a sign of poor management in AFMC. If it had achieved target levels of productivity, it would not have overspent its budgets. If it had repaired the right items, it would not have wasted a portion of the funds it received. Others argue that AFMC is paying for services that the operating commands need but do not pay for. For example, AFMC may draw down the working capital fund to pay for RSPs that the operating commands cannot buy. Or it may draw down the fund to pay for over-and-above items in programmed depot maintenance actions that the operating commands cannot fund. These pros and cons need not be mutually exclusive. Arguments on both sides may apply in any particular situation.

No matter what drives these overruns, such consistent behavior over time suggests that, unless basic changes occur, the Air Force can expect to build a program and budget during its PPBS cycle that will require significant adjustment in the year of execution. "Adjustment" means three things.

First, the Air Force must decide whether to react to such overspending by cutting its operations in the operating commands. The Air Force prefers to avoid that outcome, but mission capable rates and other measures of aircraft availability have drifted down persistently since 1991.

Second, to avoid this, the Air Force must find other sources for the funds required to sustain operations. Congress is a possibility. The Air Force aggregates a package of additional needs each summer for congressional consideration. Congress is more likely to be receptive if the Air Force can link such a request to the effects of unanticipated duties, such as deployments, or at least to the need to sustain the flying hour program to maintain training and other activities relevant to the readiness of the Air Force. Each year, the Air Force finds additional funds here. In effect, the expectation of such supplemental funding can loosen the Air Force's resource constraints during the PPBS cycle. If it can always expect Congress to provide supplemental funding for resources critical to readiness, such as DLR spares, it can underfund the resources during the programming and budgeting process without much risk.

Third, if congressional funds cannot cover the full overrun, the Air Force must look internally for opportunities to reprogram funds. This creates turbulence every summer. To date, the Air Force has accepted such turbulence rather than impose controls that would prevent the use of supplemental funding late in the fiscal year.

The main point here is that adjustments during the year of execution appear to be an integral part of the process that the Air Force currently uses to program and budget its logistics activities. Any assessment of how the PPBS process treats the logistics services that AFMC provides to support the operating commands must address what occurs in the year of execution as part of that assessment.

HOW THE AIR FORCE LOGISTICS COMMUNITY PARTICIPATES IN THE PPBS PROCESS

The segmentation of the Air Force DLR supply chain is reflected in how logistics issues enter the PPBS process. For the most part, issues relevant to AFMC support of the operating commands enter the process through the operating commands being supported. These commands bring their proposals for support to the HAF as part of their MAJCOM POM submissions, which are reviewed in the panels of the HAF Corporate Structure responsible for the MEIs supported. Input to these panels then moves up through the Corporate Structure, where major conflicts that could not be resolved at lower levels

are addressed. This process creates a final document for review by the Secretary of the Air Force and the Chief of Staff, where final adjustments occur.

In principle, many knowledgeable observers believe that this provides adequate exposure for AFMC's support activities and adequate integration across the Air Force. In fact, this process so diffuses issues about AFMC's support activities that they do not receive high priority in any forum where they are considered. As the issues of greatest importance to each MAJCOM and then each panel absorb the MAJCOMs' and panels' attention, AFMC support issues tend to get pushed aside.

Even where these issues are directly addressed, the operating commands tend to focus on elements of AFMC support most visible to them. This perspective tends to undervalue investment in pipeline and safety stock that supports all operating commands but is not visible to them. The operating commands are most concerned with having enough funds to pay for the specific items they asked to be repaired—typically items that require repair because of the activity levels of the operating commands.

In sum, because no one player providing direct input to the POM has responsibility as an advocate for the Air Force supply chain, the players tend to advocate other demands in preference to investment in the DLR supply chain.

THE SRRB CANNOT ADDRESS MOST OF THESE ISSUES

The primary Air Force initiative already under way to improve how the PPBS process addresses logistics resource questions is the SRRB. Emulating the long-standing, annual Maintenance Requirements Review Board (MRRB), the SRRB brings together representatives from all the MAJCOMs, AFMC air logistics centers (ALCs), and the HAF to develop a consensus statement of what the "true spares requirement" is for the Air Force as a whole in any particular PPBS cycle. Although not required to do so by its charter, it will also probably allocate that requirement among MAJCOMs to recommend a "fully funded" requirement for each MAJCOM with programming and budgeting authority.

The SRRB initiative emerged from the observation that persistent downward trends in mission capable rates for all major Air Force aircraft types since 1991 might be the result of a persistent failure to define the requirement for spare parts properly. The SRRB seeks to reverse these trends by defining the total requirement for spares with enough authority to encourage full funding of the "true" requirement in the PPBS process each year.

More specifically, the SRRB will change how the AFCAIG calculates MAJCOM requirements for DLRs each year. Until the Air Force ended free issue of DLRs to the operating commands, the AFCAIG focused on costing weapon systems. AFMC used central requirements computation to determine the requirement for DLRs as part of its standard PPBS submission. When AFMC began to sell DLRs to the operating commands, AFMC could not tell its new customers how much money each of them would need to program to buy DLRs because its models had no detail on MAJCOM demand. The HAF asked the AFCAIG to develop a requirements approach to allocate DLR funds among the MAJCOMs. Applying its standard approach to calculating operating and support cost factors, the AFCAIG observed what the operating commands paid for DLRs each year, looked at expected changes in their operations for the next year, and used these data to estimate expected DLR costs in the next year. For a variety of reasons, this approach systematically missed a significant portion of the Air Force demand for DLRs. Result: the "fully funded requirement" determined by the AFCAIG could not fund the DLRs the Air Force actually needed to maintain its stated mission capable rates. Recommendation from the SRRB Integrated Process Team (IPT): make a technical improvement in the estimation process to include all valid demands.

The observation that the AFCAIG process systematically underestimates demand for spares consistent with any stated total non-mission-capable rate caused by supply (TNMCS) appears to be correct if AFMC's requirements models are valid. Even if this were true, which of the issues discussed above would this change address directly?

- The SRRB will continue to rely on AFMC requirements models that have been challenged on a variety of grounds, several of which have been discussed above. Correcting the assumptions

in these models will help, but until these models are consistently validated against actual Air Force outcomes, doubts will remain. Those doubts will undermine the general acceptance of any “true” estimate based on these models.

- The new SRRB approach still fails to link spares requirements to actual availability of aircraft. It does so for the old reason—AFMC is unwilling to be held accountable for an outcome over which it has only partial control. Without adequate models, AFMC does not believe its actions on spares can be confidently linked to actual availability on the flight line. So, because of the segmentation of the DLR supply chain, the SRRB will continue to support a statement of spares requirements defined in dollar terms only. Spares will continue to be perceived in the PPBS process primarily in terms of their dollar burden not their contribution to readiness.
- Disagreement among the MAJCOMs about the allocation of the cost of this “true requirement” will continue. Each still has a strong incentive to induce the others to pay for pipeline, stock, and RSP inventories that all users benefit from. The presence of scale economies for these parts means that the SRRB still cannot easily allocate their costs among the relevant beneficiaries of a buy.¹⁶
- Hence, it is highly likely that the operating commands will continue to question whether the spares requirements developed by the SRRB are affordable when compared in priority to other things they must pay for each year. And the HAF will have little basis for questioning operating command reluctance to fund the SRRB stated requirement.
- Emphasis on a single “true” requirement, combined with efforts to shift cost to others, will support a low-level, tactical discussion of “eaches” that can be shifted back and forth in a zero-sum

¹⁶Scale economies give many players the benefits of relying on the same assets. It is technically impossible to allocate the costs of these assets in a unique way to those who benefit from them. Economists refer to this difficulty as the problem of allocating the costs of joint products. As a consequence, AFMC literally does not know who will receive an asset it buys and holds for future use, so it has no well-defined way to charge for such an asset when it buys it.

game.¹⁷ Such eaches cannot be known with any confidence in the current uncertain environment the Air Force faces.

- Without serious consideration of the high-level uncertainties associated with the external threat and commercial markets, the SRRB will have difficulty addressing strategic issues relevant to the definition of demand.
- The need to complete the “true requirement” early enough to feed the PPBS process will seriously date this single-point estimate by the time the year of execution arrives, unless the SRRB adds significant effort to update the estimate during a cycle.

In sum, the SRRB effort probably recognizes a legitimate shortfall in the AFCAIG process that should not be allowed to continue. However, a number of other changes will be required for the Air Force to benefit from this correction. Those changes should give closer attention to the issues discussed above.

FINDINGS OF THE SPARES CAMPAIGN PROGRAMMING AND FINANCIAL MANAGEMENT (P&FM) TEAM

The Spares Campaign P&FM Team has taken a broader approach than the SRRB. It found that existing spares programming and budgeting processes fail to fund the DLR spares requirement for a variety of reasons similar to those discussed above. It highlights ten key “disconnects”:¹⁸

1. The process fails to enforce APPG guidance in submissions to the POM.
2. AFMC and the operating commands do not coordinate PPBS submissions.

¹⁷In logistics parlance “eaches” refers to individual parts, considered one at a time. In an inventory worth billions of dollars, “eaches” are individual reparable units that may be worth a few hundred or thousand dollars each. An emphasis on “eaches” builds a requirement for billions of dollars of funding from the bottom up, one item at a time.

¹⁸The bullets are a direct quotation from Edward Koenig et al. (2001). We benefited from these findings as our work was under way, and the Spares Campaign benefited from ours.

3. The requirements process for DLR spares emphasizes AFMC sales to operating commands [over AFMC expenditures on DLR spares].
4. The process assumes incorrectly that MAJCOM submissions cover all spares needs.
5. The process assumes incorrectly that all funds budgeted for DLR spares go to AFMC via "sales" [when operating commands can use such unfenced funds in many ways].
6. The process does not assure programming to support important spares levels (e.g., pipeline requirements).
7. AFMC's attempts to fund remaining spares needs in the BES commonly viewed as only a price increase.
8. The process offers no recognized mechanism for AFWCF [Air Force Working Capital Fund] POM initiatives.
9. The process was built around Pre-EAF environment and is poorly designed to operate in a highly uncertain environment.
10. Recursive relationship between SMAG and DMAG confounds budgeting and pricing by preventing the SMAG and DMAG from using the same assumptions when they plan prices and budgets.

The emphasis here is a bit different. For example, this report pays more attention to the broader context of the PPBS process and less to details of how that process treats logistics. On the whole, however, the findings reported here are quite complementary with those of the Spares Campaign.

SUMMARY

The Air Force DLR supply chain is extremely complex. Although the Air Force does not understand exactly how all the pieces of the supply chain fit together, it must maintain an accountability system good enough to manage the supply chain in uncertain times. It does this by breaking the DLR supply chain into segments and developing well-defined ways to manage each segment. This segmentation makes it difficult to develop and sustain a systemwide view of the supply chain. The current Air Force approach to PPBS complicates these problems. Further, Air Force logistics organizations and per-

sonnel are not currently well prepared to participate effectively in the Air Force PPBS process. These observations suggest that the principal improvement the Air Force is currently pursuing in how it treats DLRs in the PPBS process, the SRRB, will probably not have the positive effects anticipated unless other enabling changes support it. The Spares Campaign took a broader approach that touches on many of the issues raised here. The next chapter proposes a package of changes explicitly designed to address the broader set of issues discussed above.

PROPOSED CHANGES IN STRATEGY AND POLICY

The systemwide problems in the Air Force DLR supply chain discussed in Chapter Two point to the need for a broad set of changes in how the Air Force programs and budgets for DLR spares. This chapter outlines a package of seven closely related changes:

- Explicitly reframe all logistics issues relevant to DLRs in the PPBS process to represent a realistic level of readiness achievable within designated resource constraints.
- Have logisticians participate more actively in the planning segment of the Air Force PPBS process to promote the approach above and ensure that logistics is considered fairly in higher-level PPBS considerations.
- Define an APPG process that uses a resource-constrained version of high-level strategic goals to provide effective oversight of MAJCOM POM submissions.
- Define a HAF closed-loop process that monitors disconnects within the PPBS process itself and between logistics budgets and actual logistics needs relevant to DLRs identified during the year of execution.
- Strengthen the responsibility and authority of the AF/IL to integrate horizontally the entirety of logistics requirements relevant to DLRs and represent these requirements in the PPBS process.
- Rebuild the human capital capability within the Air Force logistics community to participate effectively in the PPBS process.

- Build and sustain a credible analytic capability to support the efforts above.

These changes constitute an integrated package (see Figure 3.1). Each is likely to be more effective if the others are made. Although this chapter breaks them apart to simplify its description of them, they are all really elements of a single, unified change.

Proposed Change Number One: Explicitly reframe all logistics issues relevant to DLRs in the PPBS process to represent a realistic level of readiness achievable within designated resource constraints.

The first step in any attempt to integrate a DLR supply chain is to identify appropriate systemwide goals that can be used to align all parts of the supply chain to a single purpose. The best goals to use are typically those relevant to the final customers of the supply chain. For the Air Force supply system, the dominant customers are operational Air Force wings, which must be prepared to provide services to a wide range of combatant commanders and other customers with a variety of needs. Other customers include other U.S. military services and foreign military organizations. In each case, the dominant concerns of these customers are the following:

- Availability of suitably operational MEIs, when and where needed.
- Safety of operations.
- Total ownership costs.¹

The Air Force DLR supply chain, then, should focus on seeking policies that improve the availability of any support to MEIs demanded, when and where needed, and the reliability of this support when it is provided. These concerns can be summarized as a “readiness” con-

¹“Total ownership cost” refers to the total cost to the Air Force of serving any customer, no matter what the source of the cost. For example, agile combat support increases the direct costs of support by increasing use of premium transportation. But shorter cycle times and higher reliability of delivery reduce the demand for total inventory. Even though the direct costs of agile combat support may look higher than before, the total ownership costs associated with agile combat support is often lower.

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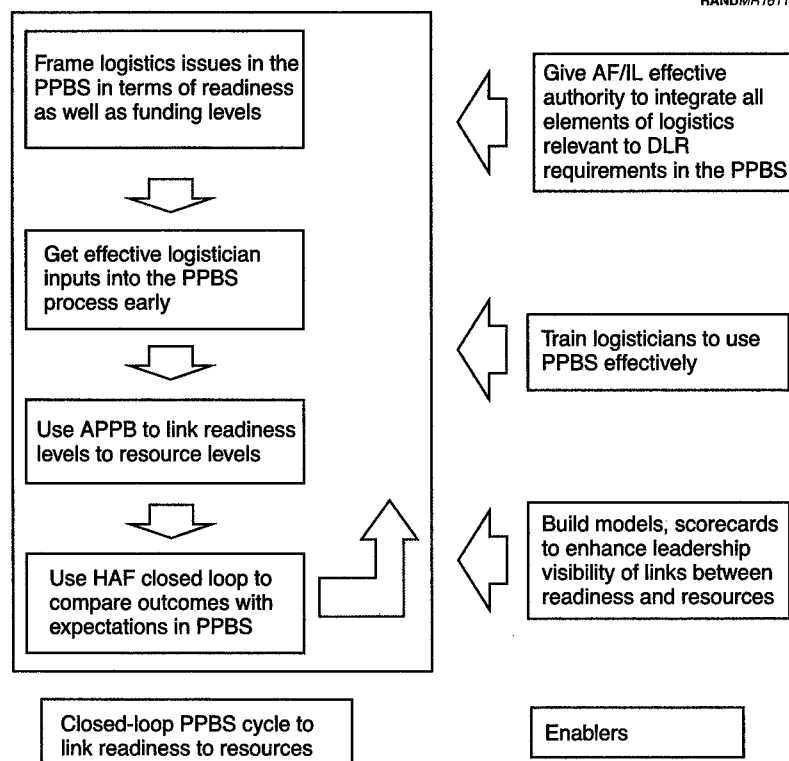


Figure 3.1—Integrated Package of Proposed Changes

cern. The DLR supply chain should also focus on reducing the total ownership cost of any level of readiness achieved, as conceived in these terms. Another way to state these goals is to say the supply chain should seek to maximize the level of readiness it provides its customers, given the resources it has available to do so.

This kind of focus is important to three different kinds of resource allocation settings.

First, presenting DLR issues in these terms in the current PPBS process would immediately emphasize the importance of DLRs as a force multiplier, not as a bill-payer. Clarifying how any expenditure on DLR spares, or “delta” in expenditure on such spares, for exam-

ple, affects the readiness of MEIs would encourage the PPBS process to compare such expenditures to other direct contributors to readiness, such as pilot training or technical modifications, rather than other activities viewed primarily as bill-payers, such as real property maintenance or base operating support.² This clarification should change the terms of the trade-offs examined in the current process.

Consider current plans in the Air Force logistics community to use the SRRB process to identify a consensus estimate for future total Air Force spares requirements and allocate the funding requirements implied by this estimate to the primary players in the PPBS process—the MAJCOMs with responsibility to prepare operative POMs. After the SRRB identifies the Air Force-wide spares requirement, it must still persuade each MAJCOM responsible for providing a share of this funding of the importance of this total to the Air Force as a whole. If the Air Force can translate specific deltas in spares funding to specific changes in readiness, the individual MAJCOMs will more likely consider such deltas in the company of other changes that they know can affect readiness. This will tend to move spares up on a MAJCOM's priority list. As long as a MAJCOM cannot actually own and control a DLR spare, it will value a spare's expected contribution to readiness less than the Air Force as a whole would. But the ability to link spares funding to readiness will make that distinction between MAJCOM and Air Force interests more visible and, perhaps, more difficult to sustain. If the HAF cannot demonstrate how the level of MAJCOM support for spares funding affects Air Force readiness, understanding why the MAJCOM would pay its "full share" of funds to support the SRRB requirement becomes difficult. No matter how authoritative the SRRB requirement is, it will remain in dollar terms and hence compete at a lower priority level in each MAJCOM than initiatives understood primarily in terms of their effects on readiness.

Second, the Air Force planning community is currently developing another approach to identifying Air Force-wide requirements and

²In programming and budgeting parlance, a "delta" is typically a change in dollars or staffing between one program or budget document and another—typically a baseline document and a corresponding document that follows it. For example, a "delta" might state the change in funding for a particular item in FY 2006 between the FY 2004 POM and the FY 2005 amended POM (APOM). It can also state the change in staffing for a particular item in FY 2006 between the FY 2004 POM and the FY 2004 BES.

linking this requirement to resource implications in a standard way. The Air Force Resource Allocation Process (AFRAP) will use a standard “capabilities construct” to document systematic links between high-level DoD strategies and specific Air Force tasks. It will link resources associated with capabilities in each of the MAJCOMs and other organizations that participate directly in the PPBS process.³ If this approach works as anticipated, the planning stage of the PPBS process will use the capability construct to organize specific data requests that can support trade-offs among options with well-defined effects on military readiness and costs.

By definition, this top-down approach to PPBS captures resources associated with logistics by looking at the specific capabilities that logistics resources support and attributing these resources to these capabilities. For example, the capability construct would support the following logic:

- Given high-level national defense priorities, PACAF must maintain a capability to provide stated levels of specific kinds of air-to-air and air-to-ground capabilities.
- F-16Cs in PACAF contribute to these capabilities.
- Given PACAF’s operational plans, its F-16Cs must maintain a specified level of availability and a specified ability to generate sorties under the conditions in the operational plans.
- Target F-16C availability and sortie rates presume a stated TNMCS rate associated with landing gears.
- To attain this TNMCS rate, PACAF must sustain an expected level of reliability for landing gear, certain stated performance levels of pipelines and repair times, certain inventory levels of the sub-assemblies associated with landing gear, and certain support levels for DLR spares and repair from other parts of the Air Force.
- Resources can be attached to the list of factors above, by year of plan. Changes in each of these factors can be associated with resource implications and implications for PACAF’s readiness.

³For details, see Wehrle (2000).

By creating a structure to capture information on all the points above, a capability construct provides an explicit way to walk from specific military requirements to resources.

Trade-offs relevant to logistics then occur as the result of trades between capabilities or the result of trades among different ways of providing capabilities. Such trades will be more likely to affect logistics resources productively the more effectively logistics resources can be linked to readiness- and cost-related outcomes. The better these links are, the more the current terms of reference in the PPBS process will change. Chapter Four discusses AFRAP at greater length as a potential enhancer of the seven changes discussed in this chapter.

Third, the PPBS process will produce better results over time if it can monitor the execution of the budgets it creates and develop information that the Air Force can use to develop more-effective budgets in the future. In an uncertain world, the Air Force will never actually do what it had planned to do when it created a budget. Differences will arise every year. It is important to understand the extent to which these differences resulted from unrealistic assumptions about how the logistics system works and from unrealized expectations about the threat environment. The more accurately the Air Force can parse the reasons for differences between plan and execution, the better able it will be to create new budgets better attuned to Air Force expectations.

An ability to link outcomes to decisions about DLR issues during the PPBS process is critical to any effort to understand the differences between plan and execution. Without such links, the Air Force simply cannot say what difference was made by any decision of the logistics system regarding readiness or resource consumption. It can measure differences in various readiness levels, but it cannot explain convincingly why these differences arose. It can measure differences in cost levels, but it cannot link these to readiness levels. In sum, any systematic effort to monitor decisions made during the PPBS process and learn from them is predicated on a clear understanding of how decisions affect desired outcomes. The better this understanding, the faster the Air Force can learn from its experience. In an uncertain world, rapid learning is particularly important. In an uncertain world, systematic learning becomes a critical element of discipline.

Proposed Change Number Two: Have logisticians participate more actively in the planning segment of the Air Force PPBS process to promote the approach above and to ensure that logistics is considered fairly in higher-level PPBS considerations.

Although many in the logistics community would argue that they actively participate in the Air Force planning process through the Agile Combat Support Panel, such participation is not enough. First, ACC manages the Agile Combat Support core competency, not the logistics principals in either the HAF or at AFMC, who might be more inclined to look Air Force-wide at logistics issues. Second, Agile Combat Support focuses on the future operational aspects of combat support (see Volume Three, Strategic Plan) rather than on ensuring that current operational demands for DLR spares are sufficiently addressed in the planning guidance and carried over into the programming and budgetary decision processes.

To overcome the stovepipes created by the decentralized Air Force PPBS process and the way individual logistics functions operate in that process, the logistics community could develop a top-down strategic plan that provides an integrated look across Air Force logistics. Currently, no formal planning mechanism exists by which the various logistics initiatives are discussed in terms of their interdependencies, desired outputs (e.g., their performance goals), and operational time frames. A strategic plan could provide the single point in the logistics community to examine its priorities and identify potential operational gaps. The development of a strategic logistics plan could provide a basis for the total logistics community to assess how it is progressing toward achieving its goals over several PPBS cycles.

As noted in the fifth proposed change below, the AF/IL should have the authority and responsibility to ensure that the Air Force maintains a strategic logistics plan, keyed to broader Air Force strategic goals, that sets the stage for each year's PPBS process.⁴ The AF/IL would produce such a strategy in concert with the AF/XO, AF/XP,

⁴For an examination of the extent to which the AF/IL has this effective authority and responsibility today, see the discussion of Proposal Number Five below on pp. 63–67.

and the MAJCOM/LGs. The Logistics Panel and IL/LG Meeting⁵ could provide forums in which AF/IL would pursue coordination. Execution of a well-coordinated strategic logistics plan will require a formal process with higher visibility than current planning efforts receive. The planning envisioned must be tied closely enough to current operational plans to set the stage for the discipline envisioned in the next proposed change.

Proposed Change Number Three: Define an APPG process that uses a resource-constrained version of high-level strategic goals to provide effective oversight of MAJCOM POM submissions.

The Air Force initiated the APPG in 1998 to translate planning goals and objectives into fiscally constrained programming guidance. The document aims to provide an audit trail for the Air Force on how well it allocates resources to its key strategic objectives in the POM and beyond. The APPG for FY 2003 included very specific programming guidance for those initiatives associated with supporting Agile Combat Support. The MAJCOMs were also directed to pay the AFCAIG bill and fund spares requirements (U.S. Air Force, 2000b). However, the document did not provide guidance on how the MAJCOMs were to fund the AFCAIG bill and what the consequences would be if they did not. The current adjudication does not hold them accountable to this guidance.

The APPG can be a valuable mechanism to link planning objectives to program guidance. The Air Force can also use it as a vehicle to help determine over time whether it is meeting its near-, mid-, and long-term objectives. The APPG can become a more active management tool if the Air Force leadership decides to use it to measure how the MAJCOMs have responded to the key planning and programming objectives stated in the APPG. The POMs would be adjudicated based on the MAJCOMs' ability to show how they have responded to the APPG's guidance.

To adopt this approach, the Air Force must focus the APPG's guidance more precisely. The Air Force leadership must induce the MAJ-

⁵The IL/LG Meeting replaced the Logistics Board of Advisors (BOA) Panel in 2001. The meeting plays a similar role but is limited to principals on the AF/IL staff and from the MAJCOM/LGs.

COMs to respond to the guidance. If the MAJCOMs choose not to comply, they must demonstrate why and how they are going to remedy the situation in the out-years. Such an approach would require stronger, clearer, and more direct HAF leadership at the front-end of the PPBS cycle. The HAF would need the clout to induce the MAJCOMs to comply with the guidance and then to carry through with the agreements reached in the program build. This approach would attempt to counterbalance the current MAJCOM-centric approach with a stronger HAF that developed specific planning and programming guidance and ensured that it was met or that alternatives were provided and debated.

Such changes in the APPG and its use would provide a specific document and process in which to make the integration across logistics planning, proposed in the first change above, real. This document would also provide an integral step in any process to compare the Air Force plan each year with its execution and to monitor longer-term implementation of the plan over a series of PPBS cycles. The next proposed change returns to these themes.

Proposed Change Number Four: Define a HAF closed-loop process that monitors disconnects within the PPBS process itself and between logistics budgets and actual logistics needs relevant to DLRs identified during the year of execution.

In effect, the Air Force uses the PPBS process as a tool to pursue a vision of improved performance—such as higher levels of readiness and lower levels of resource expenditure—wherever possible. Run as an open-loop control mechanism, the PPBS process creates specific programs and budgets and, in effect, simply hands them over to the operational Air Force for execution. Without further ado, such an approach washes its hands of the budget produced, effectively assuming that no further attention is required because the Air Force will execute it as planned. Run as a closed-loop control mechanism, the PPBS process would not simply assume that it could hand off programs and budgets for implementation. Rather, it would “close the loop” for these programs and budgets by monitoring differences between the programs and budgets on the one hand and their implementation on the other. It would ask why these differences occurred. It would then try to incorporate what it learned about these differences in future PPBS cycles.

Put another way, the current open-loop PPBS process limits attention to tracking differences between its targets and their achievement, in any cycle or over the long run. A closed-loop PPBS cycle would anticipate differences and expect to improve the Air Force's performance over time by using information about these differences and thus improve performance in subsequent cycles. An open-loop system may be acceptable in a static environment, where informal learning eventually helps programmers and budgeters get close to their stable target. Such a system cannot keep up with a continually changing environment, as the world is today. A closed loop is critical to success in managing any complex process or tool if the initial conditions do not sit still while the process or tool is in use or the process does not perform exactly as predicted. A dynamic threat environment and continual adjustment of the Air Force logistics system create important sources of both kinds of uncertainty.

The Air Force PPBS process would benefit from at least two kinds of formal closed loops not in use today.

The first would look at the mechanics of the PPBS process itself. For example, are the DLR budgets and prices that all players in the PPBS cycle use in any cycle internally consistent with one another? Today, they are not, because prices actually charged during the year of execution are not the prices used to build the budgets for this same year. A closed-loop process would monitor such a disconnect during each cycle and trace it back to root causes until solutions aimed at the apparent root causes actually yielded an acceptable level of internal consistency. The causes probably lie primarily in particulars about the PPBS process itself, such as the timing of inputs, that can be changed.

Another example: Do the MAJCOMs in fact comply with higher-level guidance on logistics resources? Again, they do not. For example, the guidance laid out in the 03-07 APPG directs the MAJCOMs to address their supply chain issues and, more important, address how their "fair share" of the AFCAIG bills were to be paid. The operational MAJCOMs built their individual POMs arguing that they were balanced, were executable, and assumed acceptable risk. All the MAJCOM representatives argued that they had not paid the AFCAIG bills in the FYDP years and assumed this debt as part of their "acceptable risk" strategy. Although this stance violated senior lead-

ership guidance and policy, it was ultimately accepted by the Air Force because no corporate mechanism exists by which the corporate-wide implications of the individual MAJCOM's position could be evaluated prior to execution.

A closed-loop process would monitor such a disconnect each cycle and identify relevant root causes until solutions aimed at the apparent root causes yielded effective solutions. The PPBS process, like any complex process, is full of disconnects of this kind. Closed-loop monitoring is a practical way to reduce these disconnects, and their negative effects, over time.

The second kind of loop looks beyond the PPBS process per se and asks, systematically, why programs and budgets in any year differ from execution in that year and why, over longer intervals, long-term plans differ from outcomes over time. Such variances can result from two fundamentally different kinds of sources:

- The world behaved differently from what was expected, in terms of threats, the behavior of sources, the reliability and maintainability of aging systems, and so on. Such changes are in effect beyond the Air Force's control. Better information about such surprises might help the Air Force reduce the importance of such surprises in the future, through better forecasting or through more-robust plans that can tolerate such surprises more easily.
- The Air Force logistics system behaved differently from what assumptions indicated. Cycle times were longer, maintenance-man-hours were higher, bills of material were less complete and accurate, customer expenditures were lower, and so on, than expected. Because these factors are generally considered within the Air Force's control, programmers and budgeters in recent years have systematically assumed that they would improve. In fact, they have improved more slowly than expected.

Both kinds of differences are relevant to the PPBS process. The first, if better understood, would encourage better or more realistic forecasting about the external environment in the PPBS process itself and more support for robust policies and technologies among the Air Force organizations that use the PPBS process. The second, if better understood, would encourage players in the PPBS process to use more realistic planning factors. By reducing differences of the sec-

and kind through the use of greater realism, the PPBS process could focus leadership attention on differences of the first kind, where high-level decisions are most important.

The dilemma for the Air Force is that its decentralized POM process focuses the leadership on addressing the resource issues that could not be resolved within the MAJCOMs or through the lower levels of the corporate structure. The process does not facilitate tracking key issues to ensure that high-level decisionmakers systematically address and review them in the PPBS process. Initiatives currently under way in the Air Force to redesign aspects of the Corporate Structure and improve the senior leadership's visibility of major resource issues might ameliorate some of the problems identified in this report, but solutions are still being studied as of this writing. Whatever the proposed solutions are, to address problems identified in this research, the proposed remedies must identify a mechanism that provides a strong horizontal integration function that pulls together the disparate elements of sustainment and their linkage to operational readiness.

Questions about differences between expected and actual outcomes point to a Shewhart version of the PPBS cycle that not only plans, programs, and budgets but also evaluates outcomes and develops explicit adjustments for gaps between expectations and realization.⁶ Such an approach can support quick reaction to surprises that occur when insoluble uncertainty yields a realization that differs from that planned. It can fill in holes where analytic models are not complete enough to support policy. It can monitor models and refine them over time to ensure that they are as empirically based as possible. Such an approach would be helpful within segments of the supply chain but particularly helpful in guiding decisions and refining understanding about the links in the supply chain that tie segments together. It will work in a decentralized system, such as that in the Air Force, only if an organization with a supply-chain-wide perspective takes responsibility for it and relevant cycles are monitored in terms of performance relevant to the whole DLR supply chain, not just parts of it.

⁶For a useful description of a Shewhart or "plan-do-check-act" cycle, see Holmes (1994, p. 1).

As noted above, such a closed-loop approach will be more effective

- the better the shared understanding of the link between readiness and resource outcomes on the one hand and policy decisions on the other (Change Number One above),
- the more complete the high-level consensus on a strategic logistics plan (Change Number Two), and
- the more precise the statement of the leadership's expectations of the performance of the logistics system and the leadership's ability to enforce those expectations (Change Number Three).

As the fifth change will explain, the most likely office in which to pursue a closed-loop approach to learning in the PPBS process is AF/IL, which would coordinate with all relevant parts of the Air Force.

Proposed Change Number Five: Strengthen the responsibility and authority of the AF/IL to integrate horizontally the entirety of logistics requirements associated with DLRs and represent these requirements in the PPBS process.

It would be natural to ask the senior logistician in the Air Force to act as the advocate for the DLR supply chain. Observers disagree on who the senior logistician is and what authority he or she possesses to act as an active advocate. A natural choice is the three-star AF/IL, who has responsibility for Air Force-wide logistics policy and for coordinating appropriation resourcing for logistics activities in the HAF. The head of AF/IL chairs the IL/LG Meeting, which includes the senior logisticians in all of the MAJCOMs and the AF/IL executive leadership. This group coordinates issues of mutual interest to its members. Personnel in AF/IL oversee the Logistics Panel in the HAF, which could potentially take on crosscutting logistics issues now handled primarily by other panels. Can the AF/IL stand up to the commander of AFMC, often seen as the senior logistician in the Air Force and who has four stars?⁷ What authority does the AF/IL have

⁷This perspective appears to carry over from the 1980s, when the four-star commander of Air Force Logistics Command was the senior logistician in the Air Force. AFMC, of course, has broader concerns; its commander is often not a logistician. Today, this is a question of perception and authority. Does the AF/IL have the effective authority, devolved from the Chief of Staff, to act as the principal for Air Force logistics policy?

to influence the logistics proposals of any other four-star MAJCOM commander? The segmentation of the Air Force DLR supply chain in effect leaves it without a single, clear-cut champion.

Formal Air Force policy already gives AF/IL considerable responsibility to coordinate logistics issues during the PPBS process. For example, Air Force Pamphlet 38-102 (U.S. Air Force, 1999, pp. 139-162) gives all of the following responsibilities to AF/IL and its constituent elements:

- Formulate Air Force logistics programs, policies, and procedures for weapon systems, including supply, maintenance, transportation, and logistics plans.
- Hold responsibility for all phases of logistics planning and policy, including strategic planning, deliberate/time-sensitive planning, and contingency/war-planning assessments. Develop links among logistics strategic planning and other Air Force planning activities and the Air Force PPBS.
- In coordination with AF/XO, develop operational goals (i.e., aircraft availability) for logistics systems. As a member of the OPS-LOG Working Group, develop methods to improve Air Force logistics availability to support operational requirements. Evaluate logistics impacts of changes in the Air Force Wartime Flying Program, determining their logistics feasibility.
- Determine Air Force logistics resource requirements. Resolve contradictory policy and guidance between the operational and logistics communities concerning DLR spare parts requirements determination.
- Prepare logistics availability and sustainability documentation. Document the logistics sustainability posture for the Air Force POM.
- Develop Air Force logistics budget/program strategies. Provide a single point of contact for logistics budget, programs, policies, and procedures. Ensure a coordinated response to logistics issues in the program/budget reviews. Direct budget submission preparation, provide justification through all review levels, and advocate the logistics program in the POM. Prepare logistics principals on the Air Force Council and other high-level Air Staff

operational and strategic bodies on matters affecting logistics. Justify and defend logistics budget requests through OSD and congressional review. Serve as the focal point in the OSD program and budget reviews for receiving, tracking, and coordinating responses to logistics management, program, and budget issues.

- Serve as the focal point for modeling and simulating inventory management policies and their impacts on both peacetime and wartime capability. Develop concepts and programs to improve capability assessment and the programming system. Develop, maintain, and operate logistics capability assessment models that translate selected funding and inventory levels into projected weapon system capabilities, in support of the PPBS.

These responsibilities, as well as its role representing the logistics perspective at each level in the Corporate Structure, give AF/IL many formal and designated opportunities to shape the PPBS process and to participate in the process as it proceeds.

These responsibilities and points of entry into the PPBS, however, will not allow AF/IL to take on the responsibilities and authorities identified above without some important changes in formal and informal policy. They include the following:

- The Secretary and Chief of Staff of the Air Force must explicitly verify their support for these responsibilities and authorities to ensure that all other players in the PPBS process—particularly players in the MAJCOMs—accept that AF/IL holds these responsibilities and authorities. Until that occurs, AF/IL cannot act with the confidence that it has full authority to match its responsibilities. The Secretary and Chief of Staff should renew their support periodically so that natural turnover in the leadership team does not dilute AF/IL's power.
- AF/IL needs additional resources to provide effective integrative capability. It needs people with the skills required to participate in the strategic planning process and to coordinate a resource-constrained APPG with real teeth. It needs people with the skills and capacity to review each POM submission from the MAJCOMs and to assess in detail how closely the submissions comply with the APPG. It needs people with the skills and capacity to

support AF/IL's presentations on disconnects between the APPG and the MAJCOM submissions throughout the Corporate Structure review process to ensure that the Corporate Structure receives a clear, integrated picture of Air Force-wide logistics priorities to complement the MAJCOM-centric views reflected in MAJCOM submissions. Adding personnel will be extremely difficult as headquarters sizes come down. It may be necessary to conduct some of this work in a field operating agency (FOA) that reports directly to AF/IL. But the Air Force should keep in mind that most of the skills noted here are skills of coordination and that the coordination in question occurs in the HAF itself.

- AF/IL needs to review systematically all submissions relevant to DLRs. The review needs to address how logistics issues are addressed in terms of current and future operational readiness. For example, although AF/IL reviews submissions to the Agile Combat Support Panel, the assessments do not systematically address how operational readiness will be affected over the course of the FYDP. The submissions are not evaluated in terms of how they comply with APPG instructions on logistics issues and the impacts on operational readiness of deferred or ignored logistics issues. The Agile Combat Support Panel focuses on a narrowly defined slice of operational readiness—the ability of the Air Force to support current and a few projected missions—while AF/IL is responsible for looking across the totality of the Air Force in terms of logistics issues and their potential resource impacts.
- AF/IL should have access to analytic methods, tools, and databases required to ensure that it can exercise all of the capabilities identified effectively.

Some object that such responsibilities and authorities would disproportionately favor AF/IL relative to other players in the PPBS process. The approach proposed here does not intend to give AF/IL a mandate to dictate to, to veto, or to shout down others in the PPBS process. Rather, it takes seriously AF/IL's responsibility and authority to coordinate, to evaluate, to communicate, to advocate, and in the end, to mobilize an integrated vision. The decentralized Air Force PPBS necessarily empowers the MAJCOMs relative to the HAF. It seeks only countervailing arrangements to ensure that the PPBS pro-

cess sees not only each MAJCOM's vision of logistics but also an Air Force-wide vision. The importance of scale economies to Air Force DLRs, discussed in Chapters One and Two, makes such an integrated, Air Force-wide vision particularly important for logistics resource issues. This proposal does not seek to allow AF/IL to dictate its terms on DLR resource issues to the PPBS process, but rather it intends that AF/IL would help the MAJCOMs develop a common vision and inform the PPBS process effectively on how PPBS decisions will affect the performance of the logistics system, Air Force-wide.

Proposed Change Number Six: Rebuild the human capital capability within the Air Force logistics community to participate effectively in the PPBS process.

A workforce knowledgeable in the PPBS process is critical to improving the logistics community's ability to articulate its resource needs. This recommendation is particularly difficult to implement given current turbulence in the Air Force and, in particular, ongoing congressionally directed headquarters reductions. In 2002, the Air Force, like the rest of the DoD, had to take an additional 15 percent personnel reduction in its headquarters staffs. In prior years, the Air Force had dealt with headquarters staff downsizings by supplementing the workforce with contractor labor and by relocating a function to the field. Turbulence among the military personnel and reductions in the civilian workforce provide little time to mentor or to train individuals in the PPBS process. In the logistics community, knowledge of the PPBS process is not critical to career progression.

To improve in this area, the logistics community must ensure that selected individuals—military and civilian—receive training and on-the-job experience in the planning, programming, and budgeting environments. Given the increasingly decentralized nature of the Air Force PPBS process, these individuals need tours in a MAJCOM's planning and programming organizations. If possible, given the increasingly joint environment of DoD, they would benefit from time in the Joint Staff or OSD. Some of these assignments should be outside the logistics community so an individual can gain a more strategic perspective on how logistics issues are viewed and addressed within the broader Air Force and in DoD in general. This recommendation does not require the Air Force to train a large

number of people in PPBS matters, but the number needs to be sufficient so the Air Force can maintain a cadre of knowledgeable people. To the extent that the Air Force relies on contractors to perform PPBS-related work in the HAF—even if relying on contractors is a direct response to downsizing of the HAF—relevant human capital critical to inherently governmental decisions is accumulating outside the Air Force.

Logistics personnel getting such PPBS training should be promotable. Otherwise, such training will not interest the best logisticians in the Air Force. And no matter how much training and experience the Air Force provides, its general-officer logisticians will not benefit directly from it themselves.

The recent pace of change in Air Force policies and procedures has complicated each of these problems. The role of the Air Force DLR supply chain is changing as logistics concepts change. The Air Force PPBS process is changing. Headquarters is shrinking. Very few Air Force logisticians have the skills required to represent a current view of the Air Force DLR supply chain in the current PPBS process or efforts to change the supply chain, such as the AFRAP review. Unfortunately, continuing change on all these fronts depreciates skills accumulated in the past. Without such skills, any single advocate or integrator for the supply chain in the Air Force PPBS process can have only a limited effect.

The Air Force logistics community recognizes these challenges and is discussing solutions. Some discussion has focused on reestablishing certification programs for resource allocation managers within the logistics community to ensure that they understand their roles and the processes and tools relevant to their work

Proposed Change Number Seven: Build and sustain a credible analytic capability to support the efforts above.

Although the Air Force logistics community uses a variety of tools to identify and manage its resources, these analyses and tools have limited credibility in the broader Air Force. They are not firmly linked to flight line and fleet, readiness-related outcome metrics that warfighters emphasize. Operating commands do not understand the contribution of basic investments in logistics pipelines and other DLR spares not directly tied to their own operations and their own

performance. In part, this is because, until recently, the Air Force has not attempted to manage its logistics analytic tools, their configuration, and associated analytic processes systematically.

As explained in Chapter Two, given the stovepiped nature of the logistics community, many tools are not linked among themselves nor do they link to Air Force-wide methodologies or analytic processes. As execution of Air Expeditionary Forces (AEFs) becomes routine, effective combat support command and control will require development of more-integrated logistics models realistically calibrated to reflect actual operations. The models the Air Force uses to support its participation in the PPBS process will benefit if they can take advantage of these new analytic capabilities.

The changes suggested above will benefit particularly from analytic methods that do the following:

- They link readiness and resource outcomes to specific high-level decisions that might be addressed in the PPBS process.
- They help decisionmakers in the PPBS process look across logistics disciplines and link these disciplines as a group to operations. Such improvements are critical to the capability construct currently under development. More generally, they would support more-effective trade-offs between logistics alternatives and between logistics and operational alternatives.
- They are calibrated to current operational concepts and the actual current performance of the logistics system.
- They are transparent and available to all players with an interest in the PPBS process.
- They are simple enough to use in the short response times required to participate effectively in the PPBS operating environment.

As noted above, AF/IL already has a responsibility to serve as a focal point for modeling and simulating logistics policies and their impacts on both peacetime and wartime capability and to develop, maintain, and operate logistics capability assessment models that translate selected funding and inventory levels into projected weapon system capabilities in support of the PPBS. These capabili-

ties need not exist within AF/IL. In fact, the Air Force's deepest capabilities to analyze logistics policies lie in AFMC and the Logistics Management Agency (AFLMA).⁸ These are natural places to build better capabilities.⁹ But AF/IL must take the lead to ensure that the methods, models, and databases developed properly reflect Air Force-wide priorities for the DLR supply chain. AF/IL is the natural source of leadership on these issues.

The changes proposed above depend critically on an ability to improve the credibility of the methods the Air Force uses to link readiness to resources. Those proposals should always be viewed in terms of the capabilities available to make these linkages. This suggests three things:

- Efforts to implement the changes proposed here should give careful attention to the capabilities of the analytic models and databases available to support them.
- Efforts to make the changes suggested here will be more successful as the Air Force's analytic capabilities improve.
- Any effort to make the changes proposed here should include an active effort to improve complementary analytic methods.

SUMMARY

As illustrated in Figure 3.1, the changes proposed above constitute an integrated package. They begin by seeking a way to think about DLRs routinely as a force-multiplier rather than a bill-payer in the PPBS process. They seek to bring logistics into a top-down Air Force strategic planning process that develops clear guidance on logistics resource decisions relevant to DLRs to the MAJCOMs. The APPG

⁸AFLMA is a field operating agency that supports AF/IL with analysis, consulting, and development of guidance on logistics issues, particularly issues outside AFMC.

⁹The Air Force Studies and Analyses Agency (AFSAA), a direct reporting unit that reports to the Vice Chief of Staff of the Air Force, has a responsibility to integrate analytic models in the Air Force. It might offer a useful place to improve links between warfighting models and logistics models to address many of the disconnects discussed in this report. To date, AFSAA has not taken on such responsibility. Given the decentralized structure of the Air Force, AFSAA appears to have little effective authority to do so at this time.

translates this guidance into specific, resource-constrained terms that the HAF can use to review MAJCOM inputs to the PPBS process and to maintain an Air Force-wide view of logistics resource issues relevant to DLRs that places MAJCOM submissions in perspective as they move through the Corporate Structure. As an integral part of the PPBS process, the HAF monitors a set of closed-loop processes that compare plans with execution and help accelerate the Air Force's learning about how to adapt logistics resource policy relevant to DLRs to the dynamic threat and sourcing environments it faces. AF/IL is the most logical focal point for these changes. The Chief of Staff and Secretary of the Air Force should clearly endorse AF/IL as the champion for these changes, with the responsibility and authority required to implement them. To take on this responsibility, AF/IL will need logisticians better prepared to work in a PPBS environment and analytic methods, models, and data that link logistics resources relevant to DLRs as clearly to high-level Air Force system metrics—readiness and total ownership costs—as possible. Such analytic methods will allow AF/IL to close the loop by demonstrating in the PPBS process exactly how logistics resources relevant to DLRs act as force-multipliers.

Three policy changes already under way in the Air Force today should make it easier to pursue an integrated package resembling the proposal above. Chapter Four describes these.

COMPLEMENTARY INITIATIVES THAT COULD FACILITATE EFFECTIVE CHANGE

The Air Force is considering a wide range of policy changes today. A number of these, if implemented, would facilitate any effort to change its PPBS process relevant to DLRs. Any effort to change the PPBS process should be aware of how success is related to these other policy initiatives and promote these complementary efforts as part of any integrated effort to change the PPBS system. This chapter briefly reviews three complementary initiatives:

- multipart pricing of DLRs,
- capability construct that links high-level decisions to use MEIs to all resources associated with their use, and
- balanced scorecards for logistics support of weapon systems.

More centralized funding of DLRs, through multipart pricing, should offset some of the problems created by the Air Force's decentralized PPBS process. Any effort to change that process should carefully reflect all Air Force initiatives in pursuit of more centralized control of DLRs.

The Spares Campaign's multipart pricing initiative could potentially centralize at least part of the decisionmaking responsibility for DLR management. Such a change would help all relevant MAJCOMs work together to create a unified program that effectively balances Air Force requirements for DLRs with other programming priorities.

Multipart pricing would change which MAJCOM develops the POM for selected DLRs. Multipart pricing requires operating commands to pay directly only for

spares support costs tied to repair of items they “consume” in the course of their normal operations, . . . the actual depot-level reparable (DLR) repair costs. . . . Congressional funding for all other central spares support requirements will be executed directly for those purposes, in lieu of attempting to collect the funding through DLR surcharges. This removes from prices all factors for spares “buy” requirements, repair requirements associated with readiness, pipeline and safety levels, and all materiel management costs. It directly and centrally funds these worldwide spares needs. (Koenig, 2001, p. 2.)¹

This change would in effect centralize, under AFMC control, PPBS responsibility for about half of the annual cost of the DLR inventory. This is the portion of the inventory that presents the greatest challenges for a decentralized PPBS process. Readiness spares packages and pipeline and safety levels all involve scale economies that extend across all users of any particular spare, thereby placing a premium on effective coordination of these users. Multipart pricing gives AFMC direct responsibility to achieve this coordination. The individual using commands retain responsibility to plan for the DLR-related expenses most directly linked to their missions—repair costs driven directly by operating command activity levels. Scale economies are in play here as well but do not play as large a role as they do for the spares assigned to AFMC.

How the AFRAP defines the capability construct that frames the Air Force resource planning process will affect fundamentally how effectively initiatives that improve sustainability of existing MEIs compete for resources with other initiatives in the PPBS.

A critical part of the HAF 2002 (HAF 02) initiative sought to assess and improve the Air Force’s resource management processes. The initiative, begun in 1999, recommended, among other things, that the Air Force replace all existing resource planning and programming processes in all its organizations with a single, uniform AFRAP.² AFRAP comprises four interactive steps (Wehrle, 2000):

¹The current pricing system builds prices up from factors that seek to recover costs associated with various cost pools. Multipart pricing effectively removes from prices the factors associated with cost pools that will be funded by direct congressional appropriations allocated to AFMC.

²An author of this report, Leslie Lewis, is participating actively in the AFRAP effort.

- Determine capability objectives.
- Develop capability options.
- Allocate resources.
- Assess performance.

Although the Air Force leadership has accepted the AFRAP concept, it has not fully implemented the concept for a variety of reasons. The most important barrier is the lack of a common capabilities construct that would provide the foundation of the concept. The Air Force Planning and Programming Directorate (AF/XP) has initiated work to develop and implement a “common capabilities construct” to tie together the Air Force vision with relevant tasks and the resources and operational concepts needed to execute these tasks.

The initial work on defining a capabilities construct has concentrated on identifying the construct’s attributes. Those involved have reached agreement that the construct must be output/effect oriented; allow the HAF to compare potential outputs with one another and establish a standard value; and, of particular importance to the sustainability issue and its associated issue of DLR spares, capture the totality of Air Force resources—it must be collectively exhaustive. Importantly, the construct must ensure that dollars are linked to capabilities. The construct should link all resources relevant to warfighting, such as DLR spares, to *operational* capabilities; *institutional* capabilities should include only elements that cannot be directly linked to the operational capabilities.

Such agreed-on attributes, if ultimately incorporated into a construct, will directly tie DLR spares and their associated costs to operational capabilities. Current work defines an operational capability as containing such elements as people, infrastructure, sustainment, and equipment. Tying DLR spares directly to operational capabilities will ensure that they are assessed as integral to achieving the desired outputs associated with these capabilities.

A four-level capability construct has been developed and is being vetted throughout the Air Force. The first level is the Air Force vision.

The second level comprises high-level operational and institutional capability areas. High-level capability areas give the senior Air Force

leadership the ability to assess major issues and their resource implications at a strategic level

The third level contains lower-level categories of operational and institutional capabilities. These categories of capabilities combine the people, training, infrastructure, and concepts of operation designed to perform a set of tasks to achieve a desired output or effect. Operational capabilities imply combat and combat support activities indirectly. Therefore, DLR spares, as they relate to achieving a desired effect or output, would be linked to a particular operational capability.

The fourth level identifies relevant tasks. Current thinking sees tasks as activities conducted at the MAJCOM level. Operational and institutional capabilities have tasks associated with them. Tasks are tactical-level actions performed to achieve the desired objectives associated with specific actions. Again, all the resource elements associated with performing a task must be identified. Much of the dialogue that occurs between the MAJCOMs and HAF during the PPBS process currently occurs at levels three and four. The HAF operates at a more strategic level of capability areas and capabilities, while the task level is where the MAJCOMs generally deliberate resource issues.

As of this writing, the Air Force is vetting a draft capabilities construct developed by RAND (Lewis, Kauver, and Brown, 2001). It will provide a formal, routine basis for assessing DLR spares requirements within the context of operational requirements and readiness. Sustainment is only one of many issues the construct will address. It complements the proposed changes discussed in Chapter Three primarily by improving the Air Force leadership's understanding of how sustainment affects key capabilities.

The changes proposed here should be carefully integrated with the AFRAP approach under consideration. Because the AFRAP approach builds links between capabilities and resources through formal MAJCOM channels, it implicitly builds in the same view of "separability" implicit in the decentralized Air Force PPBS process. Decisions made in parallel channels are "separable" to the degree that resource decisions in one channel can be made without regard to resource decisions made in another channel. In this case, for example, sepa-

rability assumes that resource decisions in the USAFE channel can be made without regard to resource decisions made in PACAF.³

As noted above, DLR spares funded by any MAJCOM using a particular MEI, like an F-16C, can support any other MAJCOM using the same MEI. Once depot-level or centralized intermediate repair facility (CIRF) maintenance assets exist to support one MAJCOM, these assets can also support every other MAJCOM with comparable MEIs. So the resource decisions that one MAJCOM makes are relevant to the resource decisions that others make. These dependencies are precisely those that lead us to seek integrating alternatives to the current decentralized PPBS structure.

In effect, this means that, when each MAJCOM has executed its version of the standard capability construct template, the implications for sustainment requirements cannot simply be summed across MAJCOMs. The Air Force will still require the integrative capabilities discussed in Chapter Three to identify interdependencies in requirements for supply and maintenance assets and to translate these into an Air Force-wide requirement. That is, the AFRAP under development is not an alternative to the integrative policy changes proposed here. Rather, properly implemented and integrated with other ongoing changes, the AFRAP offers an enhanced capability to address one piece of the puzzle—a better understanding of how logistics resources affect specific capabilities relevant to the Air Force leadership.

A balanced scorecard provides another way to link readiness-related outcomes to logistics resources. Ongoing Air Force efforts could yield a scorecard that substitutes for or complements available analytic models and databases.

One of the principal elements of Air Force Logistics Transformation, managed by AF/ILM-T, is the development of a pilot version of a balanced scorecard for the F-16 supply chain.⁴ A balanced scorecard is a widely proven commercial tool, for (among other things) relating organizational outcomes to changes in organizational resources, that

³For a more complete discussion of this concept and its implications for PPBS processes, see Lewis, Coggin, and Roll (1994).

⁴For a recent update, see Krat (2001).

does not require the kind of detailed analytic models discussed above.⁵ This F-16 pilot program may provide a demonstration of a capability to link readiness-related outcomes to logistics resources that gains enough credibility among relevant Air Force leaders and decisionmakers to support the changes, suggested here, in how the Air Force PPBS process treats logistics issues.

To understand this, consider first what a balanced scorecard does, and then consider its relationship to the kinds of analytic models the Air Force currently has available to link logistics resource decisions to outcomes.

A balanced scorecard does four important things:

- First, it provides a framework in which the leaders of an organization can reach a consensus on joint goals. Senior leaders responsible for decisions on the resources covered by the scorecard agree on common language to state what they are all doing together. Such formal agreement is quite unusual in most organizations.
- Second, it provides a framework in which the leaders can reach consensus on a simple, high-level operating concept for the organization. The concept links the high-level goals of the organization to customer priorities, the performance of processes that service customers, and investment in assets key to sustaining the organization's capabilities over the longer term. So the concept embodies the organization's strategy for making decisions today that are relevant to long-term goals and short-term constraints.
- Third, the operating concept provides a basis for selecting a small number of metrics—about 25 or so at any particular level in an organization—that the leadership at that level can use to monitor the organization's execution of the strategy embodied in the operating concept. The leadership monitors these metrics to test whether the organization actually operates as they believe it

⁵The standard reference on the scorecard is Robert S. Kaplan and David P. Norton, *The Balanced Scorecard* (1996). The Balanced Scorecard Collaborative maintains a useful forum in which to get details about how the balanced scorecard works in various real settings. For more information, go to www.bscoll.com.

does and, given how it actually operates, to identify opportunities to increase performance against high-level goals.

- Fourth, taken together, these elements allow the leadership to view its goals and operational concept in realistic—empirically well founded—terms. Having a consensus on how the organization actually works helps the leadership allocate authority and responsibility effectively and maintain accountability for actions that advance its joint goals. This consensus in effect links strategic goals to resources “well enough” to allow coherent decisionmaking on resource allocation.

By its very nature, such a process cannot be primarily quantitative; no organization has a quantitative model of all the elements relevant to its high-level goals and operational concept. So this approach to linking outcomes to resources is quite different from that reflected in traditional analytic logistics models. That said, a balanced scorecard can be built on top of detailed analytic models and, in particular, can reflect at a high level the basic structures of models that underlie it and can support a drilling down into analytic models to allow the leadership ready access to more detailed answers to their questions than the scorecard can provide by itself.

Viewed properly, then, a balanced scorecard is a complement to a set of analytic models, not a substitute for them. In fact, commercial experience indicates that a scorecard can operate effectively without detailed underlying models. It is especially useful in helping leaders rise above the day-to-day concerns of operating an organization and to think strategically about how the organization as a whole works. But the high-level consensus so critical to the success of a scorecard is likely to be easier to establish and sustain if the scorecard is compatible with reliable analytic models that give the leaders confidence in the scorecard’s fidelity in the areas where these models operate.

In principle, an effective balanced scorecard should be especially useful in the context of the PPBS process. It should help sustain consensus about the process itself and the decisions it reaches. It should help the leadership frame its decisions more strategically. To the extent that a scorecard does these things for logistics decisionmaking, it should facilitate the kinds of changes in the PPBS process that are suggested here.

As with the quality of analytic models, those implementing the changes suggested here should keep three things in mind:

- Efforts to implement the changes proposed here should give careful attention to the capabilities of any balanced scorecards available to support them.
- Efforts to make the changes suggested here will probably be more successful if the Air Force makes effective use of balanced scorecards.
- Any effort to make the changes proposed here should include an active effort to improve the use of balanced scorecards.

SUMMARY

Many changes are under review today in Air Force logistics. Several of these could directly enhance the success of the changes proposed in Chapter Three. Changes that tend to centralize the funding for Air Force DLR procurement and repair could significantly reduce the negative effects of the decentralized Air Force approach to PPBS. Multipart pricing would centralize about half of the funding for Air Force DLRs in AFMC. The AFRAP seeks a transparent, rational connection between strategic defense goals, specific military capabilities, and resources, including the resources to support capabilities. Properly implemented, this change could highlight how logistics resources contribute to military readiness. That said, AFRAP could also make it more difficult to characterize key scale economies relevant to decisions about logistics resources. The balanced scorecard provides another way to link logistics resources to military readiness. If properly implemented, it could complement AFRAP and the broader suite of analytic methods that the Air Force uses to support its PPBS process.

The more effectively changes like these are coordinated with the changes proposed in Chapter Three, the more value all of these changes, taken together, can bring the Air Force. Unfortunately, not all aspects of Air Force policy favor the package of changes proposed in Chapter Three. Chapter Five examines key elements of the Air Force culture that could defeat such a package.

GENERAL ORGANIZATIONAL BARRIERS TO EFFECTIVE CHANGE

Any effort to change behavior significantly in a large organization will face difficulty. Any effort to change how the PPBS process treats DLR-related logistics issues in the Air Force should anticipate a set of specific difficulties and develop strategies to deal with them. This chapter identifies likely organizational barriers to change in the PPBS process relevant to logistics. In particular, it examines the following:

- The lack of an organizational tradition of closed-loop resource management.
- The lack of an organizational tradition of integrated process management.
- The lack of a tradition of managing organizational transformation aggressively.
- A tradition that favors modernization and operation performance over other goals.
- Inflexibilities in the Air Force PPBS process.

The Air Force lacks a strong organizational tradition of balancing resources and readiness realistically and “closing the loop” on plans to verify the balance.

An organization with such a tradition would exhibit the following characteristics:¹

¹For details, see Kotter (1996).

- It would have a clear understanding of how changes in specific resources, including logistics resources related to DLRs, affect such outcomes as readiness levels at the leadership level and in the parts of the organization where these changes occur.
- When it changed resource levels, it would anticipate the effects of this change on such outcomes as readiness levels and monitor its system performance to determine whether the expected level of change occurred. If the change expected did not occur, it would find out why and adjust its understanding of links between readiness and resources appropriately. It would then adjust its resource use to reflect the new understanding.

Many of the challenges discussed in Chapter Two flow directly from a very different Air Force approach to resource planning and management:

- The Air Force PPBS process routinely drives from a plan to a program to a budget. The Air Force does not routinely compare the DLR-related logistics services it expected to buy with those it actually bought and carefully explain any large differences. So it has only limited visibility of disconnects between expectations and realizations.
- The analytic models available to Air Force logisticians and programmers are quite limited in their ability to predict how a change in logistics resources related to DLRs will affect readiness. This limits the Air Force's ability to evaluate actual outcomes after the fact and identify the causes of surprises with confidence.
- The Air Force PPBS process itself uses many unrealistic assumptions. Obvious examples include assumptions that future programs relevant to current resource decisions will be fully funded when they rarely are, assumptions that process improvements will be more successful than they typically are, and assumptions that "fully funded logistics requirements" will meet all relevant operational needs when in fact they will not.
- A lack of basic confidence in analytic models discourages resource allocation decisions based on them. It also discourages evaluation based on such models. Without such confidence, it is

hard to maintain the discipline required to develop realistic readiness-based programs and to ensure that the programs implemented perform as expected.

- Without well-understood links between readiness and resources, the Air Force uses broad objectives linked to core competencies to frame its justifications for funding. Because the “metrics” it uses to support this approach are broad and qualitative, they impose little discipline and do not provide measurable outputs.

Elements of the proposal here address these barriers directly. Reframing logistics issues relevant to DLRs to make explicit links to readiness opens the issue of how resource changes will affect outcomes. Redefining the APPG process to build enforceable guidance embodies an explicit closed loop that compares a plan with an outcome. The proposed HAF closed-loop process does this in another way. Each of these must use realistic assumptions and well-defined, meaningful metrics to close their loops successfully. Proposed enhancements of human capital and analytic capabilities support these closed loops directly and create an environment in which players can have enough confidence in analysis to sustain accountability when plans are not realized.

The primary residual concern in this area is why these barriers exist in the first place. Does some motivation lie behind these barriers that could make it difficult to address them directly?

One possibility is a concern about what the exact function of the Air Force headquarters is, given that the Air Force is increasingly decentralizing its management. The decentralization is meant to reduce indirect costs and put as many resources into operations as possible. Our assessment and proposals draw this strategy into question. The complex, cross-functional issues (e.g., the linkages between logistics and operational readiness) facing the Air Force might suggest that it rethink the roles and responsibilities of its headquarters, particularly in terms of its ability to provide more strategic, independent option development and analytic support to the leadership. The issues identified in this report raise concerns about any Air Force decision to move many of its analytic functions to field operating agencies and physically away from the headquarters to achieve congressionally directed headquarters staff reductions. To date, removing ana-

lytic capabilities from the headquarters has weakened the corporate Air Force's ability to identify and assess such complex issues as logistics and formulate informed options for leadership review. Placing the Air Force's analytic capabilities in field operating agencies and locating them away from headquarters diminishes their ability to participate in the identification of these critical issues and in developing options.

Recent Department of the Army and Department of the Navy reorganizations concluded that a strong analytic support capability must be physically co-located or near to the senior leadership. Its purpose is to identify and objectively assess options for the leadership. The arguments offered here suggest that the Air Force should redevelop a similar type of capability. Without recreating the centralized analytic capabilities that existed in the Air Force prior to the 1991 reorganization, this approach cannot be implemented.

The senior leadership must ultimately display a basic commitment to "close the loop" in this way and to avoid systematic surprises as a normal part of its planning. OSD and Congress can discourage a tolerance for repeated surprises by not rewarding the leadership with add-on funding well into the year of execution. The senior leadership must also resist the temptation to tolerate the use of conservative assumptions that are so unrealistic that they systematically overestimate the need for logistics resources related to DLRs to achieve a particular level of readiness. Careful, systematic planning to manage surprises and surges that could stress the logistics system, if successful, should reduce the use of very conservative assumptions to make the logistics system more robust.

These considerations suggest that the Air Force should expect to move toward a more realistic, closed-loop system over a period of time as it observes the effects of repeated, incremental adjustments in the system as a whole and gains confidence in the new direction. Any change that takes time has difficulty in an organization, such as the Air Force, where the leadership turns over so often. Long-term change will require institutional commitment by the leadership that is repeatedly and convincingly reaffirmed.

The Air Force lacks a strong organizational tradition of viewing the supply chain as an integrated process and assigning effective, clear

responsibility and accountability for and authority over the total supply chain to ensure its integration.

An organization with such a tradition would exhibit the following characteristics:²

- The organization would recognize that “the supply chain” is not just about supply. It includes every activity, in-house and outside, that contributes value to the ultimate customer that the organization serves. So it naturally includes transportation, maintenance, and logistics planning; elements of contract, financial management, and information management; and so on.
- The organization would identify a clear, simple set of “system” metrics relevant to the supply chain as a whole. These metrics typically emphasize attributes relevant to the ultimate customer that the supply chain serves. The organization would verify that performance metrics throughout the supply chain encourage players in each part of the chain to take actions that enhance performance relative to the system metrics.
- The organization would align incentives with performance metrics throughout the portion of the supply chain that it controls to encourage players in each part of the chain to take their performance metrics seriously.
- The organization would participate in formal and informal efforts to share data to improve the joint performance of the supply chain as a whole. These efforts would include connectivity of information systems to give players access to common, reliable data; formal exchange of personnel as technical advisors or managers; continuing adjustment of system and performance metrics to achieve the best joint outcomes; and formal, joint efforts to improve the supply chain as a whole.
- The organization would participate in consensus-building activities with other members of the supply chain. It would support development of consensus-based analytic models of the supply chain that individual members of the supply chain can

²For details, see Kuglin (1998).

use to support objective, constructive discussions of improvement.

Many of the challenges discussed in Chapter Two flow directly from a very different Air Force approach to DLR supply chain planning and management:

- To date, it focuses its assessment of the DLR supply chain on the portion of the supply chain associated with the traditional supply function, which focuses on organic and contract materiel management and inventory management. For example, “supply chain managers” are responsible for activities that lie almost entirely within the traditional supply function.
- The Air Force has a fairly simple set of system goals associated with mission capable rates, safety of flight, and total ownership cost. It has linked its mission capable metrics to supply and maintenance metrics in simple ways, but does not have good enough agreement on how supply and maintenance resources affect mission capable rates to enforce much discipline on this score. It has not systematically linked performance metrics throughout its logistics system—even its organic activities—to any system-level metrics.
- The Air Force does not have enough confidence in its high-level understanding of how actions contribute to the performance of key parts of its DLR supply chain to hold specific players accountable for success. So incentives are only lightly linked to the specific performance metrics in place throughout the supply chain.
- The Air Force traditionally relies on strong stovepipes to organize current use of resources and to plan for future use of resources. This structural attribute manifests itself in logistics activities relevant to DLRs in two ways. First, the MAJCOMs have primary responsibility for planning and executing their own logistics activities. The IL/LG Meeting, Corporate Structure, SRRB, and other similar groups provide mechanisms for developing consensus across MAJCOMs, but they have failed to resolve very strong and important disagreements about ongoing change in logistics policy. Second, individual logistics functions—supply, maintenance, transportation, contracting, and planning—main-

tain strong stovepipes in every part of the Air Force and are even more heavily stovepiped from operations and other functions in the Air Force. This structure adds another dimension of complexity to any effort to build and sustain consensus on logistics issues. Again, the IL/LG Meeting and Corporate Structure provide forums in which to wrestle with this complexity, but neither has found an effective way to align Air Force resource management with the key DLR supply chain processes that cross functional and MAJCOM boundaries.

- The power of Air Force stovepipes makes it hard to call out any one organization and make it an effective champion for the total Air Force DLR supply chain. The most logical candidate would be the AF/IL, but two problems complicate any attempt to give the AF/IL effective authority and responsibility. The first is the practical question of who the senior logistician in the Air Force is, the commander of AFMC or AF/IL? Formal resolutions in favor of AF/IL have not diminished the four-star power of the AFMC commander in Air Force-wide logistics issues. Second, more generally, as a staff officer, the AF/IL has great difficulty asserting effective authority to integrate logistics inputs from the MAJCOMs, all of whose commanders have line responsibility and (with one exception) four stars. Without an empowered and powerful champion for integration, the Air Force stovepipes tend to dominate logistics resource management in the Air Force.
- MAJCOM stovepipes have become more important to resource management as the Air Force has delegated more and more PPBS-related responsibilities to the MAJCOMs and removed HAF-level capabilities to integrate MAJCOM inputs. These changes simply aggravated problems caused by stovepipes already present. That said, they have had particularly negative effects on resource planning for Air Force inventory policy, which recognizes large Air Force-wide scale economies in inventory management and depends on cross-MAJCOM coordination to achieve these scale economies. The recent changes in the Air Force PPBS process have made that harder.
- Standard Air Force personnel policy does not promote significant personnel exchanges across functional lines to give personnel a more complete view of the total DLR supply chain. An important problem of this kind currently occurs in the PPBS pro-

cess: Professional logisticians in the Air Force show a general lack of interest in gaining programming and financial management skills. The Air Force does not reward logisticians for acquiring such skills or use active career management to develop them. The result is a fairly low appreciation of PPBS-related processes among Air Force professional logisticians.

- Despite many years of efforts, the Air Force does not have an integrated logistics information management system. Lack of a common data source that all players endorse leads to disagreements based on bad data that complicate joint efforts at improvement across the board.
- The Air Force limits information and personnel exchange with external sources. Without these, coordination with parts of the DLR supply chain outside the Air Force is difficult.

Elements of our proposal here address these barriers directly. Reframing logistics issues relevant to DLRs clarifies the system-level metrics relevant to the DLR supply chain and sets the stage for linking each segment of the supply chain to a common set of goals. A new APPG process provides an explicit setting in which to integrate the supply chain. A new HAF closed loop can support such an effort in a less direct way. Giving AF/IL the skills, analytic tools, resources, and, most important, the authority and responsibility to integrate the supply chain goes to the heart of the issue. This effort will work only if AF/IL has the actual ability to operate through all of the forums available—from the Corporate Structure down to the IL/LG Meeting, SRRB, and so on—to build a unified Air Force vision of the supply chain and how it should operate. In a sense, the above description of barriers is an agenda for explicit changes that AF/IL must be empowered to make to integrate the supply chain.

As with the first barrier raised above, the residual issue here is the most important one. Why have these barriers to integration persisted for so long? And why is the Air Force moving to a still more decentralized structure? The senior leadership and all key players must be committed to integration to allow progress on any of the fronts suggested here.

As above, it is very likely that the leadership and the key players will have to be led to such continuing commitment by evidence that it

yields empirically verifiable results. Repeated, incremental adjustments in the system as a whole can build such a case over time. Again, any change that takes time has difficulty in an organization where the leadership turns over so often. Long-term change will require institutional commitment by the leadership that is repeatedly and convincingly reaffirmed.

The Air Force lacks a strong tradition of managing organizational transformation aggressively.

An organization with such a tradition would exhibit the following characteristics:³

- It would view a major organizational change as a formal development program that involves investments, predictable milestones, unpredictable outcomes, and outcome-oriented metrics to track progress and adjust course as development unfolds.
- It would approach major change around the processes involved and involve all parts of the organization associated with the processes slated for change.
- It would develop formal coalitions of all players whose personnel must change their behavior on the job for change to succeed. These coalitions would develop a commonly held vision and translate outcome-oriented metrics into performance metrics designed to measure the extent to which personnel in fact change their behavior appropriately.
- It would use outcome metrics to develop organizational support for investment in training, tools, and time for personnel to set aside their normal formal duties to support change.
- It would explicitly reward personnel who change their behavior appropriately and punish those personnel who do not. To do this, it would use whatever incentive system it uses to motivate personnel in other contexts.
- It would recognize major organizational change as something that will continue in one form or another for the indefinite

³For more detail, see Camm et al. (2001) and Moore et al. (2002).

future. In response, it would integrate the concept of such change into its normal operating arrangements.

- This approach encourages a realistic approach to making and implementing plans for change. Plans for change are realistic about implementation costs and transition costs. And they are realistic about the degree of change likely to be achievable. Monitoring change repeatedly ensures the realism of the plans and the success with which they are implemented.

The Air Force generally uses a different approach to managing major organizational change.

- It prefers changes that occur within functions or formal organizations to changes that require coordination of several organizations or functions associated with a particular process. This occurs because either recommendations for change arise within long-standing functional or organizational channels or a particular organization or function takes lead responsibility for change.
- Major change often reflects the priorities of the function or organization with lead responsibility more than the priorities of the Air Force as a whole. This affects the metrics used to judge success and the shape change takes as it unfolds in the sponsoring organization or function.
- The Air Force is reluctant to make major investments in training, tools, and staff time to support change. This occurs because the budgeting system the Air Force—and DoD as a whole—uses discourages any investment that incurs costs today to achieve benefits in the future and because the Air Force rarely quantifies the future benefits that might be used to justify a current period cost associated with change.
- The Air Force tends to assume that any change will succeed without extensive oversight, feedback, and adjustment. It makes plans based on success and has difficulty identifying and correcting problems that prevent full success. As new leadership teams enter, they find it easy to substitute their new priorities for those of the previous team, often leaving earlier changes incomplete and, in effect, orphaned.

- The Air Force leadership does not focus on rewarding personnel who change their behavior appropriately and punishing personnel who do not. Performance evaluations typically give much more priority to factors other than successful change.

These barriers present serious challenges for the changes proposed here. These changes immediately jump across functional and organizational stovepipes. At a minimum, financial management and programming specialists must find common ground with logisticians in almost every part of our proposal. Any attempt to appoint a single office as executive agent risks narrowing priorities and losing the central understanding that Air Force-wide priorities must guide this effort, but some standing organization must become the integrator for change to begin. Significant enhancements in skills and tools will be necessary just to create the change itself. Additional investment will be required to support the change. The changes proposed here have the potential for identifying a suite of metrics that the Air Force could use to monitor whether personnel are adjusting their behavior appropriately to implement the change.⁴ But significant change will be hard to achieve if the Air Force as a whole does not back up these metrics with changes in incentives that increase the value of successful change.

The more attention the Air Force gives to improving its generic change management skills, the more value changes of the kind proposed here will add to the Air Force. The Air Force honors leadership and knows how to develop and sustain effective leaders. But contrary to the hopes and expectations of many successful leaders, leadership by itself is typically not enough to ensure successful change, especially when the senior leadership of the Air Force is so transient. The changes proposed here would benefit, along with many other proposed changes, if the Air Force could help its leadership understand more about the dynamics and challenges of effective change management. Particularly when faced with one semisuccessful change after another, any Air Force workforce becomes increasingly inured to the next wave of change. In an environment in which the

⁴A supply chain perspective requires identification of high-level metrics relevant to the supply chain as a whole as well as metrics actionable in each segment of the supply chain that are compatible with the high-level metrics. The Air Force initiative on a balanced scorecard illustrates metrics relevant to DLRs as well.

Air Force can expect to continue experiencing change after change, success will increasingly depend on teaching the Air Force leadership what that means and how it must change its approach to leadership to manage each change effectively.

Again, this will not happen overnight.

The senior leadership has traditionally favored modernization and operational performance relative to other goals.

Throughout its history, the Air Force has been distinguished from other parts of DoD by its commitment to push the cutting edge of technology in order to upgrade the military capabilities of its weapon systems.⁵ As the Air Force has downsized since 1986, the need to scrutinize all resource use carefully has heightened the importance of this perspective. As the Air Force budget came down in real terms, the Air Force leadership continued to seek modernization and to cut other activities where possible to preserve resources for modernization. This approach has produced such effects as the following:

- The Air Force has favored wholly new weapon systems over modified versions of existing weapon systems to introduce new operational capabilities.
- The Air Force initially addressed the increasing resource demands of its aging fleet by extending schedules for overhauls and upgrades. This approach released resources, at least initially, for modernization efforts.
- With the rest of DoD, the Air Force has tended to frame infrastructure in terms of cutting costs to release funds for modernization, not improving support for the warfighter. This approach produces a bright line between “teeth” and “tail” that neglects the deep connection between the two and emphasizes how cuts in funding for tail release funds for modernization not how it degrades support to the warfighter using existing systems.
- Observers generally agree that the Air Force has been reluctant to invest its scarce resources in process improvements and technology upgrades that could improve reliability and maintainabil-

⁵See, for example, Builder (1989).

ity of weapon systems. Whenever possible, it preserves available resources for modernization, even when doing so slows process change that could improve the performance of support in the future.

- The Air Force's basic approach to its resource allocation process tends to address modernization of systems first and considers other resource requirements, including support of existing systems, in a residual "trade-space" that effectively treats such support as a bill-payer for the new systems favored in the first step.

In this setting, the Air Force views logistics policy relevant to DLRs primarily through the lens of infrastructure policy, particularly at the depot level. Logistics is viewed more as a bill-payer than as a force-multiplier. And even where investments in the reliability and maintainability of existing systems and components could reduce logistics costs, allowing the logistics community to pay bills for the Air Force without giving up performance, these investments generally compete unsuccessfully with investments in modernization that enhances military capability directly. Investments in process changes to cut logistics costs in support of paying bills elsewhere in the Air Force compete even less successfully.

In a sense, the changes proposed here are direct challenges to this set of implicit values. Reframing logistics issues relevant to DLRs explicitly rejects the distinction between infrastructure and operational capability and implicitly questions why a dollar spent on modernization should be worth more than a dollar spent to improve support to an existing system. Building closed loops that tighten the connection between logistics resources and operational capability takes another step in the same direction. Building human capital and analytical capabilities is explicitly designed to build the credibility of such an argument.

The pattern of Air Force behavior sketched above suggests that the senior leadership could be wary of the kind of policy changes proposed here, which would support a "diversion" of funds toward DLRs to improve current support to the warfighter. A consistent refrain when such arguments are advanced is that the logistics system is extremely inefficient today. If it would simply clean up its own processes, costs could fall without endangering current support to the

warfighter. What this argument neglects is that, to clean up its processes, the logistics community needs increased investments of leadership focus and resources to discover specifically what changes would improve efficiency and what is required to make these changes occur. It takes money to make money. If the senior leadership prefers to focus its current attention and resources on modernization, it will be careful about any effort to divert this focus, even if doing so would release the resources the leadership wants for modernization in the future.

So the kinds of changes proposed here cannot succeed unless the senior leadership takes a different view of modernization. Presumably the best way to build the case for such a change is to demonstrate empirically that improved logistics support relevant to DLRs can produce results comparable to modernization, particularly in a resource-constrained world. This will probably take a long time. The challenge is to sustain enough support from a leadership predisposed to modernization to build the empirical case for an alternative view.

The basic structure of the PPBS process can limit the flexibility of the Air Force in addressing resource management issues effectively.

Even when asking how the Air Force might change its treatment of logistics issues relevant to DLRs in its PPBS process, appreciate that significant aspects of the PPBS process as a whole are unlikely to change. Three elements of the PPBS process are particularly important here:

- The PPBS process takes a long time to process information and make decisions. Planning inputs to the APPG must begin well over two years before the relevant year of execution and more than three years before that year of execution ends. The remaining years in the FYDP lie years in the future beyond this. Without an effective means for updating plans, programs, and budgets through the course of the PPBS timeline, such a delay would build in extraordinary inflexibility. Any such delay would be even more important today, when the Air Force operates in an uncertain national security environment, than it was during the Cold War, when it was easier to plan against a fairly steady external threat.

- Formal interactions between the Air Force and OSD occur throughout this cycle. OSD provides guidance and queries at fairly fixed dates in each cycle, and the Air Force responds at fairly fixed dates. Of particular importance to DLR-related logistics policy is that cost and pricing data and guidance pass back and forth repeatedly as fairly fixed points. The PPBS process gives the Air Force extraordinary flexibility to decide how it will accept inputs and respond. Whatever it chooses to do in-house, however, must always remain synchronized with the general PPBS calendar. Whatever data the Air Force uses to support its internal decisionmaking, it must draw on these data to fill specific PPBS templates at predesignated dates.
- PPBS documents and templates typically address deltas from the previous PPBS cycle. Because the PPBS timeline extends for several years, several PPBS cycles are always proceeding in parallel. To remain as flexible as possible within this context, a delta in one cycle may be a response to a problem or change that came to light in another cycle running in parallel. So the delta itself cannot be understood in isolation, within its own cycle. This process requires a fair amount of basic accounting and documents management simply to synchronize its moving parts. The mechanics are demanding enough that they can absorb the leadership focus on simply getting appropriate products out at the right time. This focus can easily draw Air Force attention away from the substantive analysis and decisionmaking that should underlie this process. The need to turn products on short timelines, to coordinate them to ensure compatibility across all active PPBS cycles, and to include all relevant players in vetting new positions can easily limit the resources, time, and focus available to determine exactly what those decisions should be.

These are serious concerns, but they must be kept in perspective. Despite these complexities, the PPBS process is extraordinarily flexible. The military departments and agencies each use very different approaches to it. Within a component, the details of the PPBS process have typically changed dramatically over time. The challenge is to recognize this degree of flexibility, to frame the concerns above primarily as constraints, and to use the opportunities presented by the PPBS process to pursue the Air Force's high-level goals. Put more crudely, the challenge is to avoid pointing fingers at the constraints

imposed by the PPBS process and blaming them for poor performance; rather, focus on the elements of the process the Air Force can control and take advantage of them.

Each of the changes proposed here targets a different opportunity for the Air Force to improve an element of the PPBS process that it can control. In particular, the proposal for a new HAF closed loop creates a learning tool that the Air Force can use to monitor its approach to PPBS on a continuing basis and adjust it to get more value from it. Such an approach requires an aggressive Air Force approach to the PPBS process. The biggest barrier to such an approach is likely to be an unwillingness to make the investments and to reassign responsibilities and authorities to make the specific changes proposed here, primarily for one of the reasons discussed above. The PPBS process itself need not add any barriers not already reviewed above.

SUMMARY

The way the Air Force treats logistics resources relevant to DLRs in its PPBS process today is not an accident. It reflects deep-rooted traditions that color how the Air Force treats many issues, not just those addressed here. The Air Force tends not to follow up on policy changes to verify that they have proceeded as planned. For example, in a PPBS cycle, the HAF does not systematically verify that the MAJCOMs propose changes that effectively reflect the intent of the APPG. It does not systematically track implementation of a program or budget to verify that deviations between the intent of the program or budget and their actual effects are understood and appropriate. When changes do not have the effects intended, it does not adjust planning factors in future programs and budgets to reflect the effects that did occur. When intended and actual effects differ repeatedly, year after year, it takes a long time for the Air Force to ask why and seek an effective way to end the deviation.

The Air Force prefers to organize itself around functions and operational MAJCOMs, not integrated processes, such as DLR supply chains. Although the Air Force has initiated many changes during the past 15 years, it has not made systematic and continuing change an integral part of how it manages its decisionmaking. The leadership of the Air Force has traditionally focused more on issues of modernization than on those of support. The changes proposed

here challenge many of these traditions fairly directly. The changes proposed here must occur within the bounds of the existing DoD PPBS process, which, as flexible as it is, imposes significant requirements that absorb significant Air Force resources and management focus, simply to comply with the procedural requirements.

So the changes proposed here face significant barriers. In all likelihood, these barriers will slow the rate at which these changes can occur. The Air Force should expect these changes to take time to demonstrate their value and gain the support of the leadership. Those responsible for the changes, at all levels, should expect such barriers, address them directly, and plan accordingly.

SUMMARY

Spares management and logistics support more generally can create important scale economies. The unit cost of managing DLR spares inventories falls as the scale of inventory management rises. And the value the Air Force can derive from any one DLR rises as that spare part becomes available to a larger, more diverse pool of users. Similarly, the effective utilization of specialized DLR maintenance assets tends to rise as the Air Force uses them to support a higher level of activity in a variety of locations. And the value that the Air Force can derive from any one DLR maintenance asset rises as it can apply that asset to support a larger, more diverse pool of users. These factors favor central control and ownership of DLR spares and maintenance assets if the Air Force is integrated well enough to apply these assets throughout the Air Force. These attributes of DLR-related assets have been widely recognized for many years.

The processes that the Air Force uses to set requirements for and to fund DLR-related assets have become increasingly decentralized over the course of the last decade. The decision to have the operating commands rather than AFMC effectively determine the requirements for procuring and repairing DLRs was the first big step in this direction. Increasing decentralization of the PPBS process magnified that initial step. The result is that DLR assets that benefit from a centralized perspective have received less and less central attention.

The Air Force is taking steps to address this problem. The SRRB process, already under way, will attempt to develop a new, consensus-based requirement for spare parts that supporters hope will increase funding for requirements that the Air Force has systematically

neglected for several years. Multipart pricing for DLRs could move responsibility for funding about half of the annual cost of the spares requirement back to one central place in AFMC. The DLRs in question are those that benefit most from a centralized perspective.

The Air Force could take additional steps that would highlight how spending on logistics resources relevant to DLRs contributes to military capability and complements efforts like those above to build and promote a centralized, Air Force-wide perspective on such logistics resources. This report proposes a seven-part change in policy:

- Frame logistics resource issues relevant to DLRs so that the effects of logistics spending on readiness and total ownership cost are clear and widely accepted in the Air Force.
- Align Air Force logistics plans more systematically to strategic defense plans, giving careful attention to how logistics resources relevant to DLRs affect strategically relevant readiness factors.
- Use the APPG to craft a crisp, resource-constrained statement on Air Force policy that the HAF could use to monitor MAJCOM submissions to the POM process and advocate a realistic Air Force-wide logistics perspective to the Corporate Structure.
- Use the APPG as a baseline to run the PPBS process as a closed-loop control system, checking planned logistics actions against executed logistics actions and checking the actual performance of the PPBS process itself against expectations.
- Give AF/IL practical responsibility and authority to lead and coordinate all of the efforts identified above.
- Build practical understanding of the Air Force PPBS process among logisticians to ensure that AF/IL has the human capability to exercise its new responsibilities and authorities effectively.
- Improve the Air Force's analytic ability to link spending on logistics resources relevant to DLRs to effects on Air Force readiness and total ownership costs to ensure that AF/IL can document convincingly the Air Force-wide effects of changing spending levels for logistics resources relevant to DLRs.

These changes are compatible with other ideas under consideration today, such as the logistics proponent proposed in the Air Force

Spares Campaign. If implemented in an integrated way, these changes would complement the provisional policy changes mentioned above, as well as other changes under consideration, such as the use of a balanced scorecard and potentially the implementation of a capabilities construct to organize Air Force resource allocation more systematically.

It will not be easy for the Air Force to make these changes. In many ways, they directly challenge important Air Force values. The standard Air Force approach to resource management does not use a closed loop to identify and understand differences between a plan and implementation of the plan. The Air Force continues to give its functions and MAJCOMs much greater emphasis in resource management than such integrated, crosscutting processes as a supply chain. The Air Force has traditionally given greater high-level attention to resource issues associated with modernization than to those associated with support. So the changes proposed here would involve a marked cultural change for the Air Force. The Air Force has no systematic way to address such cultural changes or quantum changes of similar magnitude. It will have to implement the changes proposed here within the constraints imposed by DoD's PPBS process, which shows no indication of changing in the near-term.

The kinds of changes proposed here will take time for the Air Force leadership to digest and then support. In all likelihood, the Air Force leadership will need to see evidence that changes of this kind are worthwhile. Those promoting such change should be prepared to implement such changes in an incremental fashion that allows them to demonstrate improvement over time. Each improvement can build the case for further change. Such an incremental approach will be difficult in an organization with little continuity at the top and many related changes to coordinate. But in all likelihood, the Air Force will have no choice.

Our general approach to resource management emphasizes the importance of using a monitoring cycle that is empirically well informed to proceed systematically against realistic, clearly stated goals. So it is natural to understand that it would recommend a similarly realistic, systematic approach to change itself.

BIBLIOGRAPHY

- Air Force Materiel Command Reparable Spares Management Board (Frank Camm, chair), *Final Report*, Wright-Patterson AFB, Ohio, March 1998.
- Builder, Carl H., *The Masks of War: American Military Styles in Strategy and Analysis*, Baltimore, Md.: Johns Hopkins University Press, 1989.
- Camm, Frank, Jeffrey Drezner, Beth E. Lachman, and Susan A. Resettar, *Implementing Proactive Environmental Management: Lessons Learned from Best Commercial Practice*, Santa Monica, Calif.: RAND, MR-1371-OSD, 2001.
- Dahlman, Carl J., Robert Kerchner, and David E. Thaler, *Setting Requirements for Maintenance Manpower in the U.S. Air Force*, Santa Monica, Calif.: RAND, MR-1436-AF, 2002.
- Holmes, MSgt Susan, *Process Improvement Guide: Quality Tools for Today's Air Force*, 2d edition, Maxwell AFB, Ala.: Air Force Quality Institute, Air University, 1994.
- Kaplan, Robert S., and David P. Norton, *The Balanced Scorecard*, Boston: Harvard Business School Press, 1996.
- Keating, Edward G., and Frank Camm, *How Should the U.S. Air Force Depot Maintenance Activity Group Be Funded? Insights from Expenditure and Flying Hour Data*, Santa Monica, Calif.: RAND, MR-1487-AF, 2002.

Koenig, Edward, "Air Force Spares Campaign Multi-Part Pricing," white paper, Programming and Financial Management Team, U.S. Air Force Spares Campaign, AF/ILS, Washington, D.C., July 2001.

Koenig, Edward, et al., "Recommended Changes to Air Force Spares Programming, Budgeting, and Financial Processes," Programming and Financial Management Team, U.S. Air Force Spares Campaign, AF/ILS, Washington, D.C., 2001.

Kotter, John P., *Leading Change*, Boston: Harvard Business School Press, 1996.

KPMG Consulting, LLC, "AFMC Supply Chain Gap Analysis Final Report," prepared for AFMC/LGI, Wright-Patterson AFB, Ohio, August 17, 2000.

Krat, Lt Col Laine F., "A Logistics Balanced Scorecard: LTT [Logistics Transformation Team]/SCP [Spares Campaign Plan] Integration Meeting," briefing, AF/ILM-T, Washington, D.C., August 13, 2001.

Kuglin, Fred A., *Customer-Centered Supply Chain Management: A Link-by-Link Guide*, New York: American Management Association, 1998.

Kumashiro, Maj Patrick, "AF Logistics Operational Architecture Update," briefing to Lt. Gen. Michael E. Zettler, Washington, D.C., October 2000.

Lewis, Leslie, James A. Coggin, and C. Robert Roll, *The United States Special Operations Command Resource Management Process: An Application of the Strategy-to-Tasks Framework*, Santa Monica, Calif.: RAND, MR-445-A/SOCOM, 1994.

_____, Gerry Kauvar, and Roger Brown, "Proposed Strawman Constructs for AFRAP," briefing, Santa Monica, Calif.: RAND, January 22, 2001.

Lumpkins, Sue, et al., "Potential Changes to Air Force Spares Command & Control Processes," Command and Control (C²) Team, U.S. Air Force Spares Campaign, AF/ILS, Washington, D.C., 2001.

- Moore, Nancy Y., Laura H. Baldwin, Frank Camm, and Cynthia R. Cook, *Implementing Best Purchasing and Supply Management Practices: Lessons from Innovative Commercial Firms*, Santa Monica, Calif.: RAND, DB-334-AF, 2002.
- O'Malley, T. J., *The Aircraft Availability Model: Conceptual Framework and Mathematics*, McLean, Va.: Logistics Management Institute, AF201, 1983.
- _____, "Adjustment to Aircraft Availability Targets," memorandum to Lt. Col. Russ Gimmi, Logistic Management Institute, McLean, Va., June 25, 1997.
- Operational Architecture IPT, "Logistics Operational Architecture Proposal," Air Force Logistics Transformation Team, Headquarters, U.S. Air Force, Washington, D.C., 2000.
- Pyles, Raymond, and H. L. Shulman, *United States Air Force Fighter Support in Operation Desert Storm*, Santa Monica, Calif.: RAND, MR-468-AF, 1995.
- Slay, F. Michael, Tovey C. Bachman, Robert C. Kline, T. J. O'Malley, Frank Eichorn, and Randall M. King, *Optimizing Spares Support: The Aircraft Sustainability Model*, McLean, Va.: Logistics Management Institute, AF501MR1, 1996.
- U.S. Air Force, *Headquarters United States Air Force Organization and Functions (Chartbook)*, AFPAM 38-102, AF/XPM, Washington, D.C., October 1, 1999.
- _____, *The Planning, Programming, and Budgeting System (PPBS) and the Air Force Corporate Structure (AFCS) Primer*, 10th edition, AF/XPPE, Washington, D.C., July 2000a.
- _____, *FY03-07 Annual Planning and Programming Guidance (APPG)*, Version 5.0, Washington, D.C., October 2, 2000b.
- U.S. Congress, *Department of Defense Reorganization Act of 1986* (Public Law 99-433); now U.S. Code, Title 10, Subtitle A, Part I, Chapter 5, Articles 151-155, 1986.

U.S. Department of Defense, *Stock Funding of Depot-Level Reparables*, Defense Management Report Decision 904, Washington, D.C., November 9, 1989.

U.S. General Accounting Office, *Air Force Supply Management: Analysis of Activity Group's Financial Reports, Prices, and Cash Management*, GAO/AIMD/NSIAD-98-118, Washington, D.C., June 1998.

_____, *Air Force Supply: Management Actions Create Spare Parts Shortages and Operational Problems*, GAO/AIMD/NSIAD-99-77, Washington, D.C., April 1999a.

_____, *Air Force Depot Maintenance: Analysis of Its Financial Operations*, GAO/AIMD/NSIAD-00-38, Washington, D.C., December 1999b.

_____, *Air Force Depot Maintenance: Budgeting Difficulties and Operational Inefficiencies*, GAO/AIMD/NSIAD-00-185, Washington, D.C., August 2000.

Wehrle, Lt Gen Joseph, "AFRAP and the FY03 APOM," briefing, AF/XP, Washington, D.C., September 26, 2000.

The Air Force's logistics supply chain involves the participation of many organizations, inside and outside the Air Force, to serve a variety of users with differing needs. The Air Force uses the Planning, Programming, and Budgeting System (PPBS) to fund all elements of the supply chain at levels that give its users appropriate levels of service. The PPBS process has a great deal of difficulty doing this well. Important changes in the Air Force PPBS, financial management, and logistics management processes over the past 15 years have made the task even more difficult. The authors propose several changes in strategy and policy designed to help the Air Force manage and fund its logistics supply chain in a more integrated manner—a manner that can set goals relevant to its customers and use closed-loop accountability systems to manage the supply chain, end-to-end, against these goals. Full implementation of the changes proposed would challenge Air Force organizational culture. The authors identify specific cultural barriers that the Air Force must address to effectively pursue the proposed changes.

ISBN 0-8330-3284-4



MR-1611-AF