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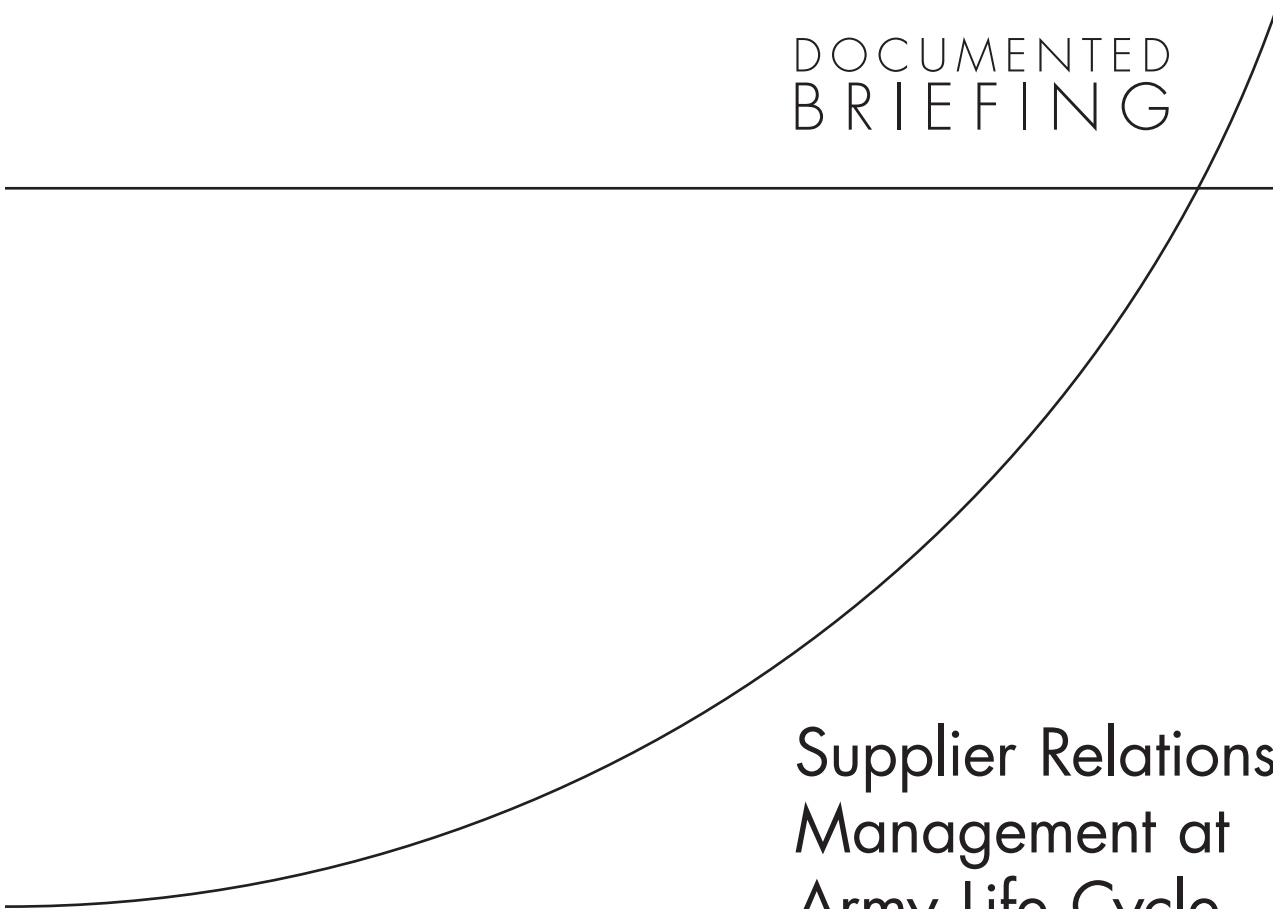
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Supplier Relationship Management at Army Life Cycle Management Commands

Gap Analysis of Best Practices

Nancy Y. Moore, Amy G. Cox,
Clifford A. Grammich, Judith D. Mele

Prepared for the United States Army

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Preface

In recent years, procurement of weapon systems and other goods and services, rather than personnel costs, have accounted for most U.S. Army expenditures. This means that the Army's ability to get the most out of its budget will depend strongly on how well it manages its suppliers.

Because supplier relationship management (SRM) is so important, U.S. Army Materiel Command (AMC) asked the RAND Corporation to identify leading SRM practices, examine SRM practices in the AMC, and suggest ways to improve the Army's approach to SRM. In particular, this study focused on how the Army can gain better performance and reduce total costs by improving its management of and partnering with large defense suppliers that span a range of products and major commodity groups. This project builds on previous RAND Arroyo Center studies to help the Army improve its purchasing and supply management. It also builds on recent RAND SRM research conducted by the authors for the U.S. Air Force. This research should be of interest to those involved in Department of Defense procurement as well as those concerned with finding ways to reduce total costs and improve supplier performance.

This research was conducted in RAND Arroyo Center's Military Logistics Program. RAND Arroyo Center, part of the RAND Corporation, is a federally funded research and development center sponsored by the U.S. Army. Questions and comments regarding this research should be directed to the principal investigator, Nancy Moore, at Nancy_Moore@rand.org, or to the program director, Ken Girardini, at girardin@rand.org.

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Summary

Purchases of weapon systems and other goods and services constitute a large portion of the Army's budget. Purchases surpassed 50 percent of the Army's total budget in fiscal year (FY) 2003 and reached 65 percent in FY 2007. As a result, improving the Army's performance and reducing costs rests in large part on improving its approach to supplier relationship management (SRM).

SRM is the process by which an organization works with its suppliers to accomplish common goals or objectives. Recent research identifies several means through which enterprises accomplish SRM, particularly to improve supplier performance and reduce total costs. These include the following:

- Rationalizing the supply base—that is, identifying a limited number of preferred suppliers and working with them to establish metrics for assessing their performance. Many performance metrics that commercial firms use to rationalize their supply base are available for the Army as well. Effective performance metrics can be one of the key contributors to SRM.
- Developing cross-functional teams with problem-solving skills that can work with suppliers to identify and eliminate problems. Regular, structured communication is critical with both teams and suppliers to identify and eliminate problems as well as to develop means for continuous improvement.
- Proactive development of supplier relationships, including establishing incentives and penalties for supplier performance.
- Integration of suppliers in new product development.
- Working throughout the supply chain to improve performance among lower-tier suppliers.

Because SRM is so important, U.S. Army Materiel Command (AMC) asked the RAND Arroyo Center to assess how it could improve its supplier

management and development to reduce total costs and improve performance. To this end, we investigated current Army SRM practices and what can be done to improve them, identifying commonly accepted best practices and comparing them to Army practices. The resulting analysis also drew on AMC order and contract data and interviews with top AMC headquarters and Life Cycle Management Command (LCMC) leadership.

Current Army SRM Practices

Current Army practices reflect some research-supported SRM best practices. However, such practices are not always widespread, and others are not used at all.

With regard to supply-base rationalization, the *Army Source Selection Guide* (Assistant Secretary of the Army, 2001) identifies market research as a first step in an acquisition plan, details source selection plans, and requires past performance as a criterion for selecting suppliers. This sequence of steps would enable the Army to rationalize its supply base, yet none of the LCMC staff with whom we spoke reported pursuing supply-base rationalization. AMC also has several constraints to improving supply-base rationalization. For example, the separation of acquisition and sustainment processes in the Army limits the search for competitive suppliers willing to provide both in a single contract. Available data limit efforts to establish supplier performance metrics to assess suppliers. Requirements for competition and socioeconomic goals also limit supply-base rationalization.

AMC has seen its numbers of contracts and suppliers increase sharply in recent years: between 1995 and 2007, the number of LCMC suppliers increased from 1,616 to 7,614, while the number of contracts increased from 4,297 to 26,288. Most Army contracts remain short-term (i.e., less than two years long) for relatively small amounts and a low number of different items, although our interviews suggest some growing use of long-term contracts. Overall, the quantitative data suggest—given a likely decreasing number of contracting personnel over time—that Army staff must spend increasing

amounts of time on contract administration rather than on broader strategies for rationalizing the supply base or otherwise improving SRM.

With regard to supplier development and helping suppliers improve, the Army has implemented very few SRM best practices. U.S. Army Materiel Command (1998) recommends building relationships and joint problem solving, as well as continuous communication with suppliers. However, the LCMCs do not currently have cross-functional teams that perform on-site risk assessments, and they only rarely seek to work with suppliers to eliminate their deficiencies. Such efforts may be better targeted at smaller suppliers than larger ones; while federal policy seeks to develop smaller suppliers, the larger ones may already be leaders in their field and need no development support from federal purchasers.

Regarding proactive development of suppliers, the LCMCs reported some limited application of SRM best practices but little or no application of others, in part because of a lack of available data. The LCMCs have worked to establish some open relationships with their suppliers through performance feedback and information sharing, but they have instituted few rewards or penalties for supplier performance. Our interviews indicated that penalties were more common than rewards, and that there was little or no use of supplier scorecards or recognition for outstanding performance. We also found no systematic supplier development by LCMCs, in part because they do not have access to AMC-wide—much less Army-wide or U.S. Department of Defense (DoD)—wide—data on suppliers. Some interviewees reported sharing aggregate, long-term forecasts with suppliers but little sharing of detailed, short-term forecasts or any systematic activities. All this prevents efforts to build, much less maintain, momentum in supplier development, including ongoing analysis of performance and continuous improvement activities. Indeed, virtually all LCMC contracts are for a firm, fixed price, with very few incentive-based ones (e.g., cost-plus-incentive-fee, cost-plus-award-fee, fixed-price-incentive-fee, fixed-price-award-fee). This may limit leverage with suppliers, particularly those

with performance problems—and underscores the importance of improving SRM practices.

With regard to development of suppliers by tier, we found that such activities are rare or do not occur among the LCMCs. Working with lower-tier suppliers occurs only rarely, although our interviews indicated that some interaction is developing. At this point, the Army—like most commercial enterprises—has not established a thoroughly integrated supplier network that includes ongoing improvement.

Challenges to Adopting Best SRM Practices

Our research points to several key challenges for SRM success. First, the Army lacks detailed, enterprise-wide data on supplier performance. This limits both possible analyses and the ability of leaders to have a DoD-wide perspective on supplier management.

Second, LCMCs, as noted, have limited access to the data that do exist. Seeing only their own contracts with suppliers limits the perspective of LCMCs, as well as their opportunities to increase leverage. It also limits the ability of leaders to gain a broader perspective on supplier management.

Third, the Army has numerous organizational stovepipes, limiting efforts to gain a global perspective on suppliers and impeding the creation of cross-functional teams. Contracting officers often become specialists on a given system or at a given location and do not work with the same supplier for other systems or at other locations. As a result, multiple, distinct relationships are established with suppliers, even if those systems were provided by the same contractor. The specialization that the Army has instituted to increase efficiency may be obstructing effective management of suppliers, and the efficiencies that it provides, especially that requiring development of smaller suppliers to serve broader needs.

Fourth, the separation of acquisition from sustainment also prevents the formation of cross-functional teams and severely limits opportunities for

continuous process improvement. This separation has produced a large number of sole-source sustainment suppliers and limits leverage over them.

Fifth, as noted, LCMC staff may spend much of their time processing contracts and have little time for broader initiatives. Some of this processing focus may be the result of policy requirements, including those for full and open competition and limited terms of contracts that may interrupt the development of supplier relationships and that require LCMC staff to compete, process, and manage multiple contracts. Socioeconomic goals, such as small business preferences, may also lead to a higher number of suppliers and contracts than would be ideal from an SRM standpoint.

Sixth, our interviews indicated that the degree to which AMC and LCMC leaders understood SRM principles varied. Government contract personnel are typically not supply chain managers, and consequently are focused on procurement regulations and policies.

Conclusions and Recommendations

Our research suggests a number of steps for improving Army SRM. First, AMC should develop systematic AMC-wide supplier management policy and guidance. This, in turn, could increase the effectiveness of managing suppliers that provide products and services across multiple LCMCs and multiple weapon systems. Many long-term suppliers have their own effective SRM programs that AMC may wish to leverage in creating and measuring the performance of new programs.

Second, AMC should centralize the storage and analysis of information on suppliers in order to better manage them. Integrating data systems would also enable more detailed measures of supplier performance and allow AMC to better share information. Such information sharing would need to be frequent and detailed and include information on overall Army- and supplier-specific forecasts as well as supplier performance. This would create a more complete picture of supplier relationships than is currently available. Ideally, integrated data would eventually extend across DoD.

Third, AMC should link acquisition and sustainment contracting. This could increase competition for sustainment items and help reduce costs and improve performance.

Fourth, AMC should leverage integrated data to conduct Army- and DoD-wide analyses. This could help the Army rationalize its supply base and identify suppliers on which it should focus its SRM efforts (e.g., those receiving more dollars or those with more problems).

Fifth, AMC should develop and adopt new measures of supplier performance. Supplier performance data are limited in accessibility and scope. Consistent measures of quality, delivery time, and cost are needed to compare suppliers' performance over time and with each other. While focusing on past performance can identify some issues that need to be addressed for improving future performance, it is not likely to include all indicators of innovation and financial health.

Finally, these data should be collated in a single brief summary, such as a supplier scorecard, that allows AMC to systematically manage its supply base. Clear and consistent scorecard data would enable efficient management of overall supplier performance and of individual contracts, identify areas for improvement, and allow ranking of suppliers for supply-base rationalization as well as for recognition or improvement efforts.

Acknowledgments

We thank all the AMC HQ and LCMC leadership who graciously answered our interview questions about their roles in various types of SRM. We also thank our study sponsors, Mr. Lane Collie, Principal Deputy G-3 for Operations/Executive Deputy, Supply Chain and Industrial Operations, U.S. AMC (AMC-G3/5), and Mr. Jeffrey Parsons, Director, U.S. Army Contracting Command, as well as our action officer, Mr. Andrew Pawlowski, AMC-G3/5, for helping us obtain data and gain access to Army leadership.

Part of this work, particularly that on supplier “scorecards,” leverages unpublished research by our RAND colleague Nancy Nicosia. Other parts, particularly that on other DoD expenditures with leading AMC suppliers, leverage work by Mary E. Chenoweth, Nancy Y. Moore, Amy G. Cox, Judith D. Mele, and Jerry M. Sollinger published in *An Analysis of Best Practices in Supplier Relationship Management and Their Implementation in the Air Force Materiel Command from 2002 to 2006*, Santa Monica, Calif.: RAND Corporation, TR-904-AF, 2011. We thank Jeffrey Tew of Accenture and Robert Monczka of Arizona State University for their reviews of this document and for their many helpful suggestions. We also wish to thank Judy Mele, who provided extensive programming and analysis expertise; Clifford Grammich, who refined and lent clarity to the report; and Donna Mead, who formatted the document.

Abbreviations

AMC	U.S. Army Materiel Command
AMCOM	U.S. Army Aviation and Missile Command
APBI	Advanced Planning Briefing for Industry
CECOM	U.S. Army Communications-Electronics Life Cycle Command
DoD	U.S. Department of Defense
EDRS	Electronic Deficiency Reporting System
FY	fiscal year
GPA	General Performance Assessment
HP	Hewlett-Packard
LCMC	Life Cycle Management Command
LOE	level of effort
MILSCAP	Military Standard Contract Administration Procedure
NIIN	National Item Identification Number
OEM	original equipment manufacturers
P&G	Procter and Gamble
PBA	performance-based agreement
PO	purchase order
PPIRS	Past Performance Information Retrieval System
PRON	Program Request Order Number
SRM	supplier relationship management
TACOM	U.S. Army Tank-Automotive and Armaments Command
TQM	total quality management

1. Introduction



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Strategic Supplier Relationship Management at U.S. Army Materiel Command

Nancy Young Moore and Amy G. Cox

The U.S. Army spends nearly two-thirds of its budget on purchases of weapons and other goods and services. As a result, to reduce its costs and improve its performance, it will have to improve its supplier relationship management (SRM), the process by which it works with its suppliers to accomplish common goals and objectives, and which may include such steps as supply-base rationalization. This is particularly true for key suppliers whose product quality, delivery, and technology are most critical to the Army's work.

The Army is not the only organization to face such challenges. Indeed, recent management research indicates that improving working relationships with key suppliers is increasing in importance among enterprises seeking to be more competitive in cost, quality, delivery, and new product development and

to implement improvement programs throughout the supplier network (Carter et al., 2007; Monczka, Trent, and Handfield, 2002).

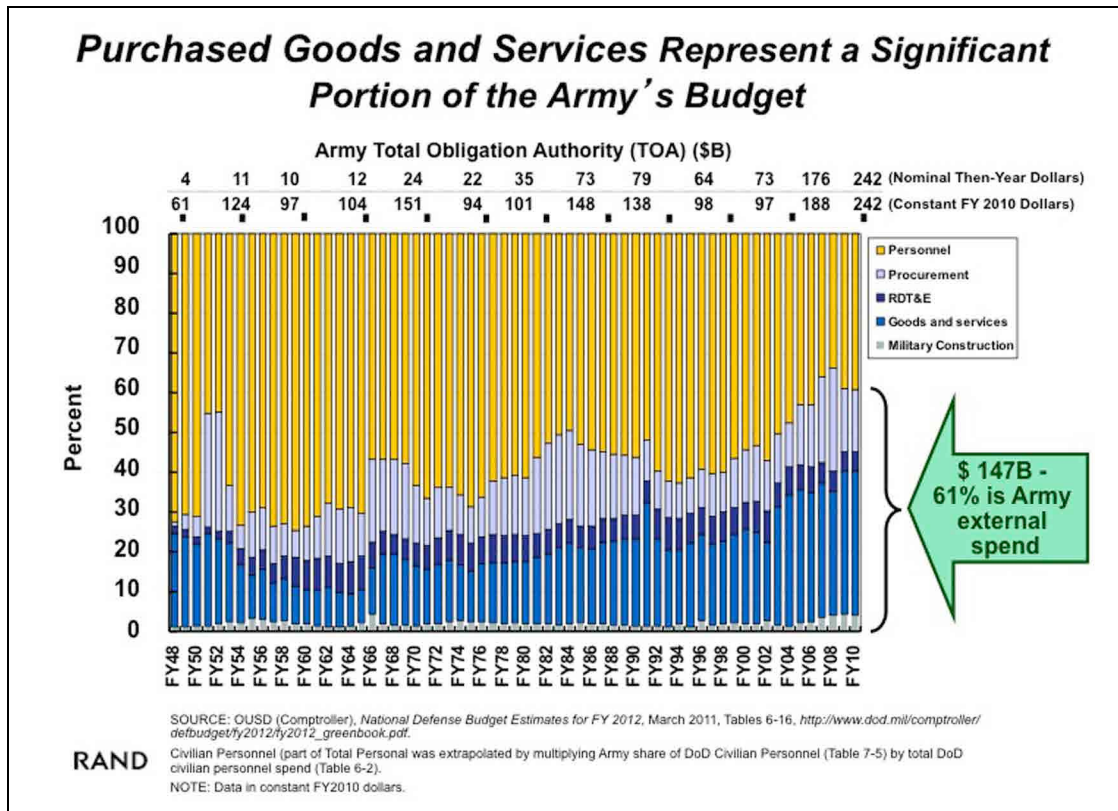
Given the importance of purchased goods and services in the Army budget and the potential supplier relationship management offers to make Army operations more efficient, in this document we review best SRM practices, current SRM practices in the Army, and potential areas for improving Army SRM. This research builds on previous RAND research and analysis to help the Army improve its purchasing and supply management.

Outline

Introduction
SRM Best Practices
SRM Stages at AMC
Critical Success Factors at AMC
Conclusions and Recommendations

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We begin by providing background on the Army's spending, SRM, and our research approach. We then summarize SRM best practices as described in the business literature. In the third section we summarize our findings from our interviews with U.S. Army Materiel Command (AMC) and Life Cycle Management Command (LCMC) leadership regarding their SRM practices and how they compare to leading SRM practices. We then discuss critical success factors for improving SRM in AMC. Finally, we present our conclusions from this research and our recommendations for improving SRM in AMC.



As noted earlier, weapon system procurement and purchases of other goods and services represented 65 percent of the Army's budget in fiscal year 2007. As the above figure shows, this proportion has generally increased over time.¹ As operations in Iraq and Afghanistan wind down, the proportion of Army expenditures for other goods and services may decrease, although it is unlikely to decrease to levels seen in earlier decades. These trends are likely to continue; while recent emphasis on insourcing and reducing contract spending may help decrease purchases of external goods and services, decreasing troop strength and reductions in overhead staff are likely to support current levels of such purchases.

¹ We estimated civilian personnel spending by multiplying the Army's share of DoD civilian personnel by total DoD civilian personnel spending.

Supplier Relationship Management (SRM)

A process for strategically and proactively managing the supply base and suppliers to effectively and efficiently improve performance and capabilities and reduce total supply chain costs

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To make the best use of the majority of its budget for goods and services, the Army may wish to improve its SRM, or “the process that defines how a company interacts with its suppliers” (Croxtton et al., 2001, p. 24). Given the expanding roles of suppliers in product development, quality, cost, and delivery, improving SRM is likely to require more than just interacting with them.

Enterprises with SRM best practices strategically and proactively manage their supply base and suppliers to effectively and efficiently improve performance and capabilities, reduce total costs, and manage the risks of the end-to-end supply chain. They aim to move from reactive, tactical management of suppliers for short-term needs to proactive, strategic management of suppliers. They also seek to cease addressing problems in quality, delivery, and cost as they arise and instead manage their suppliers to prevent such problems. Finally, they aim to increase the overall capabilities and performance of the supply base through systematic assessment and investments in supplier development targeted for the greatest gains and competitive advantage (Krause and Handfield, 1999).

Leading enterprises often segment their suppliers based on the risks and value of their products and then manage the segments differently (Moore, Grammich, and Bickel, 2007). In particular, leading enterprises will identify the suppliers who add the most value—or whose failure can pose the greatest risk—to their operations and seek to develop much closer relationships with these key suppliers than they have with less critical suppliers. Such efforts will include contracts or other agreements defining the terms of the relationship, such as performance expectations of both parties. Supplier contract structuring is part of this process; contracts should be flexible enough to enable and encourage improved performance from both parties. In some cases, there may be no contract, but the supplier relationship may still allow for rewards and other incentives to improve performance.

The academic and business literatures contain many examples of performance improvements from implementing best practices in purchasing and supply chain management. SRM is a major part of those practices and a driver of many performance improvements, particularly continuous ones. These companies also monitor and shape the capabilities and capacities of their “key suppliers.”²

Improved SRM has helped companies achieve shorter and more reliable supplier lead times, with one survey suggesting 7 to 10 percent average annual improvement in delivery responsiveness (Trent and Monczka, 1998). Sun Microsystems similarly reported using improved SRM to reduce vendor turnaround times for repair parts from about 35 to 5 days, while Rockwell Collins reported working with its suppliers to increase on-time delivery from 83.8 to 96.5 percent in three years (Pazmany, 2000; Avery, 2005). Shorter, more reliable lead times, in turn, reduce inventory requirements and increase

² Boeing identifies its “key suppliers” based upon annual spend and unique business requirements. These suppliers have a more frequent evaluation schedule (semiannual or more frequently if a program or site feels it is necessary) and are rated by all programs/sites conducting business with them (Boeing, 2007).

levels of service. For example, Cessna reported a 113 percent increase in inventory turns over six years, with dramatically higher material availability (Avery, 2003). In 2008 it reduced its supply base further, from 1,100 to 740 suppliers; achieved an on-time purchase order rate of nearly 98 percent; and improved material availability from 91 to nearly 100 percent (Avery, 2008).

Several manufacturing companies interviewed for previous RAND studies said they strategically linked their service parts and after-production support business to their production business with each supplier. They claim that suppliers typically prefer the large-volume, more stable production business to the low-volume, more variable service parts business, so they tie the service parts business together with the production business to make it more attractive. More importantly, there is competition among suppliers at the time of selection for production. After production has begun, service parts are usually sole-source. Consequently, they typically negotiate service parts relationships at the time of initiation of production for the expected useful life of their product even if this period is expected to continue after production ends.³ In addition, supplier performance on service parts contracts is part of the selection criteria for awarding future production business.

Effective SRM has also improved product quality. One analysis suggests that companies implementing SRM improvements can expect to reduce defect rates by at least 10 percent annually (Trent and Monczka, 1998). For example, Honda of America reported that it had reduced defects in parts per million from 7,000 to less than 150 in 12 years (Fitzgerald, 1995; Nelson, Mayo, and Moody, 1998).

Finally, effective SRM can help reduce product development time. One analysis suggests leading companies improving SRM can expect to reduce product development time by more than 20 percent (Trent and Monczka,

³ Life of Part contracting is a part of Cessna's new product development process (Morgan, 2000).

1998). For example, General Electric reported that development time for its jet engines decreased from 60 months to 28 months (Siekman, 2002) after SRM improvements.

Research Overview

Objective

- **Help the Army improve its supplier management and development to reduce total cost and improve performance**

Key questions

- **What are best practices for Supplier Relationship Management (SRM) and supplier development?**
- **What are current Army practices for SRM?**
- **Does anything hinder the implementation of best practices where appropriate?**
- **What can be done to improve Army SRM?**
- **How would the Army know if SRM is helping?**

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In this report we identify best practices in SRM and supplier development that can reduce Army costs and improve the performance (e.g., quality, delivery schedules, flexibility, and technical competence) of contract repair, supply, and services; highlight impediments to applying these best practices within the Army; identify current Army SRM practices; and recommend ways in which the Army can continue to successfully adapt best practices and develop a strategic SRM plan.

In particular, we seek to answer the following five questions:

- What are best practices for SRM and supplier development? (Section 2)
- What are current Army practices for SRM? (Section 3)
- Does anything hinder the implementation of best practices where appropriate? (Section 4)
- What can be done to improve Army SRM? (Section 5)
- How would the Army know if SRM is helping? (Throughout)

We Used a Multi-Method Approach to Answer These Questions

- Reviewed current SRM literature to identify best practices
- Combined and analyzed administrative data from 3 LCMCs
 - Order data
 - Contract data
- Interviewed top AMC HQ and LCMC leadership including acquisition, supply, logistics, PEOs
 - 23 interviews with 29 people
 - 30 to 60 minutes each
- Analyzed AMC HQ and LCMC materials

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We used several methods to answer these questions.

First, we reviewed scholarly and applied literature on SRM to identify current best practices in the field.

Second, we compiled data on orders and contracts from each of three LCMCs: U.S. Army Aviation and Missile Command (AMCOM), U.S. Army Communications-Electronics Life Cycle Management Command (CECOM), and U.S. Army Tank-Automotive and Armaments Command (TACOM). Each LCMC is responsible for a portion of the materiel by which AMC ensures Army readiness. These are the agencies that manage the suppliers of various weapon systems and services. We analyzed data from each of the three LCMCs by spend, type of contract, number of suppliers, and number of parts.

Third, we interviewed top personnel at AMC headquarters and the LCMCs, including commanders and senior staff at each location as well as acquisition and materiel management/supply personnel, a few program executive officers, and additional personnel recommended to us during the

interviews. Our interviews occurred between March and September 2008. We sought a comprehensive picture of current SRM practices, including those directed explicitly from the top and any isolated practices. In all, we interviewed 29 individuals in 23 sessions lasting 30 to 60 minutes each. We developed a customized interview protocol covering 14 topics with open-ended questions. The topics in the protocol derived from the project research questions as well as from our investigation of best practices in SRM. Research staff with expertise in qualitative data collection guided the framing of individual questions and the analysis of the answers. The protocol was vetted with subject matter experts prior to being fielded with interviewees. (See Appendix A for further information.)

Finally, we analyzed material that we received during our interviews that related to SRM practices.

2. SRM Best Practices

<i>Outline</i>
Introduction
SRM Best Practices
SRM Stages at AMC
Critical Success Factors at AMC
Conclusions and Recommendations

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In this section we describe SRM best practices and present a model for developing world-class suppliers and a world-class supply base. We also review enterprise and industry organizational structures for facilitating SRM and summarize SRM best practices.

**"SRM is not just a set of guidelines,
but a way of thinking"**

**Richard A. Hughes
Vice President Global Purchases
Procter & Gamble**

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Source: Teague, 2008a

Among the leading practitioners of SRM best practices is Procter and Gamble (P&G), which in 2008 won the *Purchasing* magazine Medal of Professional Excellence “[f]or building close and productive relationships internally and with suppliers, and for delivering savings of \$1 billion—plus annually” (Teague, 2008a). The firm’s vice president for global purchases views “SRM [a]s not just a set of guidelines, but a way of thinking” (Teague, 2008a). It requires finely tuned practices such as spend analyses; a rigorous supplier categorization/stratification process; supplier strength, weakness, opportunity, and threat analyses (also called SWOT analyses); a global, enterprise-wide approach to supplier selection; measuring and analyzing supplier performance and helping suppliers make adjustments where necessary; regular supplier summits by region and category to share information and business needs and to review technology road maps and new ideas; helping suppliers get better prices from their own suppliers by using P&G’s scale as leverage; and constant communication. In addition to these practices, P&G, in response to supplier

requests, also developed a supplier portal on its website to provide suppliers with better access to key information on product schedules and changes in specifications.

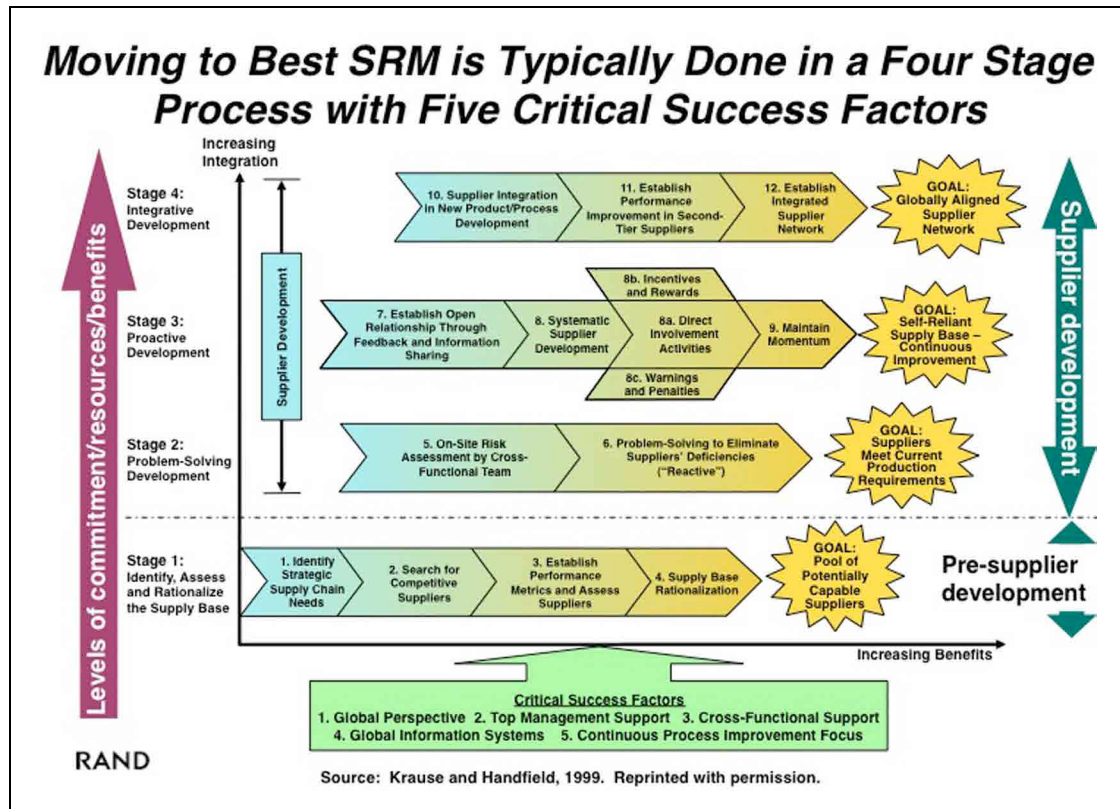
P&G recently implemented a formal supplier performance-management system that included metrics on

- competitiveness
- cost advantage
- commercial responsiveness
- service/supply assurance
- thoroughness of commercial agreements
- proper invoicing
- diversity spend
- social responsibility
- environmental sustainability
- delivery compliance
- quality of product or service
- quality assurance capability
- continuous improvement
- use of e-connectivity tools
- ideas generated
- seamless teams
- strategic alignment
- collaboration
- trust level
- communication
- ease of issue resolution (Teague, 2008b).

Note that most (though not all) of these categories and metrics are applicable in an Army setting.

More generally, The Hackett Group found that “world-class” procurement organizations—those that are in the top decile on effectiveness

measures for such variables as quality and economic return and efficiency measures for such variables as cost, cycle time, and productivity—operate with 46 percent fewer suppliers and have procurement costs that are about 20 percent lower than typical companies (“Hackett Report Finds Best Procurement Orgs See Greater ROI,” 2005). Such companies also invest more in training to provide personnel with opportunities to develop greater supplier development and management skills.



Most research on supplier management and development involves case studies such as those on P&G. Nevertheless, some broader analysis is available, including Krause and Handfield's (1999) work on developing a world-class supply base.⁴ The Krause and Handfield model is helpful because it is among the most recent and thorough models on supplier development, it is unique in being based on empirical data, and it is oft cited and at least partially understood by interviewees for this and related research.

After extensive analysis, Krause and Handfield found that an SRM process typically comprises four major stages, each requiring greater levels of commitment and resources than the preceding one and delivering a higher level of benefits to an enterprise and its suppliers over time. They define supplier development as

⁴ For more detail on this process, see Appendix B and the original source material.

a bilateral effort by both the buying and supplying organizations to jointly improve the supplier's performance and/or capabilities in one or more of the following areas: cost, quality, delivery, time-to-market, technology, environmental responsibility, managerial capability and financial viability. (Krause and Handfield, 1999, p. 7)

As organizations advance through the stages of the Supplier Development Model, the benefits increase and suppliers become increasingly integrated with the buying enterprise. Yet, achieving the benefits associated with the higher stages requires increasing amounts of commitment and resources from top management.

We summarize the various steps involved in each stage of Krause and Handfield's process for developing a world-class supply base. These are shown in the left column of the figure above. For more details on the various steps in the process, see Appendix B.

The first stage of this model is pre-supplier development. **Stage 1: Identify, Assess, and Rationalize the Supply Base** includes the first four steps:

1. *Identify strategic supply chain needs.* The buyer prioritizes supply needs and focuses initially on those that are most pressing. For example, focusing on improved supplier performance might involve cost reductions, technology road maps, or growth plans.
2. *Search for competitive suppliers.* Market research aids in identifying suppliers—both current and potential—that might be more competitive. Substeps of this process may include a focused search in a target country or region, in which buyers might host conferences or meetings or other events to meet potential suppliers and then, once a large pool of suppliers is identified, narrow options to those that can best meet specified requirements and help fulfill a strategy for a commodity.
3. *Establish performance metrics and assess suppliers.* The buyer defines measures of performance and begins the ongoing process of performance measurement in this early step. This can help in

identifying supplier problems requiring immediate attention, targeting supplier development efforts, phasing out poorly performing ones, and identifying high-performing ones for more business.

4. *Supply-base rationalization and leveraging total spending.* This step starts with a spend analysis, in which the buyer identifies all the business it has with each supplier. Steps include assigning an enterprisewide, cross-functional team to group, segment, and prioritize spending; documenting and analyzing purchases and spending by category groups or subgroups; documenting the current supply base and identifying prospective risks; and segmenting and classifying purchases by their strategic importance. Such information can help buyers reduce total costs by leveraging spend and managing risks. (For further information on supply-base rationalization and related initiatives, see Moore, Grammich, and Bickel (2007) as well as Moore et al. (2002). Within the federal government, such efforts are referred to as “strategic sourcing.” See Johnson (2005).)

After completing these steps, a buyer should have accomplished the goal of Stage 1, identifying a **pool of potentially capable suppliers**.

The other three stages in the Krause and Handfield model are classified as supplier development and are contingent upon establishing long-term, mutually beneficial relationships with suppliers.

Stage 2: Problem-Solving Development includes the following two steps (numbers 5 and 6 in the model):

5. *On-site risk assessment by cross-functional teams.* Sending one’s own team out to a supplier provides an invaluable and objective evaluation of real and potential supplier problems, including cost, quality, delivery, cycle time, product and process technology, engineering capabilities, management skills, and risks (i.e., weaknesses requiring immediate or future action). The supplier assessment serves as a free

consultation for the supplier, but one geared toward the needs of the buyer.

6. *Problem solving to eliminate suppliers' deficiencies (reactive)*. This step addresses problems identified in the on-site supplier assessment. The focus here is on resolving immediate problems that are affecting supplier performance.

After completing these two steps, the buyer will have accomplished the goal of Stage 2, having **suppliers that meet current requirements**.

Stage 3: Proactive Development consists of the following three steps (7 through 9 in the model):

7. *Establish open relationships through feedback and information sharing*. Part of joint continuous improvement, this step involves reiterating weaknesses that require future action and targeting past performance metrics that need improvement.
8. *Systematic supplier development*. By this step, enterprises have resolved major supplier problems and developed their relationship to the point that they are involved in the supplier's development. This can include direct activities, such as process mapping, *kaizen*⁵ events, inventory reductions, training, total preventative maintenance, incentives and rewards, and warnings and penalties.
9. *Maintain momentum*. Here, the buyer creates opportunities with suppliers to continue established development activities, such as ongoing supplier councils.

The goal of Stage 3 is creating a **self-reliant supply base** that practices **continuous improvement**.

⁵ Womack and Jones (1996, pp. 307–308) define *kaizen* as “continuous, incremental improvement of an activity to create more value with less *muda*.” They define *muda* as “any activity that consumes resources but creates no value.”

Stage 4: Integrative Development consists of the following three steps (10 through 12 in the model):

10. *Integrate suppliers in new product/process development.* In this step, the buyer invites key suppliers to be partners in its own planning and development processes.
11. *Establish performance improvement among second-tier suppliers.* After mapping the end-to-end supply chain, the buyer extends the SRM process to second-tier suppliers to create an extended enterprise.
12. *Establish an integrated supplier network.* The culminating step is the creation of a fully integrated supply system with long-term relationships that extend up the supply chain to higher-tier suppliers.

The goal of Stage 4 is to bring about a **globally aligned supplier network**.

Krause and Handfield also identified five critical success factors to implementing their supplier development model:

- *Global perspective:* A global perspective is particularly important in Stage 4: Integrative Development. Competition and the global, interconnected economy are driving enterprises to think and act more globally. This includes growing organically or through mergers and acquisitions to meet global demand, sourcing globally to deliver the best value to customers as well as meet domestic content laws and aid local product acceptance, and establishing, where appropriate, local production facilities. Some enterprises are requiring suppliers to supply the enterprise's global facilities equally well and measure suppliers' performance globally.
- *Top management support:* The support of top management for both buyers and suppliers is important to gain resources, schedules, and formal agreements for joint supplier development efforts.
- *Cross-functional support:* As mentioned in the discussion of step 5, involvement of different functional personnel from the buying enterprise, including those from purchasing, quality assurance,

engineering, materials management, manufacturing, and other functions, is required to perform supplier-risk and other assessments necessary for proactive supplier development.

- *Global information systems:* As enterprises and their supply chains become more globally dispersed, global information systems are required to effectively communicate within and among them. Such systems can communicate forecasts, production requirements, design changes, and forthcoming solicitations. They can also facilitate new product development activities and supplier performance measurement and feedback. Finally, they can serve as a repository of enterprise knowledge on supply markets (e.g., capacities, prices, trends), suppliers (e.g., availability, quality, design capabilities), and local laws, regulations, customs, and competitors.
- *Continuous process improvement focus:* A culture of continuous improvement, initially at the buying enterprise and eventually at supplier enterprises, is critical to the success of the supplier development model and SRM in general. Several techniques (e.g., statistical process control, lean approaches, *kaizen* events, Six Sigma, total quality management (TQM) for continuous improvement, *kaikaku*,⁶ process reengineering for discontinuous improvement) can help enterprises improve the quality of their products and processes. These techniques help enterprises establish rigorous processes for successfully analyzing problems, identifying root causes, developing preventative actions, and monitoring process outcomes. They also provide a means for communicating within enterprises across locations, functions, and management levels, as well as among supply

⁶ Womack and Jones (1996, p. 307) define *kaikaku* as “radical improvement of an activity to eliminate *muda*.”

chain partners, on the need for change and ways to effectively implement improvements.

Following each of these four stages—identifying, assessing, and rationalizing the supply base; problem-solving development; proactive development; and integrative development—can help enterprises to see SRM not just as a set of guidelines, but as a way of thinking as they continually improve their supply chains.

Companies Starting These SRM Stages Use Several Criteria to Determine Which Suppliers to Measure

Based upon	Percentage
Portion of total annual spend	72.4
Type or nature of the product	65.8
Nature of the supplier relationship	52.6
Size of the supplier	10.5
Geography of supplier	9.2

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Source: Aberdeen Group, 2002 as adapted in Matthews and Stanley, 2008

Any large organization that seeks to develop its supply base must focus its SRM strategies on some suppliers more than others, at least initially. As with all other aspects of SRM, decisions about which suppliers to develop first should be strategic. The figure above shows how companies choose which suppliers on which to focus performance measurement efforts (Matthews and Stanley, 2008). Most commonly, they use the amount of dollars spent with a supplier, the type of product made by the supplier, and the nature of the existing relationship with the supplier to determine whether they should work on developing that supplier. More than half of the companies in Matthews and Stanley's study used one or more of these criteria in determining how to focus their SRM efforts.

Initially focusing SRM efforts on a smaller set of suppliers can help target limited resources while maximizing the return on investments. The findings presented in the chart suggest that AMC and the LCMCs should rank their suppliers by total spend, relevance of the product to supporting the warfighter,

and strength of their existing relationships. Federal policy to boost spending with small businesses may also lead Army personnel to focus on them.

Within These Stages, a Key Principle of SRM Is Joint Continuous Improvement

Continuous improvement occurs with:

- Imbedding in the culture of the relationship
- Specific plans and goals for improvement
 - Defined projects
- Regular performance measurement
 - Centralized around supplier scorecards that measure performance
 - Targets improvement efforts
 - Affects future contracts

***As one exemplar firm says,
“There is no best, only better...”¹***

RAND

¹Source: Cooke, 2008

A key principle underlying the Supplier Development Model is continuous improvement. Pre-supplier development activities in Stage 1 lay the foundation for joint continuous improvement efforts with suppliers in all aspects of the buyer-supplier relationship. Enterprises develop specific plans and goals for improvement in the supply base as a whole as well as with key suppliers, and they define and execute joint projects as the relationship grows.

Companies embracing best practices regularly measure and shape their suppliers' performance. They establish a supplier performance measurement system, often through supplier scorecards, which regularly measure supplier performance on key dimensions linked to their strategic goals.

Suppliers with top ratings or performance win preference for additional business and less oversight. Suppliers falling below specified standards may be required to develop “get-well” plans, with regular monitoring of their progress.

Best SRM Practices Include Scorecards as an Essential Tool in Supplier Management

Problems with supplier performance cost customers money, time, and productivity

 **Supplier scorecards provide a way to measure performance accurately and consistently**

 **Suppliers' scores are then compared with:**

- **Contracts to identify rewards and consequences**
- **Each other to identify areas for future improvement or awards**

"Poor supplier performance accounts for billions of dollars in product recalls and even consumer deaths." (Kay, 2005)

RAND

Supplier performance problems can lead to increased costs, delayed delivery, tarnished reputations, and lost productivity in all industries. In one extreme case, Ford Motor Co. lost \$3 billion after it recalled more than 13 million defective Bridgestone/Firestone tires, tires that may have resulted in 250 deaths (Kay, 2005).⁷ Similarly, supplier performance problems can adversely affect life-saving equipment and essential services that contractors provide to the Army.

Supplier scorecards are an essential tool for companies that employ SRM to improve their suppliers' performance (Carter and Choi, 2008; International

⁷ This incident also underscores the importance of communication throughout the supply chain and across an enterprise. Some divisions within Ford knew about these defects long before others. Proper communication could have alerted the entire corporation to the magnitude of the defects—and perhaps have mitigated them. (Greenwald, 2001; Ackman, 2001.)

Procurement Leadership Forum, 2007; Leenders et al., 2002). Scorecards enable companies to compile information on supplier performance in a systematic way that facilitates assessment. In the short term, buying enterprises use performance scores to reward exceptional performance and take action when performance falls below contract specifications. In the long term, buying enterprises compare suppliers' scores to identify improvement. They also compare individual suppliers' performance with that of other suppliers to identify those that have the highest performance, deserve increased business, or need to improve. Scorecards are instrumental for supplier improvement and development as well as the supply-base rationalization that is fundamental to SRM (Krause and Handfield, 1999).

Scorecards Supplement Best SRM Practices Through All Stages of Development

- **Stage 1. Identify, Assess, and Rationalize Supply Base**
 - Scorecards enable comparisons across suppliers for:
 - Supplier selection
 - Supply base rationalization
 - Supplier performance awards
- **Stage 2. Problem-Solving Development**
 - Scorecards identify when suppliers meet current needs
 - Ongoing use of scorecards continues supplier selection
- **Stage 3. Proactive Development**
 - Ongoing use of scorecards focuses attention on continuous improvement
- **Stage 4. Interactive Development**
 - Scorecards provide the format for establishing performance improvement with second-tier suppliers

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A supplier scorecard can or should be integrated into all stages of SRM (Barrett, 2008). The slide above illustrates how this occurs at each of the four stages identified earlier.

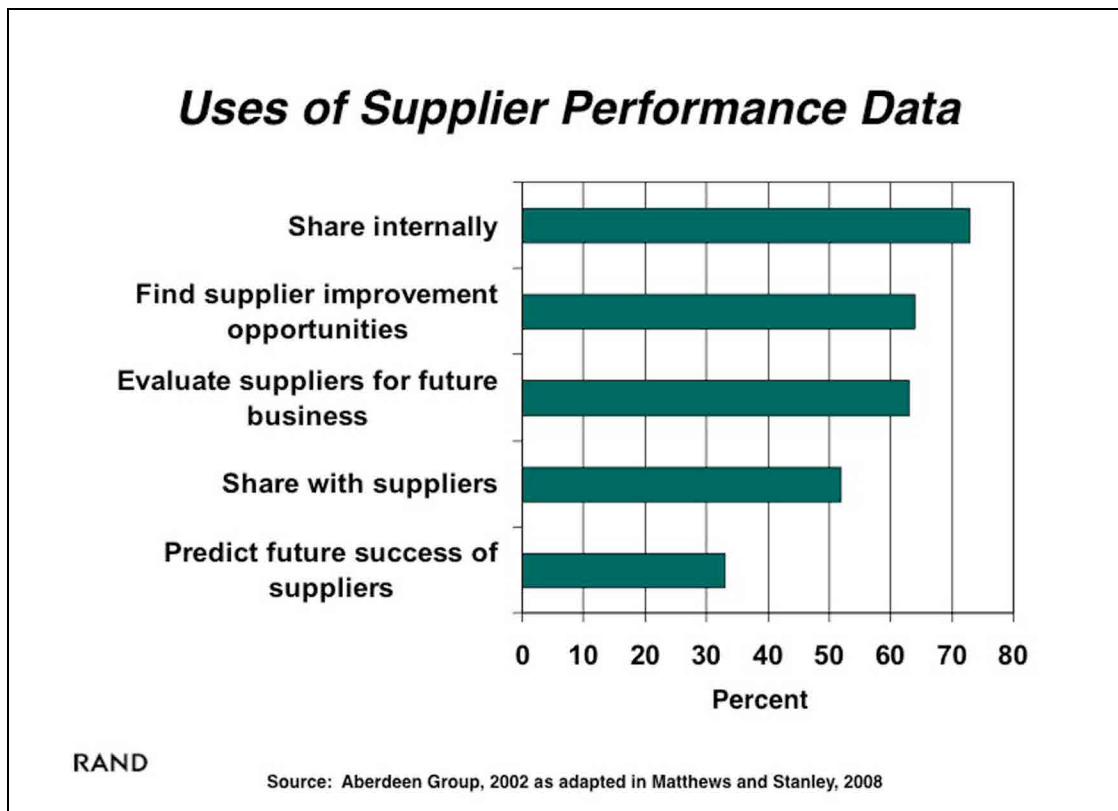
In the first stage, scorecards help buying enterprises streamline their supply base to focus on high-performing suppliers. With regularly updated information, scorecards enable buying enterprises to review suppliers' performance for contract selection, to winnow out poor performers in future selections, and to reward high-performing suppliers, not only with continual selections and additional business but also with special industry honors.

In the second stage, buying enterprises begin to work with high-performing, underperforming, and emerging suppliers to begin improving their performance. Scorecards continue to identify which suppliers meet or surpass current needs, in terms of both contractual requirements and other measures of performance, such as continuous improvement or customer responsiveness. By

the end of Stage 2, the scorecards have helped buying enterprises to solidify the primary members of their supply base.

In the third stage, scorecards enable buying enterprises to measure and compare suppliers in terms of their goals and progress for continuous improvement. This, in turn, enables the relationship with the supplier and the supplier's performance to develop further. By Stage 3, buying enterprises may also use scorecards to measure a supplier's technology development.

In the fourth stage, buying enterprises expand the use of scorecards to include second-tier suppliers, measuring and assessing the performance of the companies that supply the buying enterprise's suppliers.



Companies use supplier scorecards in a wide variety of ways (Matthews and Stanley, 2008). In one survey, nearly three in four reported using them for internal assessment of their suppliers. About two in three reported using scorecards to identify areas where suppliers needed to improve; a similar proportion reported using them to help with future source selection. Just over half of companies reported that they shared the scorecards with the suppliers, and about one-third used the information to predict future supplier success.

Scorecards Typically Measure at Least Three Areas of Performance

- **Quality** – The proportion of an order that is not defective
- **Delivery** – The proportion of an order that arrives on time
- **Cost** – Acquisition and sustainment costs, relative to other suppliers
- **Other measures**
 - Continuous improvement
 - Social responsibility (e.g., use of small, diverse businesses)
 - Environmental responsibility
 - Customer satisfaction
 - Customer service
 - Management capability

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Because supplier scorecards are integrated into so many areas of SRM, they need to serve a number of functions. Ideally, they assess current performance and enable comparisons over time, draw attention to both weak and strong performance, point to areas where further supplier development is needed, and identify suppliers that offer the best investment for future contracts (Trent and Monczka, 1998). The key to scorecards' utility is their ability to measure relevant areas of supplier performance in easily understood ways. The more common areas of performance that buying enterprises seek to measure and improve are *quality*, *delivery*, and *cost* (Carter and Choi, 2008; Matthews and Stanley, 2008; International Procurement Leadership Forum, 2007; Kay, 2005; and Krause and Handfield, 1999).

Enterprises often measure the quality of materials by the number of parts per million (PPM) ordered that are defective and the quality of services by the proportion provided that meets the customer's satisfaction (e.g., the percentage of rooms cleaned thoroughly or the number of days that all rooms are cleaned

thoroughly) (Carter and Choi, 2008; Matthews and Stanley, 2008; Baldwin, Ausink, and Nicosia, 2005; Baldwin and Hunter, 2004; Carbone, 2005b).

Enterprises may easily measure delivery performance by measuring the proportion of orders that are shipped or delivered on time (Carter and Choi, 2008; Matthews and Stanley, 2008). For services, enterprises may measure delivery by the proportion of services delivered on time or the proportion of days that a service is delivered on time.

Enterprises may measure cost by total cost per item or service, including acquisition, support, and management (Matthews and Stanley, 2008; Kay, 2005; Burt, Dobler, and Starling, 2003; Leenders et al., 2002; Krause and Handfield, 1999). Some companies using SRM have successfully negotiated support costs as part of suppliers' initial bids, thereby avoiding sole-source relationships for post-acquisition support and reducing overall costs (Chenoweth, Arkes, and Moore, 2010).

Many buying enterprises include other aspects of performance in their supplier scorecards. These can include critical success factors of SRM, such as continuous improvement or management capability, as well as such factors as social or environmental responsibility that may be part of a customer's mission (Matthews and Stanley, 2008; Keebler et al., 1999; Krause and Handfield, 1999). The Army may wish to base scorecard measures on innovation in supporting the warfighter and meeting federal requirements for the utilization of small and diverse businesses.

Measurement Is the Key Component of Scorecards

- **Define with**
 - Quantitative measures whenever possible
 - Straightforward, objective measures that ease calculation and understanding
 - Refined measures and thresholds as suppliers develop
- **Collect Data**
 - By customer and by supplier
 - Verify for accuracy
- **Compare**
 - Across suppliers – objective measures are most useful
 - Across data sources and over time – verifies accuracy
- **Frequency of**
 - Measuring performance – e.g., quarterly, monthly
 - Giving feedback to suppliers – e.g., with a rotating average or with each measurement

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Exactly how scorecards measure supplier performance can be as important as what they measure (Burt, Dobler, and Starling, 2003; Leenders et al., 2002; Monczka, Trent, and Handfield, 2002). Generally, the measures need to be as objective as possible, simple, and reproducible.

Buying enterprises and their suppliers tend to prefer quantitative measures to qualitative ones, viewing them as more objective and precise (Monczka, Trent, and Handfield, 2002; Keebler et al., 1999). Describing a supplier's delivery as 96 percent on time, for example, communicates much more than defining it as "very good." Simpler measures tend to work better than complex ones because they are more easily understood and more easily calculated without error. Simple does not mean gross; the percentage of parts that are not defective is precise without being complex. Finally, measures are likely to be refined as suppliers develop (Burt, Dobler, and Starling, 2003; Monczka, Trent, and Handfield, 2002). For example, measures may shift from the

percent of shipments that are on time to the percent of deliveries that are on time as suppliers develop their capabilities.

Measures are only as good as the data used to create them (Carter and Choi, 2008; Monczka, Trent, and Handfield, 2002). Ideally, data are collected—or at least approved—by both the customer and the supplier, ensuring that the resulting scores are accepted by both parties. Data collected by the buying enterprise have two important advantages: the elimination of a conflict of interest in reporting the information and consistency across many suppliers. Regardless of the source, checking the data for accuracy is essential, and reporting those checks demonstrates transparency and trustworthiness in the process (Raedels, 2000).

Once collected and defined, performance measures need to be compared not only with contractual commitments, but also over time and across suppliers. Comparisons of the same supplier over time show progress toward meeting performance goals or improvement beyond current goals, while comparisons across suppliers make clear who the consistently high and low performers are. Comparisons across suppliers may also be used for awarding annual honors or prizes as well as selecting future contractors and supplier development efforts.

Calculating scores more frequently improves their accuracy (Carter and Choi, 2008; Monczka, Trent, and Handfield, 2002). Automating data systems for ongoing collection and calculation of measures also can save labor time (Hannon, 2005). Some companies assess the measures monthly or quarterly and share a rotating average with their suppliers during regular quarterly meetings (Carter and Choi, 2008; Kay, 2005).⁸

⁸ Data envelopment analysis (Cooper, Seiford, and Zhu, 2004) offers one advanced and effective means of providing comparisons across operations, facilities, and suppliers. It has been used by the U.S. Postal Service, FedEx, UPS, and manufacturing organizations to provide metrics for application to SRM.

Boeing Measures Its Suppliers on 3 Areas With 5 Performance Thresholds				
	Threshold	Quality	Delivery	GPA *
Gold	Exceptional Clearly exceeding expectations	100% acceptance for 12-month period	100% delivered on time for 12-month period	4.80–5.0 and no Yellow or Red ratings
Silver	Very Good Meeting or exceeding expectations	99.80% acceptance for 12-month period	98.00% on time for 12-month period	3.80–4.79 and no Yellow or Red ratings
Bronze	Satisfactory Meeting expectations	99.55% acceptance for 12-month period	96.00% on time for 12-month period	2.80–3.79 and no Yellow or Red ratings
Yellow	Needs Improvement Not meeting expectations	98.00% acceptance for 12-month period	90.00% on time for 12-month period	1.00–2.79
Red	Unsatisfactory Clearly failing to meet expectations	< 98.00% acceptance for 12-month period	< 90.00% on time for 12-month period	Less than 1.00
RAND *General Performance Assessment of 4 areas: management, schedule, technical, cost and quality Source: Boeing Company. 2007				

In the figure above and in the next few pages, we provide examples of supplier scorecards, some elements of which the Army may wish to adapt for its own use. This figure is an example of the scorecard Boeing uses for its suppliers (Boeing, 2007). Boeing measures three main areas of performance: quality, delivery, and an amalgamation of several factors called “General Performance Assessment,” or GPA. Boeing defines quality as the percentage of all orders that are acceptable over a rotating 12-month period. It defines its delivery metric as the percentage of all orders that are delivered on time (i.e., according to the contract) over a rotating 12-month period. Its GPA averages the scores given for a supplier’s management capabilities, schedule, technical capabilities, cost, and quality. The scores that Boeing gives for each of these factors follow clearly defined guidelines.

For each of the three main areas of performance in the scorecard, Boeing has five thresholds, or grades, of performance. The importance of quality to Boeing is evident in the very narrow range of product quality that is

satisfactory. Anything less than a 99.55 percent acceptance rate is not satisfactory to Boeing. Delivery of shipments has to average at least 96.00 percent on time to be even minimally satisfactory. GPA has to be at least 2.8 on a five-point scale to be satisfactory.

***Cessna's Supplier Scorecard:
Supplier Tracking and Rating System (STARS)***

Rating	Category	Quality/ reliability	Schedule	Cost
1	Outstanding	Defect rate < 100 PPM Field performance level of 100%	100% of receipts on time	Annual Productivity Plus or market competitive
2	Superior	Defect rate < 1,000 PPM Field performance level of at least 98%	At least 99% of receipts on time	Annual Productivity or market competitive
3	Acceptable	Defect rate < 5,000 PPM Field performance level of at least 95%	At least 98% of receipts on time	Firm Fixed Pricing or market competitive
4	Marginal	Defect rate < 7,500 PPM Field performance level of at least 92%	At least 95% of receipts on time	Escalatory
5	Unacceptable	Defect rate > 7,500 PPM Field performance level less than 92%	Fewer than 95% of receipts on time	Escalatory

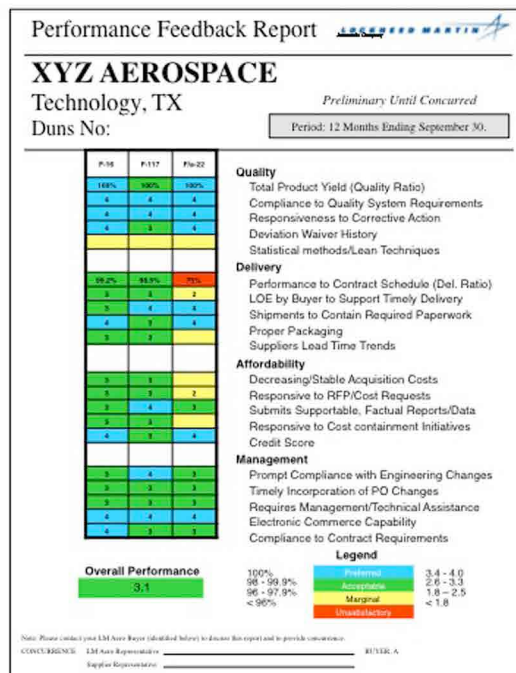
RAND

Source: Cessna, 2007

Other companies also measure quality, delivery, and cost thresholds, tailoring these metrics to areas of performance that are particularly important to them. The figure above shows Cessna's scorecard, which covers quality/reliability, schedule, and cost (Cessna, 2007, p. 11). Like Boeing, Cessna has five thresholds in its ratings, ranging from unacceptable to outstanding.

Cessna measures quality by both performance and defect rates, considering "outstanding" to be fewer than 100 defective parts per million and a 100 percent level of field performance—that is, reliability of a supplier's products once in the field. Cessna measures schedule or delivery as the percentage of deliverables received on time. Like Boeing, Cessna uses delivery rather than shipment time as the metric. To measure cost, Cessna uses a combination of the supplier's own productivity along with its competitiveness in the marketplace (i.e., an industry cost comparison).

Example: Lockheed Martin Supplier Scorecard



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Used with permission of Lockheed Martin

Lockheed Martin provides a third example of a relevant industry scorecard. Its scorecard covers supplier performance regarding quality, delivery, affordability (i.e., cost), and management. Each of these areas includes the scores from five different measures.

The measure of quality includes individual measures of total product yield (i.e., nondefective rates), compliance with Lockheed Martin's system requirements, supplier responsiveness to taking corrective action, history of waivers, and lean techniques. The measure of delivery includes the percentage of orders delivered on time, level of effort (LOE in the figure) by the buyer to support timely delivery, inclusion of required paperwork with shipments, proper packaging, and trends in lead time. Affordability includes measures of cost that are declining or stable, responsiveness to cost requests, submission of accurate supporting data on cost, responsiveness to cost containment initiatives, and the supplier's credit score. The measure of management includes prompt compliance with changes in engineering, incorporation of purchase order (PO)

changes, whether the supplier needs assistance, e-business capability, and compliance with the requirements of the contract. The supplier helps collect and analyze data.

The averaged scores for quality, delivery, affordability, and management are combined to create an overall score. Both the overall score and the individual scores are compared against a four-threshold scale that denotes performance as preferred (blue), acceptable (green), marginal (yellow), or unsatisfactory (red).

The Lockheed Martin scorecard has evolved over time to include more refined measures. Several aspects of continuous improvement efforts, including lean techniques for quality, trends in lead time for delivery, and cost containment initiatives for affordability, are folded into the four areas of measurement.

For AMC, Data Are Available to Develop a Supplier Scorecard

	<i>Quality</i>		<i>Delivery</i>	<i>Cost</i>
Data	Electronic Deficiency Reporting System + Active Contract File	Past Performance Information Retrieval System	Active Contract File	National Stock Number Master Data Record
Fields	• Deficiency type • Part number • Supplier ID • Hours used before failure • Total number of same parts	• Technical quality • Product performance	• Percent shipped in days specified by contract	• Cost per part • Supplier ID
Measure	Initial failure rate Average hours of use before failure	Unsatisfactory (1) to Exceptional (5)	Actual days to shipment vs. contractual days to shipment	Dollars per part, vs. industry average/PPI

RAND

Measures are best constructed as trends over time.

DoD and the Army have made available the necessary data to construct an AMC supplier scorecard similar to those presented earlier for leading private enterprises. The figure above presents some ways to construct a scorecard without developing new data sources. For illustrative purposes, we concentrate here on the three most common supplier performance measures: quality, delivery, and cost. These are not the only measures of performance that could be constructed.

The most common source of information on federal contractors' past performance is the Past Performance Information Retrieval System (PPIRS).⁹

⁹ For a blank PPIRS form, see Appendix C. Federal contracting regulations require the use of past performance in source selection, and the most common source of information on federal contractors' past performance is PPIRS. PPIRS is a federal data system expressly for the purpose of making future contract selections. Access to the performance data in PPIRS is limited to federal employees who are working on source selections, and contractors themselves are allowed to view reports on their own performance only. Data are the result of

These data rate 13 areas of performance, including measures of quality, delivery, and cost (PPIRS, undated). Unfortunately, the data are subjective, with five possible values: exceptional, very good, satisfactory, marginal, and unsatisfactory. Suppliers may also review evaluations of their performance and can appeal them for revision if they disagree (PPIRS, undated; U.S. Office of Management and Budget, 2000). For this reason, more objective data sets would be preferable where or when available.

Two sources of data are available on quality of material parts. The Electronic Deficiency Reporting System (EDRS) is the Army's repository for reports on product deficiencies (U.S. Army, 2005). It contains extensive information on product failures, including the nature of the failure and the number of hours that the product operated before failing. It can provide straightforward and objective measures of quality, such as the percentage of a supplier's parts that fail before ever operating and the average number of operating hours for parts that later fail. The Active Contract File, with data on the total number of parts ordered, can also be used to calculate the percentage of parts that fail. For quality of services, PPIRS data offer subjective five-point scale measures of technical quality and past performance.

subjective evaluations (i.e., exceptional, very good, satisfactory, marginal, unsatisfactory) of up to 13 possible performance areas. The performance areas are technical (quality of product), product performance, systems engineering, software engineering, logistics, support/sustainment, product assurance, other technical performance, schedule, cost control, management, management responsiveness, subcontract management, and program/other management.

PPIRS includes reports of performance from five federal data systems: the Contractor Performance System, the Past Performance Data Base, the Architect-Engineer Contract Administration Support Data Base, the Construction Contractor Appraisal Support System, and the Contractor Performance Assessment Reporting System. Information from all of these data systems makes PPIRS the most common source of information. Agencies may also track performance individually. PPIRS includes performance reports only on large dollar-value contracts, including any contract totaling more than \$5 million, any Services and Information Technology contract over \$1 million, any Ship Repair and Overhaul contract over \$500,000, and any Fuels and Healthcare contract over \$100,000.

The Military Standard Contract Administration Procedure (MILSCAP) master file, containing award data for Program Request Order Numbers (PRONs), may provide usable information on delivery performance, including the number of actual and contract-specified days for an item to ship. This may yield the percentage of orders from a supplier that is shipped on time. For example, a large number of shipments requiring more than the contract-specified number of days for delivery can indicate items for which AMC may wish to undertake supplier development efforts. Analysis of such data was beyond the scope of this research.

Finally, the National Stock Number Master Data Record offers cost data. This file includes information on the cost of items, which can yield measures on cost per part and comparisons to industry averages in the Producer Price Index for similar parts.

For all of these measures, performance assessments would be most reliable when compared over time. Although we have made suggestions for comparison groups, the most reliable comparison group is the same supplier's performance in preceding months and years, i.e., whether performance improves or declines. Quality and delivery measures are simply the difference in defect rates and on-time shipment rates from the rates of previous years. For the cost measure, the difference in costs between rates should be divided by an index of inflation to control for inflation over time.

<i>Converting These Data into a Scorecard ...</i>				
	<i>Threshold</i>	<i>Quality</i>	<i>Delivery</i>	<i>Cost</i>
Gold	Exceptional Clearly exceeding expectations	100% initially operable, 12-month period	100% shipped on time for 12-month period	Cost per part is XX% less than industry avg
Silver	Very Good Meeting or exceeding expectations	XX% initially operable, 12-month period	XX% shipped on time for 12-month period	Cost per part is XX% less than industry avg
Bronze	Satisfactory Meeting expectations	XX% initially operable, 12-month period	XX% shipped on time for 12-month period	Cost per part = industry avg cost per part
Yellow	Needs Improvement Not meeting expectations	XX% initially operable, 12-month period	XX% shipped on time for 12-month period	Cost per part is XX% more than industry avg
Red	Unsatisfactory Clearly failing to meet expectations	XX% initially operable, 12-month period	XX% shipped on time for 12-month period	Cost per part is XX% more than industry avg
<i>Thresholds would be derived from current performance levels and AMC goals</i>				
RAND				

The figure above shows one way to convert currently available AMC data into a scorecard. Here, we use Boeing's supplier scorecard as an initial model, with measures derived from DoD and Army data sources. For quality of material items, the basic measure would be the percentage of the product over a 12-month period that is operable or not defective, according to the EDRS. For quality of services, the basic measure (not shown) would be the percentage exceeding a specified threshold rating in PPIRS. For delivery, the scorecard shows the proportion of orders over a 12-month period shipped within the days allotted by the contract. For cost, the scorecard shows the ratio of the cost the enterprise incurs from a particular supplier (i.e., price) to the average industry cost for similar items.

The thresholds along the left side span five categories of performance (similar to the PPIRS categories). Thresholds for each level of performance would reflect current levels of performance and AMC goals for improved performance. That is, they would challenge suppliers to improve.

As suppliers develop, thresholds can be raised, and the areas of performance that are measured can expand. Other areas of performance might include management capability, responsiveness to AMC needs, flexibility, development of suppliers' suppliers, and contribution or innovation to supporting the warfighter. Measurement in many of these areas is necessarily subjective and therefore may be more productive to implement after relationships with suppliers have developed.

Once Developed, Scorecards Must Be Combined with Supplier Development

- **Scorecards are one part of a broader system of managing suppliers**
- **Scorecards provide essential information for managing the supply base and developing suppliers**
 - **Regular meetings with suppliers use scorecards to address:**
 - **Suppliers' strong and weak areas**
 - **How individual suppliers compare to suppliers on average**
- **Scorecards provide essential information for rewards and incentives**
 - **Use of certain types of contracts increases leverage by introducing incentives**

• Cost-plus-incentive-fee	Cost-plus-award-fee
• Fixed-price-incentive-fee	Fixed-price-award-fee
 - **High performers are more likely to obtain future contracts**
 - **Annual prizes and honors for suppliers with high performance**

RAND

Scorecards are only summary presentations of information for a specific period. To be sure, the information that they convey is essential for effective management of suppliers. Nevertheless, scorecards by themselves do not create a high-performing supply base. Rather, they are one part of a broader management system that develops suppliers (Day et al., 2006; Hughes, 2005; Krause and Handfield, 1999).

Scorecards create an accurate platform for discussing performance with suppliers and setting performance goals. For example, in the regular meetings that AMC and the LCMCs hold with the Army's top suppliers, scorecards can illuminate the strong and the weak areas of a supplier's performance, how the supplier compares with other suppliers, and where AMC and LCMC command staff need to work with suppliers to improve their performance.

Crucial to supplier development is the use of rewards and other incentives to improve supplier performance (Carter and Choi, 2008; Kay, 2005; Leenders

et al., 2002). Scorecards help indicate which suppliers merit rewards—and which need “get-well” actions.

SRM Exemplar Firms

- **BF Goodrich**
- **Boeing**
- **Caterpillar**
- **Cessna**
- **Eaton**
- **Honda of America**
- **Toyota**
- **Sun Microsystems**

RAND

Several firms, including those listed in the figure above, incorporate other exemplary practices in purchasing and supply management, and SRM particularly. These companies seek to manage their total business with each supplier. That is, they consolidate their contracts and relationship with each supplier or each supplier's business units or locations into one or very few contracts and link future business to supplier performance on all contracts and relationships.

Several manufacturing companies interviewed for previous RAND studies said they strategically linked their service parts and after-production support business to their production business with each supplier. They claim that suppliers typically prefer the large-volume, more stable production business to the low-volume, more variable service parts business, so they tie the service parts business with the production business to make it more attractive. More importantly, there is competition among suppliers at the time of selection for production. After production has begun, service parts are usually sole-source.

Consequently, they typically negotiate service parts relationships at the time of initiation of production for the expected useful life of their product, even if this period is expected to continue after production ends. In addition, supplier performance on service parts contracts is part of the selection criteria for awarding future production business. These companies also monitor and shape the capabilities and capacities of their “key suppliers.”¹⁰

Best-practice companies also try to balance competition, supplier dependence, and risks. They want to form close relationships with their key suppliers, but they also want to ensure that those suppliers continue to improve. Thus, they very carefully manage long-term competition so that it provides incentives to continually improve while not undermining the building of trust and benefits, such as communication, cooperation, integration, and joint improvement initiatives, for longer-term relationships. For example, while Toyota uses one supplier per part for each model, it typically has more than one supplier across models, varying total business with each supplier based on performance. When a rare crisis occurs, Toyota works closely with suppliers to get through it (Liker, 2004). Toyota continually challenges its suppliers to improve. Its supplier development includes a series of aggressive targets and challenges to meet those targets (Liker, 2004).¹¹

Similarly, in 2004, Cessna developed its Supplier Value Improvement and Supplier Development processes to manage performance, develop capability,

¹⁰ Boeing identifies its “key suppliers” based on annual spend and unique business requirements. These suppliers have a more frequent evaluation schedule (semiannual or more frequently if a program or site feels it is necessary) and are rated by all programs/sites conducting business with the company (Boeing, 2007).

¹¹ Honda offers another example of helping suppliers get through crises. It helped Northwest Tool & Die exit bankruptcy by teaching it how to design and manufacture more efficiently and by steering millions of dollars of new business to it. This also helped Northwest reduce its prices to within 15 percent of its low-cost Asian competitors (Muller, 2007). Similarly, when an earthquake hit Japanese piston ring maker Riken Corp and halted production, Toyota dispatched more than 200 engineers to help Riken resume production (Ohnsman, 2007).

and build value-adding relationships based on mutual trust. Cessna's goal is to move from a traditional price approach to acquisition decisions to total cost of ownership and, ultimately, to total value of the acquisition (Cessna, 2007).

For products that need service parts, leading manufacturers require that SRM personnel in their production and service divisions work toward common goals. One company told us that whether production or service SRM personnel work to resolve an issue with a supplier depends on the specific issue.

Many companies known for their SRM involve key suppliers early in the product design process—a practice called “early supplier involvement.” Such early involvement is critical given that 90 percent of the cost of new products, and much of the challenge in ensuring quality, is in the design stage (Nelson, Moody, and Stegner, 2005). The design stage is also the best time to manage supply-chain risks and balance needs for innovation and reductions in total costs. It is also an ideal time to reduce complexity and costs through parts standardization and reuse across products. Companies that involve suppliers early want to leverage their suppliers' design capabilities, knowledge of manufacturability, and innovation. Honda will “invite” some suppliers to locate guest designers in its facilities and work side by side with its resident engineers, designers, and technologists in the very early stages of a new project (Laseter, 1998).

Best SRM practices include hosting annual high-level meetings with key suppliers, often called supplier conferences or supplier councils. These meetings demonstrate mutual commitment to the relationship, promote two-way dialogue on expectations and ways to improve, facilitate the sharing of future plans and technology road maps, highlight planning and improvement efforts, and are a forum to present supplier awards.

Leading companies recruit top engineering, manufacturing, and procurement personnel for their SRM needs. Representatives from one company told us that such positions are highly sought because of the importance that the company places on SRM. For these positions, the firm selects personnel with good “soft” skills, such as communication and problem

solving, as well as knowledge of internal processes and data systems, then trains them on the technical aspects of SRM. Nelson, Moody, and Stegner (2005) claim that investments in supplier development and supply-base management yield huge payoffs. They report that at Deere and Delphi, a \$100,000 investment in one supplier development engineer often yields a threefold to tenfold return in benefits, with top performers realizing an even greater yield.

(For more on SRM organizational structure, see Appendix D.)

Clearly, many long-term suppliers have their own effective SRM programs that AMC may wish to leverage in creating and measuring the performance of new programs. We turn next to the development of SRM stages at AMC.

3. SRM Stages at AMC

<i>Outline</i>
Introduction
SRM Best Practices
SRM Stages at AMC
Critical Success Factors at AMC
Conclusions and Recommendations

RAND

In this section we summarize what we learned from our interviews about AMC HQ's and the LCMC's supplier management efforts and how they compare to Krause and Handfield's Supplier Development Model.

Some Army Policies Support the First Two Stages of SRM Implementation

<i>SRM Stages</i>	<i>Policies</i>
I. Identify, assess, and rationalize the supply base	<i>Army Source Selection Guide</i> • Identifies market research as 1st step in acquisition plan • Details source selection plans • Requires past performance as an evaluation criterion <i>AMC Partnering for Success (optional)</i> • Use of past performance and ongoing performance review • Senior management commitment • Measuring and celebrating success
II. Problem-solving development	<i>AMC Partnering for Success (optional)</i> • Building relationships and joint problem solving • Continuous communication with suppliers
III. Proactive development	None found
IV. Integrative development	None found

RAND

We began our research by reviewing Army policy related to SRM. We found that AMC already has policies that support SRM's beginning stages. The Army's *Source Selection Guide* (Assistant Secretary of the Army, 2001) details several steps that mirror the ideal SRM approach to selecting a supplier. The *Source Selection Guide* is required policy; it describes the standard that all AMC personnel are to follow in any acquisition. Theoretically, Army personnel should already be following some SRM procedures.

The first step that the *Source Selection Guide* identifies for any acquisition plan is market research. The guide lays out specific sources of information on companies but does not explicitly suggest site visits. It also provides "general sources of information from the market place, government sources, and the internet," knowledgeable individuals, government databases, commercial databases, formal requests for information published in trade publications, pre-solicitation meetings, and supplier literature. It presents detailed steps for selecting a supplier, including the use of measurable criteria for evaluating

competing proposals. Finally, it notes that all selections must use suppliers' past performance as part of the selection criteria, unless the acquisition cost is expected to total less than the simplified acquisition threshold.¹² All of these practices are consistent with Stage 1 industry best practices for SRM, but they do not cover all aspects of Stage 1.

AMC has also published *Partnering for Success: A Blueprint for Promoting Government-Industry Communication and Teamwork* (1998). Although it is an optional part of the acquisition process, this guide is more closely linked to SRM principles. It encourages building collaborative relationships that benefit both the Army and suppliers. *Partnering for Success* also advises the use of past performance in selection decisions and goes beyond this to incorporate the advisability of ongoing review of supplier performance once a contract is under way. In addition, it emphasizes the importance of the commitment of senior management to partnering with suppliers, without whom supplier management has no teeth. Both of these tools are elements of Stage 1 industry best practices for SRM. With regard to Stage 2, *Partnering for Success* provides directions on how to develop stronger relationships with suppliers to support joint problem-solving efforts. Part of this process necessarily involves regular and ongoing communication between the Army and its suppliers, and the manual gives specific directions on how to conduct that as well.

¹² The simplified acquisition threshold is the cost ceiling for contracts that have much simpler requirements. The Federal Acquisition Regulation defines the simplified acquisition threshold as "\$150,000, except for acquisitions of supplies or services that, as determined by the head of the agency, are to be used to support a contingency operation or to facilitate defense against or recovery from nuclear, biological, chemical, or radiological attack" (41 U.S.C. 428a), as "\$300,000 for any contract to be awarded and performed, or purchase to be made, inside the United States," and as "\$1 million for any contract to be awarded and performed, or purchase to be made, outside the United States" (Federal Acquisition Regulation, 2011).

Although they only partially address the first two stages of SRM best practices and do not address the latter two stages at all, these manuals offer tools for building a solid SRM foundation. Next, we examine how AMC can put these policies into practice.

<i>How Are the LCMCs Doing with Stage I: Identifying, Assessing, and Rationalizing the Supply Base?</i>		
Industry Best SRM Practices	LCMC	
	Limits	Practice
1. Identify supply chain needs	--	Some
2. Search for competitive suppliers	Separation of acquisition and sustainment	Some
3. Establish performance metrics and assess suppliers	Available data	Few
4. Supply base rationalization	Requirements for competition and socioeconomic goals	Rare

GOAL:
Pool of potentially capable suppliers

RAND

Our interviews with AMC HQ and LCMC leadership indicate that the AMC policies related to SRM have not yet been fully implemented. As noted earlier, the first stage of SRM best practices involves four steps: identifying strategic supply chain needs, searching for competitive suppliers, establishing performance metrics and assessing suppliers, and rationalizing the supply base. When we spoke with AMC and LCMC personnel, we found some evidence of the first step, identifying strategic supply chain needs, but it was not clearly addressed in any systematic way. One interviewee, discussing evolving efforts to identify strategic supply needs, noted, “In the 1990s, [we were] out of touch with the suppliers, and the suppliers couldn’t meet our current needs . . . There was not enough funding. It was a community effort, including the suppliers, to get well, and now they are back into the green.”

The second step in Stage 1, searching for competitive suppliers, is split between acquisition and sustainment in AMC. Because contracts for these two expenses are written separately, the competition that exists for acquisition is not

always present when selecting suppliers for sustainment, often because only the suppliers that created the systems are qualified to sustain them. This lack of competition limits the degree to which AMC can search for competitive suppliers. Because SRM steps build on each other, the lack of competition also limits the potential impact of subsequent steps in the process. The personnel we interviewed were well aware of this limit and expressed frustration. As one interviewee put it,

One of the big contractors we have, I have tried to get them to streamline since the late 1990s. I can't tell you the numerous false starts we've had with them—lean Six Sigma, etc. I can't get a bite at all. The government has improved, and the big defense contractors have not. The sole source and lack of efficiency has worked very well for them for a lot of years.

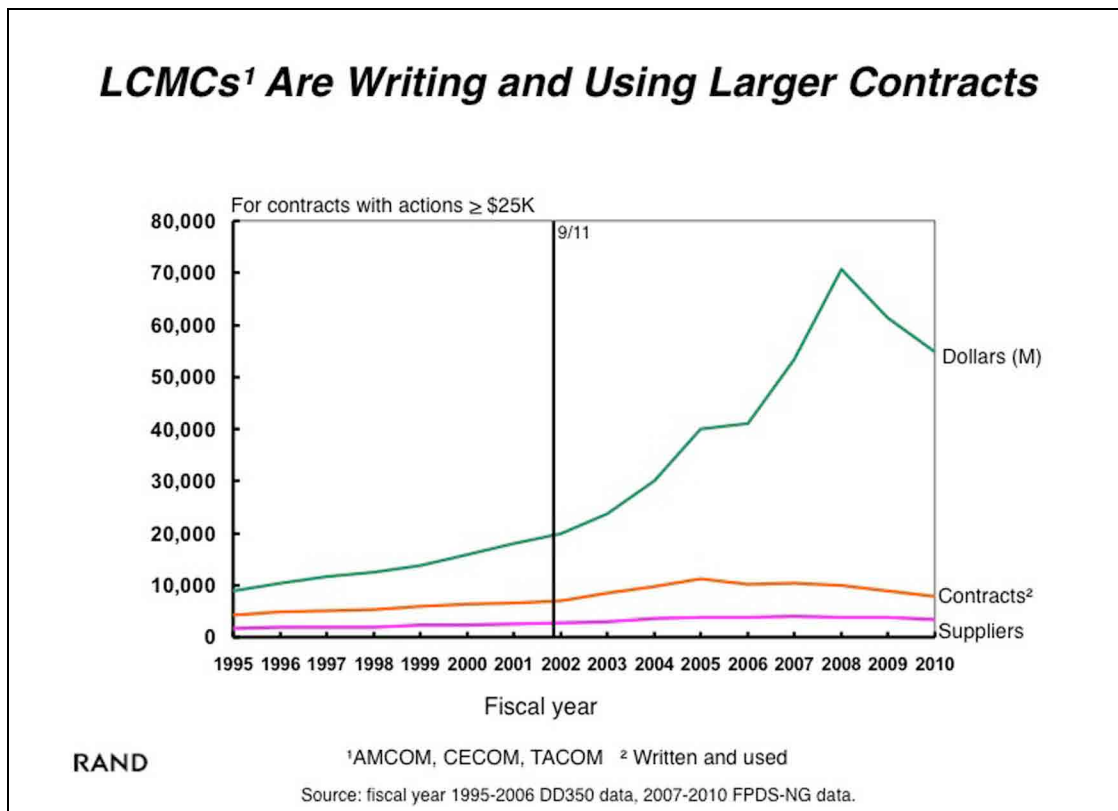
Nonetheless, several personnel reported regular processes for comparing supplier bids and selecting the most competitive supplier when competition exists. Further implementation of the ideal SRM model will require making sustainment a part of acquisition—even if sustainment requirements can only be estimated—in order to maintain competition and limit AMC total costs.

The third step is establishing performance metrics and assessing suppliers. Few personnel we interviewed reported using any consistent, objective measures of performance to compare suppliers. Those who did had collected the measures from top suppliers specifically for that purpose. Nevertheless, all of the interviewees reported using information on a supplier's past performance from PPIRS to inform selection in some manner. Part of the reason for the limited use of performance measurement is undoubtedly that the information generally available for such metrics is limited. The PPIRS data are the most common source of information on supplier performance available to LCMCs, but, as noted earlier, these measures are subjective and can be appealed and ultimately revised when suppliers protest low performance evaluations (U.S. Office of Management and Budget, 2000). The one LCMC where staff had created metrics and conducted ongoing performance assessments had collected

its own data for this purpose. One interviewee, in describing the importance of analyzing past performance and the limitations of the data, said,

Well, quite frankly, since we started using past performance as a factor, we've really cleaned up our suppliers. We don't just use PPIRS . . . we go out for a competitive source selection, and we ask them to give us a listing of contracts of the last three years that are similar. And we ask them to give it to us with points of contact. And we talk to the points of contact and do an assessment on top of PPIRS and use that as part of our selection process. We used to have a tremendous number of delinquencies a number of years ago, and we have cut that way back. We hardly ever terminate anybody for default now.

We found little evidence of the fourth step, rationalizing the supply base, in our interviews with AMC personnel. In part, this is because the federal requirement for competition in contracting (41 U.S.C. 251) and federal goals for utilizing small, socioeconomically diverse suppliers (10 U.S.C. 2323) can pose limits on supply-base rationalization that are not evident in the private sector.



To assess the extent to which the Army supply base has been rationalized, we analyzed LCMC contract action data and PRON data. These data apply to contracts written both by the LCMCs and by others (i.e., contracts created by others through which the LCMCs made purchases). Because thresholds for detailed reporting of contract actions have changed over time, from \$25,000 to \$2,500 in fiscal year (FY) 2005 and then from \$2,500 to \$3,000 in FY 2007, we present two types of analyses: one for all contract actions of at least \$25,000 from FY 1995 through FY 2007 and another for all contract actions from FY 2005 through FY 2010.¹³

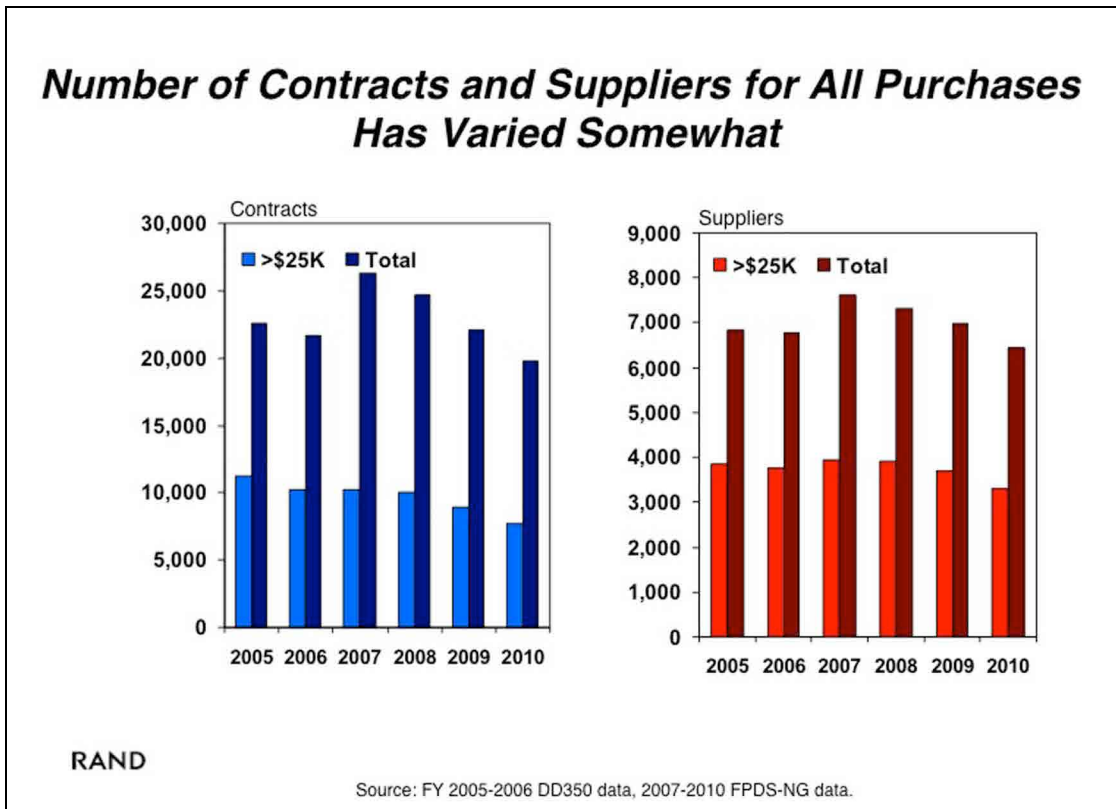
¹³ Prior to FY 2005, DoD required contract actions of at least \$25,000 to be reported on forms listing supplier name, address, and other information. This makes it possible to calculate numbers of suppliers and contracts for such actions. DoD required actions below the \$25,000 threshold to be reported only on summary forms noting how many actions went to small businesses and other categories of business of interest to federal policymakers. As noted, DoD reduced this reporting threshold from \$25,000 to \$2,500 in FY 2005. The

The data validate our interview findings that the Army supply base had not yet been fully rationalized by FY 2010. From FY 1995 to FY 2001, the number of (nominal) dollars spent on LCMC contracts with actions of at least \$25,000 doubled while the number of contracts and suppliers used increased by about half.¹⁴ From FY 2002 to FY 2008 (or subsequent to the September 11, 2001 terrorist attacks on the United States), the number of dollars spent on LCMC contracts increased about fourfold, while the number of contracts and suppliers used roughly doubled. From FY 2008 to FY 2010, the number of dollars spent on LCMC contracts decreased by 23 percent, the number of contracts by 22 percent, and the number of suppliers by 15 percent.

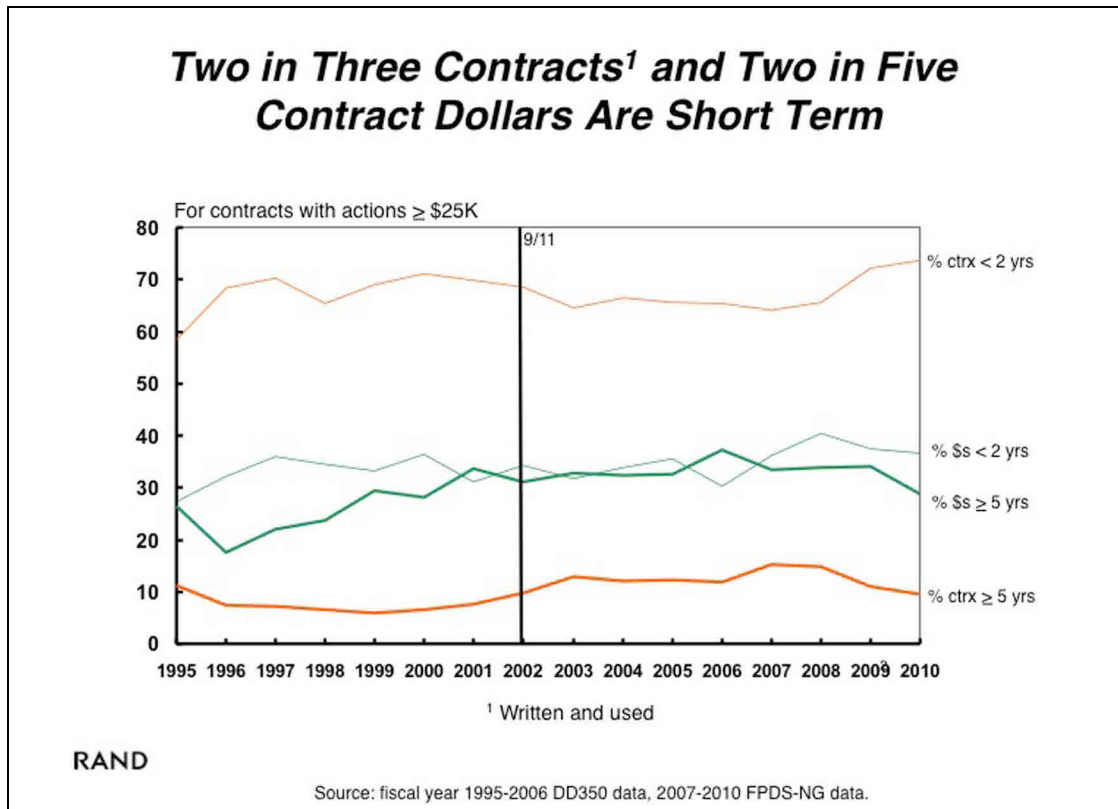
Had the supply base been rationalized, the increase in expenditures from FY 2002 to FY 2008 could have been managed without the need to have as large an increase in the number of suppliers or contracts, by making contracts that covered more items and longer periods.

Army began implementing the lower threshold, and the reporting of detail for lower-value contracts, in FY 2000, but this was not fully implemented until FY 2005.

¹⁴ The figure above includes information on contracts written by the LCMCs and those used by the LCMCs but written by others in DoD.



The number of contracts and suppliers that LCMCs use are particularly high on contracts of lesser value. The number of contracts with actions of at least \$25,000 decreased from 11,206 to 7,729 from FY 2005 to FY 2010, while the number of suppliers for these contracts decreased from only 3,863 to 3,306. By contrast, from FY 2005 to FY 2008, the total number of LCMC contracts only decreased from 22,565 to 19,814, while the number of suppliers for these contracts only decreased from 6,845 to 6,432. In other words, the reduction in contracts and expenditures appears to have been limited to larger contracts, that is, those with actions of at least \$25,000. A very large majority of dollars are spent on such contracts. Nevertheless, these data indicate that contracting personnel may spend large amounts of time administering large numbers of small contracts rather than engaging in strategic SRM.



The effectiveness of SRM depends, in part, on building long-term relationships that benefit both parties. Numerous regulatory requirements can impede the development of such relationships with federal contractors.

One indicator, albeit imperfect, of long-term relationships in government contracting is the proportion of contracts that are at least five years long. Such contracts are not always a measure of the quality of the relationship between buyer and supplier, especially if the contract is poorly structured and lacks performance incentives or options to terminate. Nevertheless, an inability to devise such contracts may inhibit SRM development.

The U.S. Code usually limits contracts to five years, which is not necessarily long by SRM standards. Federal Acquisition Regulation requirements for recurring new competitions and renegotiations can also impede the development of truly long-term contracts and, therefore, of long-term relationships. Implicit long-term relationships may occur in the

commercial sector without a long-term contract, but they are less likely in government.

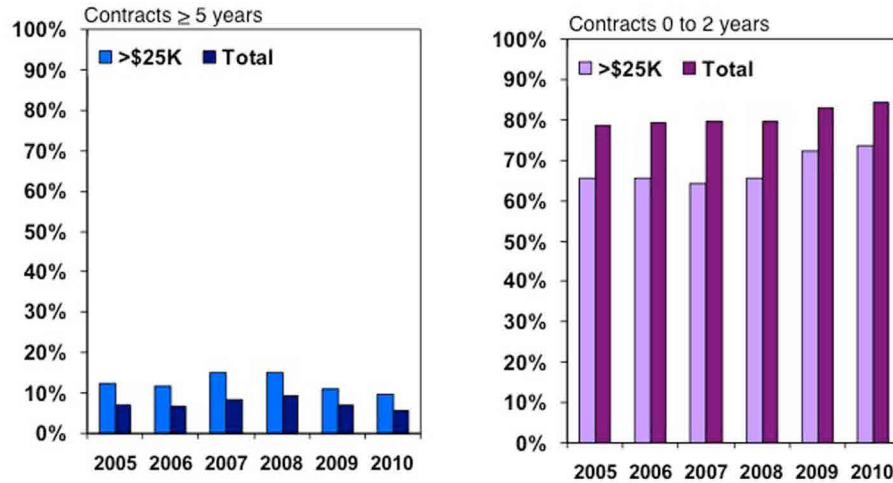
Our analysis of LCMC contracts by length offers little indication that long-term relationships are growing in LCMC contracting.¹⁵ Among LCMC contracts with actions of at least \$25,000, the proportion of dollars spent on contracts at least five years long (as shown by the thick green line in the figure above) in FY 2010 was about the same as it was in FY 1995. Similarly, the proportion of such contracts at least five years long (as shown by the thick orange line) in FY 2010 was slightly lower than it was in FY 1995.

At the same time, contracts that were only zero to two years long increased as a proportion of all contracts (as shown by the thin orange line) and still constitute most contracts with actions of at least \$25,000.¹⁶ The proportion of dollars spent on such contract actions, shown by the thin green line, also increased, and accounted for more than one in three dollars spent on actions of at least \$25,000.

¹⁵ For this specific analysis, we focus only on contracts written by the LCMCs because the LCMCs can directly negotiate their length.

¹⁶ We define a year as 365.25 days. Hence, a contract from zero to two years would be a contract whose length is between zero and 730 days, while a contract of at least five years will be at least 1,827 days long. Between FY 1995 and FY 2007, the LCMCs wrote 1,661 contracts, accounting for 1.3 percent of all contracts that they wrote during this time, whose indicated length was less than zero. We assume that these contracts represent coding errors. They are included in the total from which we calculate proportions of contracts by length but are not counted among contracts shown as zero to two years in length.

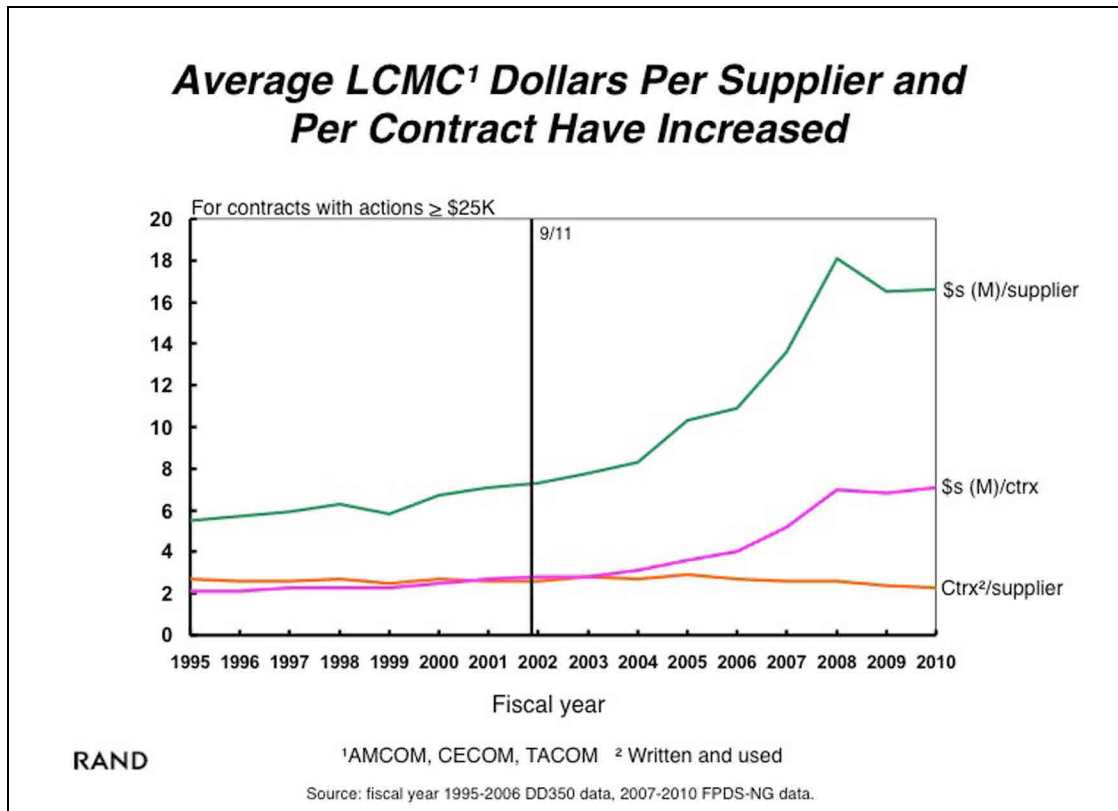
Proportion of All Contracts for Short Terms Has Remained Stable



RAND

Source: FY 2005-2006 DD350 data, 2007-2010 FPDS-NG data.

Not surprisingly, smaller contracts are more likely to be shorter-term, and larger contracts are more likely to be longer-term. Between FY 2005 and FY 2010, larger contracts, that is, contracts with actions for at least \$25,000, were less likely to be less than two years in length than all contracts were. They were also about twice as likely to be more than five or more years long as all contracts were. The high proportion of contracts less than two years in duration and, especially, the proportion of contracts of lower value suggest that LCMC personnel must spend a great deal of their time writing and renewing small, short-term contracts rather than pursuing strategic SRM.



Another way to measure the extent to which a supply base has been rationalized is to assess the dollars spent per supplier, the dollars spent per contract, and the number of contracts per supplier. Increasing dollars per supplier and contract but decreasing numbers of contracts per supplier would all be signs of supply-base rationalization.

Among larger contracts—that is, those with actions of at least \$25,000—there is some evidence of rationalization. The number of dollars per supplier and dollars per contract more than doubled between FY 2001 and FY 2008, while the number of contracts per supplier has remained about the same. In FY 2009, there was some decrease in dollars per supplier and dollars per contract, perhaps reflecting overall reductions in expenditures that year, but both these numbers increased slightly in FY 2010.

***Dollars Per Supplier and Per Contract Have Increased
on All Contracts***

	Fiscal Year			
	2007	2008	2009	2010
Contracts per supplier on . . .				
. . . Contracts with actions $\geq$ \$25,000	2.6	2.6	2.4	2.3
. . . All contracts	3.5	3.4	3.1	3.1
\$sM per supplier on . . .				
. . . Contracts with actions $\geq$ \$25,000	13.6	18.1	16.5	16.6
. . . All contracts	7.0	9.7	8.8	8.5
\$sM per contract on . . .				
. . . Contracts with actions $\geq$ \$25,000	5.2	7.0	6.8	7.1
. . . All contracts	2.0	2.9	2.8	2.8

RAND

Source: FY 2006 DD350 data, 2007-2010 FPDS-NG data.

By the measures of contracts per supplier, dollars per supplier, and dollars per contract, rationalization is more evident among larger contracts—that is, contracts with at least one action of at least \$25,000—than it is among all contracts. While these trends indicate rationalization both for larger contracts and for all contracts, they appear to be a bit steadier among all contracts. Assuring that these trends become stronger for all contracts can help the Army face challenges posed by limited numbers of contracting personnel coupled with greater demands on the contracting workforce (Acquisition Advisory Panel, 2007; Federal Acquisition Institute, 2007, 1998).

***Some Suppliers and Contractor ID Codes
Had Many Contracts In FY 2010***

	All	AMCOM	CECOM	TACOM
# Contracts	19,814	5,383	7,150	7,499
# Suppliers	6,432	2,130	2,225	3,209
# Ctr ID Codes	7,370	2,453	2,521	3,589
# Contracts/supplier				
Average	3.1	2.5	3.2	2.3
Maximum	219 Raytheon	142 Lockheed	204 Sanmina- Sci Corp	128 BAE Systems
# Contracts/Ctr ID				
Average	2.7	2.2	2.8	2.1
Maximum	205 SCI Technology	77 Applied Indust Tech	204 SCI Technology	88 Connectec

RAND

Source: FY10 FPDS-NG data

Finally, we analyzed the number of contracts per parent supplier and per supplier location to look for possible areas of consolidation. The figure above shows the ranges of these measures across the weapon system LCMCs.¹⁷ While the average number of contracts per supplier is 3.1 across all three LCMCs, the highest number is 219 contracts for the parent supplier Raytheon. Similarly, by contractor ID,¹⁸ the average number of contracts is 2.7 per supplier location, but the maximum is 205 at parent supplier SCI Technology. Within each LCMC, we see a low average number of contracts per supplier or contractor ID

¹⁷ Because contracts can be shared by LCMCs, the sum of the number of contracts, suppliers, and contractor ID codes by LCMC will exceed the total number reported above. The “all” column above reflects only the three LCMCs we analyze; it does not reflect all the AMC.

¹⁸ Large suppliers often have multiple contractor ID codes for different business units or places of performance.

but a high maximum number of contracts per supplier or contractor ID. Suppliers and locations with a high number of contracts would be likely candidates for consolidation (particularly, as we will discuss, of sole-source contracts) and more active management. Managing relationships with the suppliers and the locations that use the most resources can make a big impact on an organization's bottom line.

Average NIINs Per Spares Contract in FY 2007 Was Relatively Low

	All	AMCOM	CECOM	TACOM
total value \$s B	3.81	1.24	1.18	1.39
# NIINs	7,344	1,933	1,487	3,924
# contracts	4,612	1,339	286	2,987
# suppliers ¹	990	386	137	585
# NIINs/contract				
Average	1.8	1.6	5.8	1.4
Maximum	226	118	226	70
# NIINs/supplier ²				
Average	6.5	5.1	11.6	4.9
Maximum	498 Raytheon	240 Boeing	391 Raytheon	136 BAE

¹Numbers do not add because LCMCs share some suppliers

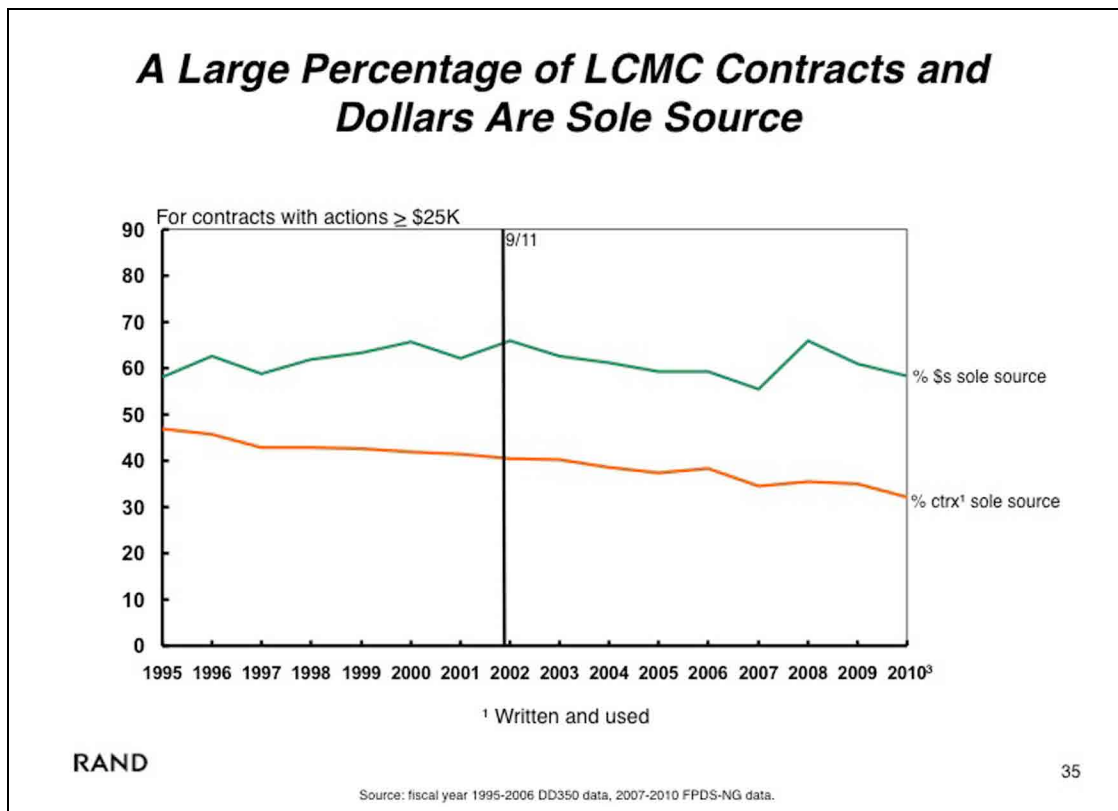
²Could not match all NIINs to suppliers

RAND

Source: FY 2007 PRON and FPDS data

The number of parts per contract can provide another measure of supply-base rationalization. The figure above summarizes the number of National Item Identification Numbers (NIINs)¹⁹ per spares contract in FY 2007. Across the LCMCs, the average number of unique NIINs per contract is 1.8. The SRM principles of rationalizing the supply base and consolidating contracts with suppliers offer a way to increase the number of NIINs per contract and thereby reduce the amount of resources spent writing and managing individual contracts.

¹⁹ NIIN is the federal identification for each unique part.



A large percentage of LCMC contracts and dollars remain sole-source. Among large contracts—that is, those with at least one action of at least \$25,000—nearly one in three are sole-source. Nearly three in five dollars the LCMCs spend on large contracts are spent on sole-source contracts. The reduction in the proportion of sole-source contracts indicates that the LCMCs may have been taking advantage of some contract consolidation opportunities.

Sole-source contracts offer easy consolidation opportunities because they may not need to adhere to the Competition in Contracting Act or policies discouraging contract bundling that prevent small businesses from competing. When there is only one source for a routinely purchased good or service, it can also be easier to develop long-term relationships. Nevertheless, suppliers with sole-source contracts have less incentive to reduce their costs or improve performance because the Army does not have a choice of suppliers for these goods and services. Such suppliers may be much less receptive to participating in joint improvement efforts.

Taken Together, These Data Indicate that the Army Spends Much of Its Time Processing Contracts

- Growing numbers of: suppliers, contracts, dollars, contracts per supplier
- Falling dollars per contract
- Persistent high percent of contracts are short term
- Low number of NIINs per spares contract
- High numbers of contracts with some suppliers

Grouping these contracts in a strategic way can save time and money – Stage 1 of Supplier Relationship Management

RAND

Overall, the contract and PRON data we have analyzed suggest that staff members spend much of their time at the operations level, i.e., processing contracts. Growing numbers of suppliers, contracts and dollars per supplier, and short-term contracts covering few NIINs require staff members to spend vast amounts of time processing contracts. In turn, little time is likely available for strategic SRM practices. Putting more strategic practices into place would likely lead to long-term savings in contract dollars as well as staff time.

***How Are the LCMCs Doing with
Stage II: Problem-Solving Development?***

Industry Best SRM Practices	LCMC	
	Limits	Practice
5. On-site risk assessment by cross-functional team	--	Not currently
6. Problem-solving to eliminate suppliers' deficiencies	--	Rare

GOAL:
Suppliers meet current production requirements

RAND

In Stage 2 of SRM best practices, the buying enterprise works toward helping key suppliers solve problems that prevent it from meeting its production requirements. In the first step of Stage 2, step 5 in the overall process, the buying enterprise sends a cross-functional team of staff to suppliers' locations to do an on-site assessment. In step 6, which follows directly, the customer's staff helps the supplier solve identified problems that affect supplier cost or performance. In our interviews, several AMC personnel reported that they used to do selected on-site assessment and problem solving, but more recently, limited resources have prevented the practice. Personnel also reported AMC staff occasionally working with suppliers to help solve problems but not on site.

***How Are the LCMCs Doing with
Stage III: Proactive Development?***

Industry Best SRM Practices	LCMC	
	Limits	Practice
7. Establish open relationship through feedback and information sharing	--	Some
8. Systematic supplier development	Available data	Not done
9. Maintain momentum	--	Few

GOAL:
Self-reliant supply base – continuous improvement

RAND

Stage 3 of SRM best practices moves past current problem solving into proactive development. Here, the focus shifts from fixing problems to growing and improving in a way that improves efficiency and effectiveness and prevents future problems. Step 7 (the first in this stage) involves establishing an open relationship with key suppliers through ongoing feedback and information sharing.

Several of our interviewees reported using practices that develop open supplier relationships. The most common is an annual meeting hosted by each LCMC for its suppliers during which the LCMC shares long-term forecasts. Called the Advanced Planning Briefing for Industry (APBI), the meeting is useful for sharing general information but does not involve near-term forecasts or feedback on individual suppliers' performance problems. Two LCMCs reported that they hold regular individual meetings with their large suppliers, but these meetings are not systematic across AMC. At one LCMC, an interviewee described the process by saying,

Our contracting folks and our logistics support folks do the prep work, and . . . we send it to them a month ahead. Then the conversation is, “What have you done in the last 30 days to address this stuff that you knew we were going to talk about?” . . . We talk about the things that I really have a problem with.

The interviewee noted that conducting such meetings on a regular basis is quite effective in improving supplier performance: “It usually takes one [scolding] to get them, and then they realize that the work was all in the prep.” Still, such discussions of suppliers’ performance problems were reported infrequently.

We heard little in our interviews about other steps in this stage. This is not surprising, given that the steps build on each other, and implementation of the steps in Stage 2 is minimal.

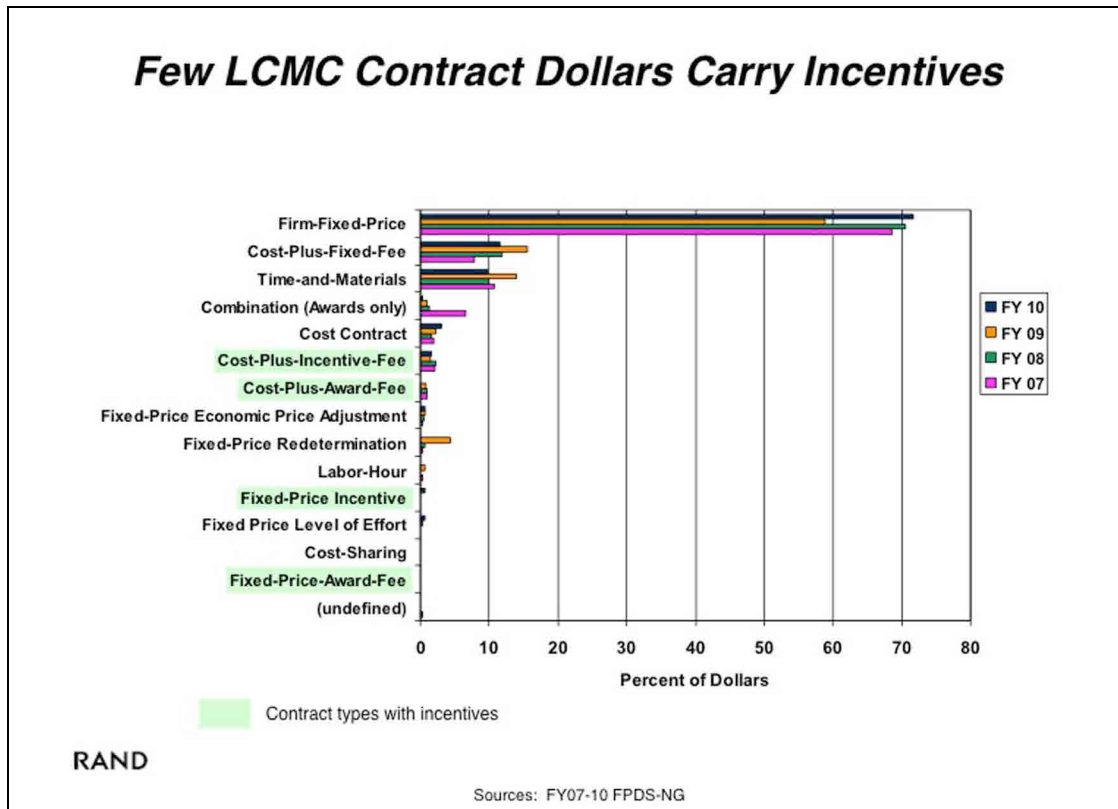
Step 8 is about systematic supplier development, in which the buying enterprise helps suppliers continue to develop and improve their processes and procedures in an organized and ongoing fashion. Although we heard of a few individual incidents in which personnel worked with suppliers on process improvement, this does not appear to be happening systematically within LCMCs or across AMC. One reason for the lack of systematic supplier development is that LCMC personnel do not have access to AMC-, Army-, or DoD-wide data.

The SRM step 8 also involves delivering rewards and penalties to suppliers based on their performance. We heard reports of LCMC personnel giving such rewards or penalties from a few of our interviewees. Rewards included public recognition at supplier meetings and, in one instance, nomination for an AMC-sponsored recognition award. One interviewee said, “This is one of the carrots . . . I will use you as the example of who’s fundamentally changing a paradigm. I won’t show somebody who’s doing bad in front of anyone else, but I will show people who are doing well.” Penalties included enforcing fines for late deliverables, although this is rare and not an option for many contracts.

In step 9, maintaining momentum in supplier management, the relationship between the customer and supplier continues to develop, analysis of performance is ongoing, and continuous improvement work becomes truly continuous. We did not hear evidence of these actions by LCMC personnel, but this is not surprising given that they were still building the earlier steps upon which such momentum is based.



As the above figure shows, nearly all LCMC contracts between FY 2007 and FY 2010 were firm-fixed-price contracts. DoD encourages the use of such contracts (DLA, 2008; DoD, 2006, 2003). Very few contracts carry rewards or penalties. Altogether, no more than 0.2 percent of contracts in any of the past four years included any of the four incentive types highlighted in green in the figure.



Similarly, a very low proportion of dollars are spent on contracts with incentives. In none of the past four years did the proportion of dollars spent on any of the four types of incentive contracts exceed 2.2 percent. The low proportion of expenditures made through incentive contracts, including both those with rewards and those with penalties, may limit the LCMCs' leverage with suppliers, particularly those with performance problems, in implementing SRM best practices.

***How Are the LCMCs Doing with
Stage IV: Integrative Development?***

Industry Best SRM Practices	LCMC	
	Limits	Practice
10. Supplier integration in new product development	--	Rare
11. Establish performance improvement in second-tier suppliers	--	Rare
12. Establish integrated supplier network	--	Not done

GOAL:
Globally aligned supplier network

RAND

Stage 4 of SRM best practices includes three final steps. In step 10, the buying enterprise integrates suppliers into new product development. We heard very little discussion of such actions. One exception was a senior leader who encourages suppliers to be innovative: “If you come to me and say, ‘Here’s a better way to do this, to make it more effective’—not more efficient but more effective for supporting the soldier—then I will do business with that.” In another instance, to fulfill security requirements of another agency, an LCMC had to vet suppliers early in the process. These suppliers subsequently played a bigger role than usual in product development.

In step 11, the buying enterprise moves beyond improving its own operations and those of its suppliers to working directly with its suppliers’ suppliers. Specifically, it will work with second-tier suppliers common to its prime suppliers to increase leverage with them and to encourage or help these suppliers manage and improve their performance. Working with second-tier suppliers has not happened often in AMC, according to our interviews, and

remains far below the ideal level for SRM. Nonetheless, some interaction is happening. One person reported, for example, that

[company name withheld] has done more to understand second- and third-tier sourcing: how to prepare for a [post-]supplemental and avoid driving out the industrial base. We asked OEMs [original equipment manufacturers], “What does [company name withheld] need to do to keep you and the vendor base warm in cost and capacity, to bring you into the budget process?”

Step 12, the last, is the culmination of these best practices, in which the buying enterprise has established a thoroughly integrated supplier network that includes ongoing process improvement with first-tier and second-tier suppliers. Neither AMC nor most commercial enterprises have reached this advanced stage of SRM.

***Quantitative Data Confirm Some Reports
but Suggest a Different Picture for Others***

<u>Interview Data</u>			<u>Quantitative Data</u>
<u>Many</u>	<u>Some</u>	<u>One or No</u>	<u>N/A</u>
Regular meetings with suppliers	Encouraging cooperative thinking and innovation	Encouraging suppliers' process improvement	N/A
Negative incentives for suppliers	Positive supplier incentives	Using scorecards or Nominating for AMC award	Few contracts with incentives
Use of data on past performance	Helping suppliers solve performance problems	Rigorous analyses of performance data	Limited performance data
Sharing aggregate, long-term forecasts with suppliers	Sharing detailed, short-term forecasts with suppliers	Systematic activities	Limited access to contract data
Growing use of long-term contracts			Many small, short-term contracts

RAND

The figure above summarizes our interview responses with regard to SRM practices. Some SRM practices were reported by many of the 29 people interviewed; these are shown in the green column. Other SRM practices were reported by only some of the interviewees (the yellow column), while still other practices were reported rarely if at all (i.e., by one or no interviewees, in the red column). Finally, where possible, we compared these results with quantitative data related to these practices to provide a context for the interview findings (shown in the rightmost column).

Many of the leaders we interviewed reported several practices that are consistent with SRM best practices. These include negative incentives for suppliers. Ideally, SRM would use positive incentives far more than negative, but negative incentives are better than none. The primary negative incentive at the LCMCs is giving suppliers negative feedback, typically informal and oral but also on occasion formally through PPIRS. Most LCMC leaders described this as a common practice with top suppliers, but it is largely reactive. That is,

when performance problems arise, LCMC leaders discuss them with the relevant suppliers, usually at their regularly scheduled meetings. A more strategic approach would prevent problems before they occur, would involve tracking performance closely enough to enable such conversations before problems escalate, and would include more than just the top suppliers.

A second major negative incentive that most LCMC leaders reported using with suppliers was not awarding contracts to suppliers with substantial performance problems. Leaders reported that they do not inform suppliers losing contracts because of their poor past performance. One leader reported enforcing contract fines for late deliverables. This is a new approach, and not available on many contracts, but it is one that suppliers reportedly responded to strongly.

Analyzing suppliers' past performance is a key component of SRM, and all of the leaders with whom we spoke reported using information on suppliers' past performance, mostly with PPIRS. Nevertheless, few could specify exactly how they used such performance information except for considering it in award selection. One LCMC has developed its own system for measuring the performance of key suppliers but uses it for fewer than ten suppliers.

SRM also relies on ongoing communication with suppliers for performance feedback, forecast sharing, and relationship building. AMC HQ and all of the LCMCs conduct meetings with suppliers at least annually. AMC HQ holds quarterly meetings with eight to ten suppliers chosen from a list of DoD's top 100 suppliers.²⁰ It is not clear how frequently any one of the top 100 suppliers meets with AMC HQ, as the meetings themselves are new in the past year (i.e., AMC HQ personnel have not met with all 100 yet, nor have they begun second rounds). The LCMC APBI meetings bring all suppliers together, and LCMC leaders share aggregate forecasts of one to three years with suppliers. Some of the meetings also include public acknowledgment of top-

²⁰ For annual lists of DoD's top 100 suppliers by dollars, see [usaspending.gov](https://www.usaspending.gov).

performing suppliers and additional individual meetings with selected top suppliers during which performance problems are addressed. Most leaders also reported meeting more frequently with their top sole-source suppliers, usually semiannually or quarterly. Those meetings involve similar discussions about long-term forecasts and problems with performance. At least one LCMC includes a social event at these meetings to build and strengthen relationships with top suppliers.

Most leaders also reported increasing use of long-term contracts (five or more years). This is confirmed by our analyses of contract dollars, although most dollars are still in short-term contracts.

A few AMC HQ and LCMC leaders reported additional SRM best practices, shown in the yellow column in the figure above. Some leaders use positive incentives with suppliers, including public recognition of strong performance at supplier meetings and new contract awards because of positive past performance. Some interviewees reported making the link between good past performance and new awards explicit to suppliers, but not all did so.

A few leaders with whom we spoke said that they work with suppliers to solve performance problems. Although not widespread and only sometimes done on site at suppliers' facilities, this practice has yielded positive results for the Army. For example, according to two of our interviewees,

We do that routinely. Who's in charge depends on what the mission is. We just had someone go out and talk to this company to see if we could get a higher success rate on ***. We sent lean Six Sigma experts to Kuwait to help some of our contractors.

As soon as we become aware of any safety issue, we have a whole team of guys who quickly go to the company and work with them to fix it. As far as safety of our soldiers is concerned, we don't run out of money for that.

A few leaders also talked about sharing short-term and detailed forecasts beyond those presented at the APBI meetings with selected suppliers. These

include upcoming and fast-turnaround needs often related to ongoing efforts in Iraq and Afghanistan. One interviewee said,

Yes, we do that. I would say that mostly in the sustainment side, out of our logistics and readiness center, we provide them that info. We want them to be locked in with us so that they can supply our needs. And we have surge provisions built into the contracts for that.

Finally, a few leaders encourage innovation among some of their suppliers, stressing the Army's long-term mission over short-term costs. They reported rewarding suppliers who develop improved ways of supporting the warfighter, even if it means a short-term outlay of funds. On a related note, some leaders encourage cooperative relationships with their suppliers that are characteristic of SRM. The leader who held social events after regular meetings with large suppliers provided a good example of this: "Absolutely, it's about trust; it's about relationships, both personal and professional. It's about getting to know them, getting to know the family, the kids."

While we found that some SRM practices were broadly applied (the green boxes) and some in pockets (the yellow boxes), several other key components of SRM are rare to nonexistent among AMC and LCMC practices. Perhaps most obvious is the lack of a supplier scorecard for ongoing measurement of supplier performance. Only one office reported using anything like a scorecard.

Very few interviewees reported rigorous analyses of performance data, whether or not they used scorecards. Almost none could describe the use of data to characterize suppliers' past performance, partly because the data themselves are problematic. The limited instances of rigorous performance analyses we did find could serve as a starting point for other offices and for collecting more useful and reliable performance data.

In addition, we found little evidence of LCMC or AMC honors or prizes for high-performing suppliers. Only one interviewee reported nominating suppliers for the one honor that we encountered, which was AMC-wide. Many leaders told us that they had not even heard of the AMC award.

In general, we found little to no systematic approach to SRM best practices. SRM activities are clearly present, often in pockets, but they are largely ad hoc. Aside from the regular but unclear use of suppliers' past performance in awarding contracts and the regular APBI meetings, we heard about no regular practices that crossed LCMCs. We also heard no reports of encouraging suppliers to engage in process improvement in ways unrelated to specific contract problems.

Our quantitative analyses of contract action data lend some additional insight to the interview findings. Examinations of the types of contracts used by LCMCs show that only very small percentages of contracts and contract dollars carry incentives. This suggests that the positive and negative incentives that LCMC leaders give their suppliers could be strengthened through the greater use of performance-based contracts, such as cost-plus-incentive-fee, cost-plus-award-fee, fixed-price-incentive-fee, and fixed-price-award-fee contracts.

Our attempts to analyze supplier performance data were severely limited by the lack of comprehensive, consistent, and objective performance data. We were unable to obtain access to the PPIRS data, despite several attempts to gain permission. PPIRS has information on supplier performance that is the most readily available to LCMCs, but it typically includes only reports related to a particular contract. And, again, the system does not have rigorous, quantitative performance data. In addition, the ability for suppliers to contest and (reportedly) change performance assessments makes its reliability suspect. This suggests that LCMCs that want to analyze supplier performance in a rigorous way must collect their own data.

Our analyses of contract data revealed two findings that relate directly to what we heard in the interviews. First, AMC-wide, Army-wide, and DoD-wide data on contracts, like those on performance, are not readily available to LCMCs. This limits the LCMCs' ability to negotiate effectively with suppliers because, without wider information on purchases, they cannot increase their leverage with suppliers. Combining contract data would help LCMCs identify top suppliers and could allow a systematic approach to dealing with particular

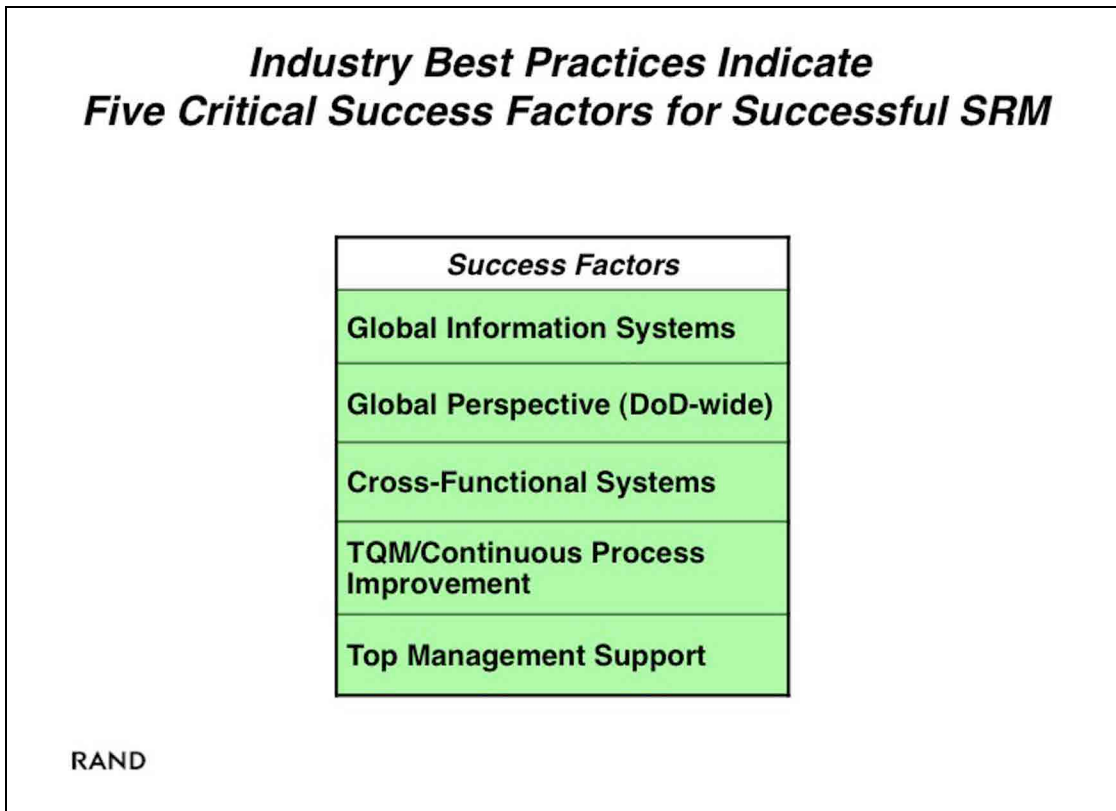
suppliers. Second, although contract dollars are increasingly spent in long-term contracts, many of these contracts are focused on only one or two NIINs, and many contracts are still short-term and small in terms of dollar amounts.

4. Critical Success Factors at AMC

<i>Outline</i>
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SRM Best Practices
SRM Stages at AMC
Critical Success Factors at AMC
Conclusions and Recommendations

RAND

We turn now to a discussion of five critical success factors for SRM and accompanying obstacles at the LCMCs. These can help close gaps between AMC current practice and best practices required for effective supply-base management.



In addition to the stages of SRM development described in the previous section, five critical success factors help to characterize SRM best practices. These are noted in the figure above. The first, global information systems, includes information on supplier performance that spans the buying enterprise. For LCMCs, this means data systems that present information on supplier performance for all of DoD. Analyses of suppliers' performance by contract, LCMC, AMC, Army, and DoD would provide critical information for strategic sourcing as well as leverage for supplier negotiations.

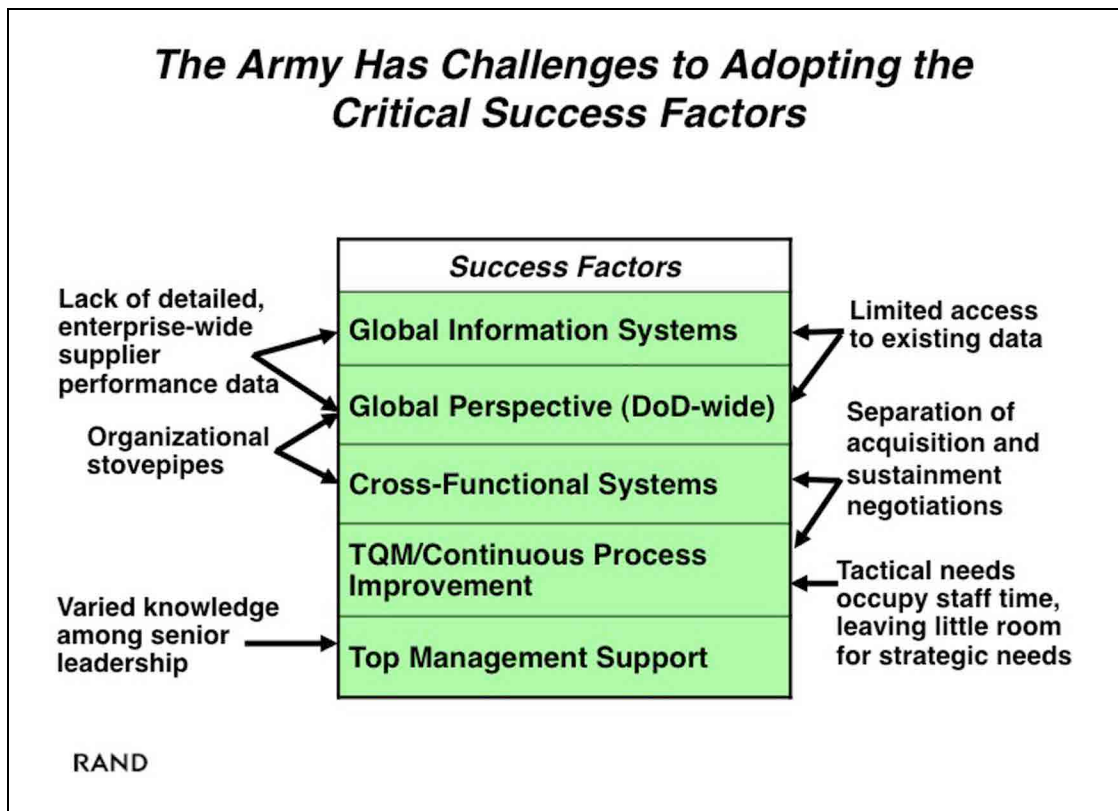
The second, a global perspective, refers to an enterprise-wide approach to supplier management. Creating policy and analysis that is enterprise-wide gives an organization the greatest leverage in negotiations. For LCMCs, this means that purchasing and supplier performance would be managed strategically at the DoD or at least the AMC level. It also means looking globally for suppliers.

The third second critical success factor is cross-functional systems. This refers to an organizational structure that crosses roles and career fields. By

maintaining an organizational structure that creates interactions across functional areas, an enterprise keeps track of its total needs (i.e., requirements) and manages its suppliers with all of those needs in mind. For LCMCs, this means that managing suppliers would involve both strategic policy and operating teams that span weapon systems and sustainment.

The fourth critical success factor is an emphasis on TQM, or continuous process improvement. The approach to ongoing quality improvement of any and all processes ideally permeates both the buying enterprise and the suppliers. Improvement involves measurable goals with clearly delineated steps. Improving processes is often, but not always, directly or indirectly related to total cost; an organization may have other goals that form the impetus for continuous process improvement. All processes in an enterprise embracing continuous process improvement are open to questioning and improvement. For the LCMCs, an emphasis on continuous process improvement refers to improvement of internal processes at the LCMC, AMC, Army, and DoD levels as well as working with suppliers to improve their processes. Improvement might be made in terms of supporting the warfighter, lowering costs, increasing efficiency, or other goals.

The fifth critical success factor is the support of top management. Top management support is important for both the thorough execution of SRM within an organization and for relationships with suppliers. Leaders set the tone in any organization, and their understanding of and enthusiasm for SRM dictates the degree to which it is put into practice. For LCMCs, top management support would include support from leaders at the LCMCs, AMC HQ, Army HQ, and DoD.



A number of practices and structures in the Army present some challenges to adopting the critical SRM success factors. The figure above identifies these challenges and their relationships to the success factors.

First, the Army lacks detailed, enterprise-wide data on supplier performance. This limits the breadth of information available to support analysis and negotiations as well as the ability of leaders to gain a DoD-wide perspective on supplier management.

Second, LCMCs have limited access to the data that do exist. Because LCMC leaders see only their own contracts with suppliers, their leverage with suppliers is severely limited, as is their perspective on supplier management.

Third, as noted earlier, LCMC staff spend much of their time processing contracts and have little time to devote to strategic management. Some of this is the result of policy requirements. The federal government has an expressed preference for full and open competition, whereby any responsible contractor may compete for contracts. This interrupts the development of supplier

relationships and requires LCMC staff to compete, process, and manage more contracts. The federal government also has small-business participation goals (currently set at 23 percent of goaling dollars) that must be met, which can increase the number of contracts that need to be written and managed (in part because small businesses need to be reevaluated regularly to ensure that they have not outgrown their small-business designation). LCMC staff also, as noted earlier, must devote a great deal of time to short-term contracts covering few NIINs. The extensive time spent processing contracts limits SRM development and makes it difficult to find time for process-improvement and supplier-development projects.

Fourth, the Army has numerous organizational stovepipes that limit its ability to maintain a global perspective on suppliers and that impede the creation of cross-functional teams. Contracting offices are stratified and stovepiped such that they often become system- or location-specific. Coordination between weapon system staffs is also minimal. Moreover, a contract office supporting one weapon system cannot establish policy for a range of systems, even if those systems are provided by the same contractor. Furthermore, as we note later, organizational stovepipes can hinder communication between DoD contracting offices. Within AMC alone, for example, AMCOM, CECOM, and TACOM each ordered electrical connectors from the same supplier, with each LCMC spending between \$60,000 and \$80,000 for the connectors. Pooling such contracts would increase leverage with the supplier and eliminate some of the transaction costs involved in processing and managing separate contracts. Ironically, some of the specialization within DoD and the Army that was designed to increase efficiency has come to limit efficiency by obstructing effective management of suppliers.

Fifth, we found that the degree to which top AMC and LCMC leaders understand SRM principles varies. Some leaders are well versed in SRM while others appear to know little about it. This obviously limits the implementation of any new SRM practices, some of which may be seen as contrary to typical

federal contracting principles that stress regulations over relationships and operations over strategic analysis. SRM is primarily a supply chain management practice, and contracting officers are not trained as supply chain managers. Rather, federal contracting training is highly focused on procurement regulations and policies, and procurement agencies lack the staff, time, and resources to conduct additional training (Voinovich, 2008). Because implementing SRM represents a major change in thinking and practices for many contracting staff, the enthusiastic and thorough involvement of AMC and LCMC leadership is critical.

Finally, DoD separates acquisition from sustainment, which prevents certain cross-functional teams from forming and limits continuous process improvement. The separation of acquisition and sustainment means that even if SRM best practices are employed for acquisition, SRM for sustainment is seriously hindered. Many suppliers become sole-source. This leaves little leverage to LCMCs beyond enforcing sustainment contract requirements. Although adding sustainment into acquisition contracts is not DoD practice, it is common practice in private industry.

Organizational Stovepipes Duplicate Efforts

Company	Product	Total LCMC \$s	Percent		
			AMCOM	CECOM	TACOM
Dell, Inc.	ADP components	1,354,310	19.0	63.7	17.3
L-3 Communications	Hardware	19,786	33.6	15.6	50.8
National Instruments Corp.	Electric, electronic meas. equip.	116,219	13.9	24.4	61.7
QinetiC N. Amer Operations	Applied, exploratory defense	5,130,119	11.9	56.9	31.2
Tyco Industries	Electrical connectors	201,932	37.8	31.2	31.0
Tyco Industries	Electrical wire and cable	113,517	29.6	13.3	57.1

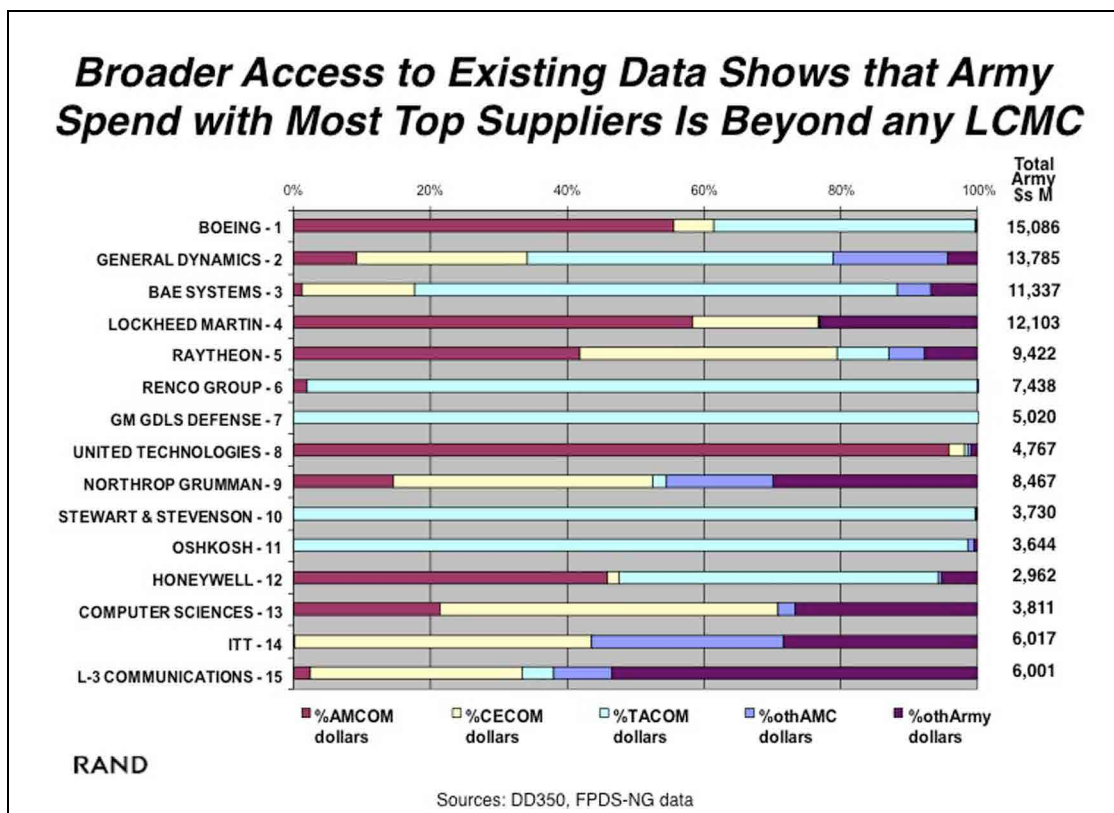
RAND

Sources: FY 2007 FPDS data

Earlier, we noted that organizational stovepipes can hinder communication between DoD offices and possibly limit leverage with suppliers. In the figure above, we present some examples of where this may have happened.

The figure shows some examples of all three LCMCs buying similar products from the same company. For example, the LCMCs in FY 2007 spent more than \$5 million with QinetiC. CECOM was the largest purchaser from QinetiC of the three LCMCs but represented just over half the leverage the LCMCs could exercise with the company. The three LCMCs also spent more than \$200,000 with Tyco for electrical connectors and more than \$100,000 for electrical wire and cable. AMCOM was the largest purchaser for one of these products, while TACOM accounted for most of the other. We excluded about four dozen other cases in which more than one LCMC purchased from a company but one or more LCMCs did not account for at least 10 percent of purchases from the company. Eliminating organizational stovepipes that

prevent combining LCMC purchases with the same firm would increase leverage with suppliers and eliminate some of the transaction costs involved in processing and managing separate contracts.

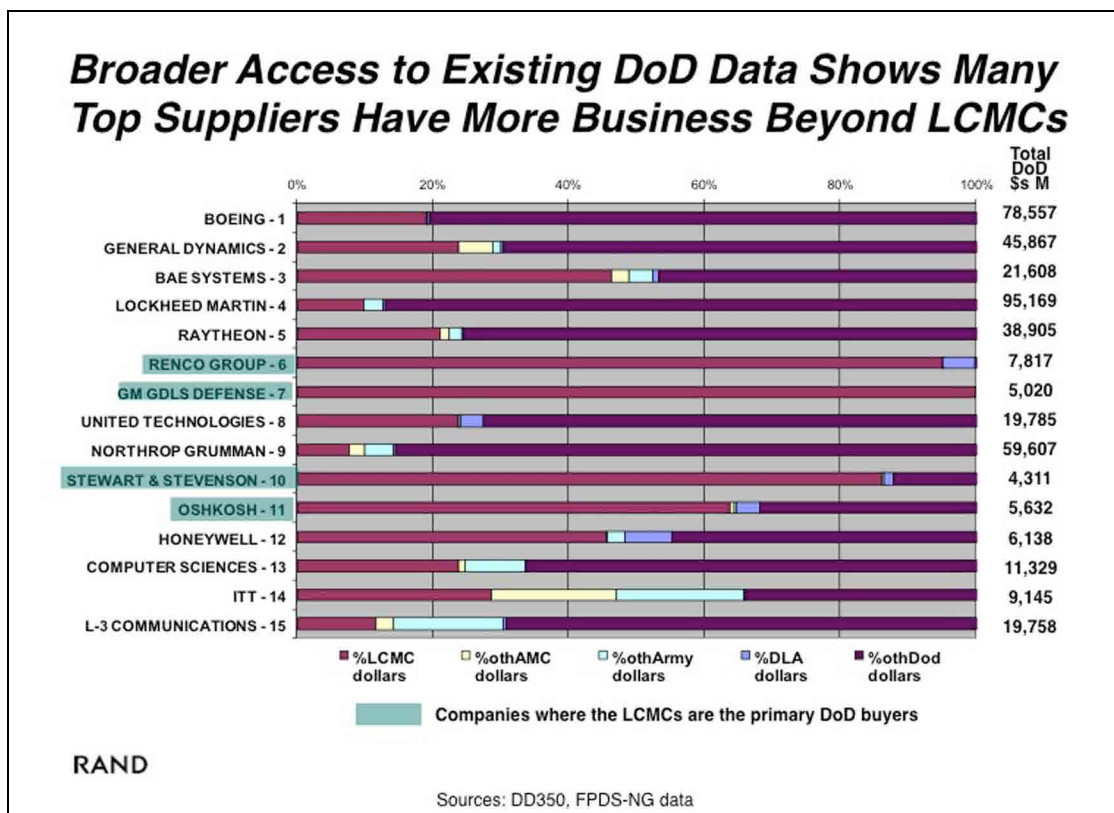


Army spend data help illustrate challenges to the SRM critical success factors, particularly those requiring greater leverage with suppliers. The figure above, which pools data from each of the three LCMCs and AMC, shows the top 15 LCMC suppliers by spend for FY 2004 through FY 2007. The suppliers' names are listed on the left in descending order of LCMC spend; the total spend for the entire Army is listed on the right. The horizontal bars represent the percentage of the Army's business with each supplier for each LCMC.

When LCMCs conduct a spend analysis, they are only able to see their own spend with a supplier. This can lead to erroneous conclusions about the importance of the LCMC as a customer. For example, one of AMCOM's top suppliers is Lockheed Martin (the magenta-colored bar in the fourth row). Yet AMCOM's business with Lockheed Martin constituted only about half of the Army's total business with the company. Similarly, one of CECOM's top suppliers is ITT (the cream-colored bar in the second to last row). Yet

CECOM's business with ITT is less than half of what the Army spends with ITT in total. Should AMCOM and CECOM not realize the other Army expenditures with these suppliers, they may underestimate their influence in negotiations with them, because they do not realize the combined leverage opportunities. If relationships with these suppliers were managed Army-wide, then leverage with them would increase greatly. To identify such leverage opportunities across AMC or across the Army, LCMCs must pull data from other systems or download and analyze Federal Procurement Data System data, as we have done.²¹

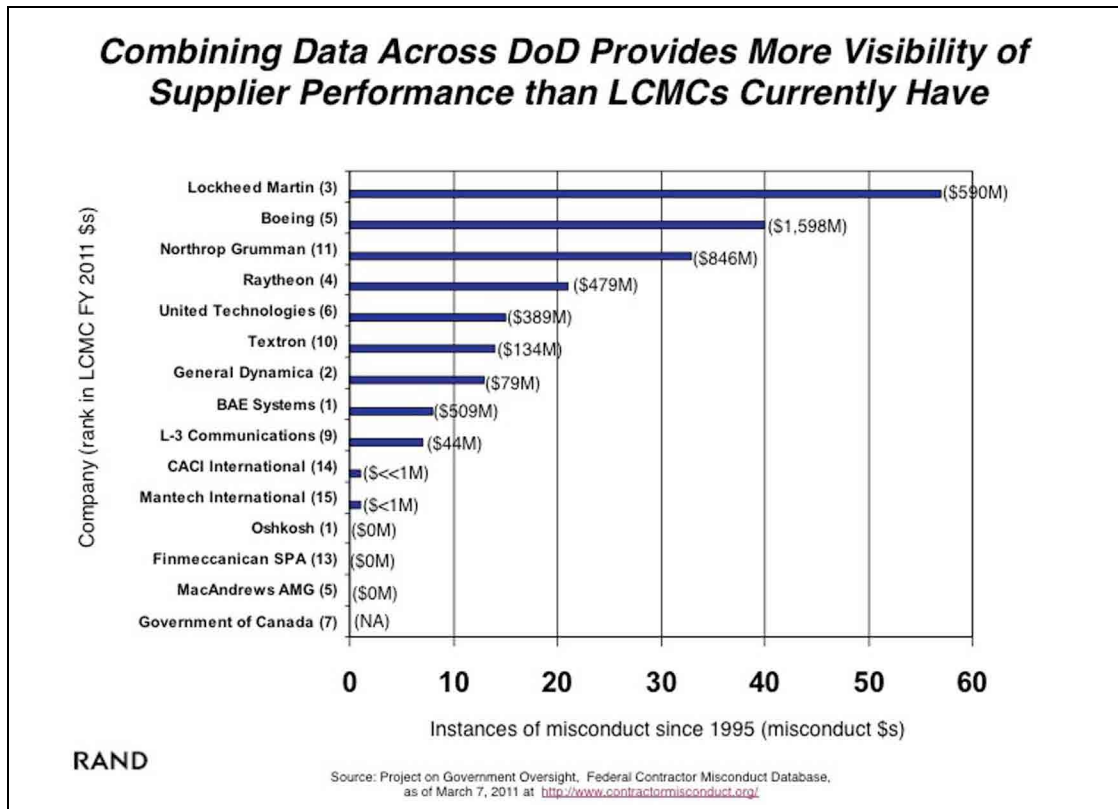
²¹ The Army Contracting Business Intelligence System permits the Army to analyze all contract actions for active contracts. It also includes data on NIINs, and therefore perhaps offers insights not available in the Federal Procurement Data System (FPDS).



Broader DoD data show that still greater leverage with suppliers may lie outside the Army. The above figure again lists the top 15 LCMC suppliers (on the left) for FY 2004 through FY 2007. On the right is the total DoD spend with these suppliers for the same period. In the center is the distribution of this spend: the proportions by the LCMCs, other parts of AMC, other parts of the Army, the Defense Logistics Agency, and other parts of DoD.

DoD leverage in negotiations, whether for contracts, performance improvement, or continuous process improvement, is splintered to the degree that its business is divided among these different groups. For example, although Lockheed Martin is one of AMCOM's top suppliers, AMCOM constitutes only a small fraction of all Lockheed Martin business with DoD. AMCOM's efforts to manage this supplier would be far more effective if they were part of broader DoD efforts. The LCMCs constitute a majority of DoD business with only 4 of their top 15 suppliers (the shaded names in the figure). This means that LCMC efforts may have a strong impact with only a few of these suppliers,

and only when such efforts are combined across AMC (as they are in the figure).



The figure above provides a final example of how the narrow scope of data typically available to LCMCs limits their analyses and prevents them from obtaining a clear perspective on their relationships with suppliers. The figure combines data on supplier misconduct from across the LCMCs. It shows the number of incidents of alleged and substantiated misconduct among the LCMCs' top 15 suppliers (rank in terms of spend is in parentheses after the name). LCMCs lack direct access to these total counts of misconduct; we compiled them for this analysis. With the limited data currently readily available to an LCMC, it could draw the conclusion that an individual supplier's performance is solid when in fact there may be multiple misconduct charges at another LCMC or elsewhere in the federal government.

5. Conclusions and Recommendations

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We conclude with a summary of our findings and recommendations.

Our Interviews and Analyses Suggest the Following Areas for SRM Improvement (1 of 2)

- **Develop AMC-wide supplier management policy and guidance**
- **Establish centralized information sharing with top suppliers that is more frequent and detailed**
 - Forecasts
 - Real time demands
 - Performance
- **Link acquisition and sustainment for supplier management**

RAND

A number of areas appear to be emerging as next steps for implementing SRM in the AMC.

First, the lack of systemic policies and guidance indicates that AMC should *develop AMC-wide supplier management policy and guidance*. We found SRM policies put into practice in several pockets within the LCMCs, but their effectiveness is limited by their isolated implementation. More importantly, their continuation could also be subject to leadership turnover. Putting SRM principles into practice uniformly would create a comprehensive, standard approach for Army suppliers that would create momentum and result in greater gains. Policies and practices that are both systematic (i.e., consistent) and systemic (i.e., AMC-wide) can increase the effectiveness of managing particular suppliers more than simply adding up individual LCMC efforts. Many long-term suppliers to AMC and DoD have their own longstanding and effective SRM programs. AMC may wish to leverage this experience in creating new SRM programs. Leading companies invest more in training to provide

personnel with opportunities to develop greater SRM skills. This suggests that AMC will get from its SRM efforts what it puts into them. Developing personnel capable of implementing new SRM strategies may be one of the top areas (in addition to supply-base rationalization) in which the AMC can expect the greatest returns for its efforts.

Second, the findings suggest that part of this AMC-wide supplier management policy should *establish centralized information sharing with top suppliers that is more frequent and detailed*. By centralizing information sharing, AMC would provide a consistent message with greater weight. The information sharing would need to be frequent and detailed, involving information on Army and supplier forecasts, real-time Army demands, and performance issues for both the Army and the supplier.

Third, AMC needs to better *link acquisition and sustainment for supplier management*. As noted previously, the sole-source suppliers that result from the separation of these two stages of supply leave the Army with little leverage to manage sustainment suppliers. Although separating acquisition and sustainment would be a fundamental change in how the Army does business, such a change is possible. Requiring sustainment costs to be part of an acquisition bid gives incentives to suppliers to make their own processes more efficient and can help the Army keep costs down.

Our Interviews and Analyses Suggest the Following Areas for SRM Improvement (2 of 2)

- **Integrate data across individual data systems of LCMCs to enable more detailed and widespread measures of supplier performance**
 - **Leverage these data to conduct Army-wide and DoD-wide analyses**
 - **Collect new measures of supplier performance across DoD**
 - **Use these data to develop and use a supplier scorecard for selecting and managing suppliers**
 - **Manage overall and contract supplier performance**
 - **Target supplier improvement initiatives**
 - **Rank suppliers**
 - **Establish multiple prizes and honors for continuous improvement**
- RAND

Fourth, the limited accessibility of individual LCMCs to total data on spend, contracts, and supplier performance indicates that the AMC should *integrate data across individual data systems of LCMCs to enable more detailed and widespread measures of supplier performance*. This would support analyses and supplier management at both the LCMC and AMC levels. Ideally, integrated data would eventually extend to the DoD level, but if that proves difficult, creating an Army-wide system would be a critical interim step.

Fifth, as a natural next step, the AMC should *leverage these data to conduct Army-wide and DoD-wide analyses* of contracts and supplier performance. The findings of such analyses would be a key aspect of the information sharing with top suppliers, noted earlier. In addition, they would provide key input for strategic sourcing and for identifying which suppliers AMC should choose for more detailed SRM efforts (e.g., those with more spend and those with more problems). Supply-base rationalization may be the area where the AMC can

presently realize the greatest returns for its time and resources, albeit within some constraints that socioeconomic goals in contracting may pose.

Sixth, these system-wide data and analyses need to be supplemented by new measures of supplier performance. Accordingly, the military should *collect new measures of supplier performance across DoD*. The data on supplier performance are limited in accessibility for LCMCs, as other data are. Supplier performance data are also limited in scope. Consistent measures of quality, delivery time, and cost are needed to enable comparison of suppliers' performance over time and with each other.

Finally, AMC should collect and *use these data to develop and use a supplier scorecard for selecting and managing suppliers*. This would propel progress in the development of SRM at AMC by providing clear and consistent data. Scorecards enable efficient management of supplier performance (overall and on individual contracts), identify areas for supplier process improvement, rank suppliers for supply-base rationalization, and determine which suppliers should be recognized for outstanding performance and significant improvement. Such recognition should occur in formal ways, with prizes and honors given at public meetings to exemplary suppliers.



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Appendix A.

Interview Protocol and Summary of Responses

Our analysis includes the results of open-ended interviews with top personnel at AMC headquarters and at the LCMCs. We selected interviewees based on their roles as command and senior staff, as acquisition and materiel management/supply personnel, or as program executive officers. We also interviewed a few additional individuals who were recommended to us during the interviews because they had particular knowledge or experience that was relevant. There were 29 interviews in all, with each interview lasting 30 to 60 minutes. We used the structured interview protocol shown below, following up with questions of clarification as necessary. We compiled all of the interviews and compared their content and tone as well as the responses to each question. We noted where particular responses were frequent (occurring in many or most of the interviews), where they were occasional (occurring in only a few of the interviews), and where they were rare (occurring rarely or never in the interviews). We also summarized the responses to each question, comparing across the interviews to ensure that we included everything. We compiled this analysis individually and then as a team to ensure validity.

- I. Does AMC/LCMC have efforts to measure or assess supplier performance?
If yes—*
 - A. Would you describe these activities?*
 - B. Are they still going on? Who is conducting them?*
 - C. How are they faring?*
 - D. Is there someone we should talk to in order to get more details on this?*

Responses included developing and collecting own assessment measures, using the information in PPIRS, and applying the requirements of individual contracts. Several respondents did not have specific efforts.

II. Does AMC/LCMC classify supplier performance into categories such as superior, acceptable, marginal, unsatisfactory? If yes—

A. Would you describe these activities?

B. Are they still going on? How often are they updated?

C. Who makes these classifications?

D. How are they faring?

E. Is there someone we should talk to in order to get more details on this?

Only one of the 29 interviewees reported classifying supplier performance into categories.

III. Do AMC/LCMC personnel plan and host any regular meetings or councils for suppliers? If yes—

A. Would you describe these activities? What is the agenda for these meetings?

B. How often do they happen?

C. Who within AMC organizes these meetings?

D. How are they faring?

E. Is there someone we should talk to in order to get more details on this?

Virtually everyone we interviewed described regular meetings that personnel hosted for suppliers. For the LCMCs, these included yearly APBI meetings; AMC hosts quarterly meetings with different suppliers. Several interviewees also mentioned biannual or quarterly meetings with a small group of top suppliers, special meetings for small businesses, and industry conferences.

IV. Does AMC/LCMC make suppliers aware of their performance, individually or in comparison to other suppliers? If yes—

- A. Would you describe these activities?*
- B. Are they still going on? How often do they happen?*
- C. Who is conducting them?*
- D. How are they faring?*
- E. Is there someone we should talk to in order to get more details on this?*

The vast majority of those interviewed reported that they make suppliers aware of performance problems, nearly always doing so individually. Few reported making comparisons with other suppliers. Those who did so compared suppliers with all other suppliers as a group, not with individual suppliers. A few leaders reported recognizing suppliers' positive performance in front of their peers at supplier meetings, but this was not common.

- V. Will you describe AMC/LCMC's work with performance-based agreements (PBAs)?*
 - A. What areas are they most prevalent in?*
 - B. How are they faring?*
 - C. Who else should we talk to in order to get more details on PBAs?*

Interviewees discussed PBAs and performance-based logistics in a wide range of ways. Several reported that they had PBAs but could not offer any specifics about them, others could not comment on them because it was not their area of expertise, and still others spoke about specific efforts they were making to increase the number of PBAs and performance-based logistical decisions in their programs.

- VI. Does AMC/LCMC have any other efforts to manage supplier performance other than PBAs? These might include goals for suppliers, progress made against those goals, targeted modification plans or "get-well" plans for suppliers not performing well, supplier scorecards, or minimum requirements for suppliers. If yes—*

- A. Would you describe these activities?*
- B. What are the specific metrics that you use?*
- C. Are they still going on? Who is conducting them?*
- D. How are they faring?*
- E. Is there someone we should talk to in order to get more details on this?*

This question also yielded a wide range of answers. A few interviewees discussed communication efforts with suppliers, including commander visits and meetings. One person talked about encouraging suppliers to offer creative ways to meet Army needs, worrying less about costs than about supporting soldiers. Another described a contract effort designed to lower repair costs, while another described offering incentives for improved delivery. Several interviewees reported no other supplier management activities.

VII. Does suppliers' past performance affect future supplier selection? If yes—

- A. Would you describe how this works? Is there a particular method for taking past performance into account?*
- B. Who runs this program?*
- C. How is it faring?*
- D. Is there someone we should talk to in order to get more details on this?*

All interviewees said that past performance was a part of the supplier selection process for individual contracts. This is not surprising because it is a federal requirement. Many used PPIRS (which includes Contractor Performance Assessment Reporting System data) as the source for information on past performance. A few solicited additional information directly from the bidders. A few interviewees also pointed out that this is not an option for sole-source contracts. One person pointed out that it was hard to eliminate suppliers with poor performance if the Defense Contracting Management Agency has

determined that a supplier is capable. Only one of the leaders reported ongoing assessment of past performance.

VIII. Does AMC/LCMC have any award programs for suppliers? If yes—

A. Would you describe these programs?

B. Are they still going on? How often are they given out?

C. Who runs them?

D. How are they faring?

E. Is there someone we should talk to in order to get more details on this?

Almost all the individuals we interviewed knew of no prizes or honors regularly given to suppliers, although several reported that such programs had existed in the past. Two interviewees reported a specific annual honor given by AMC. The first described the AMC Value Engineering award, based on improving quality, cost, and time, and the second described an AMC award for technical improvement.

IX. Does AMC/LCMC have any efforts to help suppliers continually improve or develop new capabilities? These might include teaching suppliers about process improvement techniques, sending staff to help suppliers on site, or requiring continual improvements. If yes—

A. Would you describe these efforts?

B. Are they still going on?

C. Who leads these?

D. How are they faring?

E. Is there someone we should talk to in order to get more details on this?

Several interviewees described specific efforts to work with suppliers to improve the suppliers' performance. Lean Six Sigma was the most commonly mentioned approach. Only a couple of the interviewees described anything

formalized in these efforts. Most efforts to improve supplier performance occurred in response to problems that arose. One individual described difficulty in getting improvements from big suppliers that have had years of sole-source contracts and inefficiency.

X. Does AMC/LCMC regularly exchange information, such as forecasts, production plans, product plans, or growth plans, through announcements or other meetings with suppliers? If yes—

A. Would you describe these activities? What kind of information is shared?

B. Are they still going on? How often do they happen?

C. Who runs them?

D. How are they faring?

E. Is there someone we should talk to in order to get more details on this?

Most interviewees reported that they did exchange forecasts with suppliers. This often happened at APBI and other meetings with suppliers. Forecasts ranged from one to five years. Two interviewees (in different commands) reported developing particular data tools to build collaboration by sharing forecasts and real-time demands. One interviewee described great difficulty in predicting future needs and real-time demands.

XI. Does AMC/LCMC also use web portals or other electronic means to exchange information with suppliers on an ongoing or continuous basis? If yes—

A. Would you describe these activities? What kind of information is shared?

B. Are they still going on? How often do they happen?

C. Who runs them?

D. How are they faring?

E. Is there someone we should talk to in order to get more details on this?

Several interviewees spoke about putting solicitations for upcoming contracts on the web, especially on the Federal Business Opportunities and

Interactive Business Opportunities web pages. One person reported that their command had a website for suppliers with information from each APBI meeting. Beyond this, none described Internet portals for use after contracts had been awarded.

XII. Does AMC/LCMC make particular efforts to improve relationships or build trust with suppliers? If yes—

A. Would you describe these efforts? How do they work?

B. Are they still going on?

C. Who is conducting them?

D. How are they faring?

E. Is there someone we should talk to in order to get more details on this?

Many interviewees described various communication efforts that they made with suppliers—through supplier meetings and, more often, through email and telephone contact—that developed relationships and built trust. A few individuals talked about the importance of strong relationships and trust for supplier management, and a few others described how relationships had improved over the past several years. One interviewee described frequent relationship-building meetings that the interviewee's commander had with suppliers, outside of regularly scheduled meetings. Another described adding a social component to the APBI for the express purpose of developing that relationship further. Finally, one individual described ongoing efforts with both suppliers and Army personnel to replace an adversarial model with a partnering one.

XIII. Does AMC/LCMC have any other efforts to improve supplier relations, performance, or management?

A. Would you describe these efforts?

B. Are they still going on?

C. Who is conducting them?

D. How are they faring?

E. Is there someone we should talk to in order to get more details on this?

Although most respondents reported that they had covered all of their efforts by this point in the interview, some reported a wide range of additional efforts. For example, one interviewee mentioned looking strategically across suppliers and across the different services of the military for solutions when large-scale problems arose. Another described newly implemented additional meetings with randomly selected suppliers that were designed to increase open communication about all aspects of the relationship. Still another described taking some senior personnel out of their regular operations to lead strategic teams for improving specific aspects of supplier relations.

XIV. Does AMC/LCMC have any other efforts to reduce their numbers of contracts, shift to longer-term contracts, or analyze supply markets and suppliers?

A. Would you describe these efforts?

B. Are they still going on?

C. Who is conducting them?

D. How are they faring?

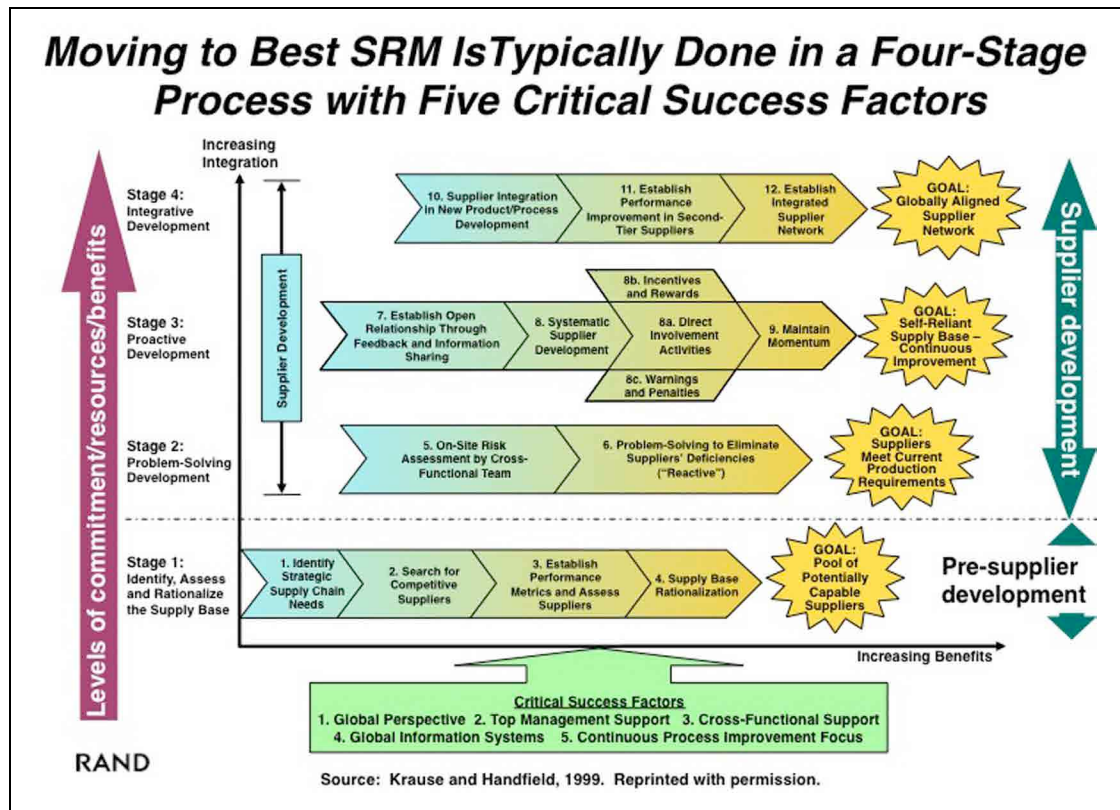
E. Is there someone we should talk to in order to get more details on this?

Most LCMC interviewees described efforts stretching back 10 to 15 years to move toward more long-term contracts. Several described how these efforts had led to substantial improvement in the number of long-term contracts. They reported that the vast majority of their dollars and “major” National Stock Numbers were in long-term contracts. This was clearly a conscious goal for the LCMCs. Indeed, a few interviewees reported that they were always looking for new opportunities to consolidate contracts. AMC personnel were more likely to refer to the stand-up of the new Army Contracting Command as evidence of a movement toward more strategic contracting. Finally, a few

interviewees reported that, although they wanted more long-term contracts, there were not enough government contract specialists available to make it possible.

Appendix B.

A Detailed Description of Krause and Handfield's Supplier Development Model



The figure above outlines Krause and Handfield's (1999, p. 9) four-stage Supplier Development Model. In this appendix we describe each stage in more detail.

Stage 1: Identify, Assess, and Rationalize the Supply Base.

This stage has four steps.

1. *Identify strategic supply chain needs* (p. 19). Strategic supply chain needs are those whose fulfillment can lead to dramatic performance improvements in cost, quality, and delivery/cycle time, as well as in technology and

financial health, management, and capacity. The top ten supplier improvement goals identified by Krause and Handfield were as follows:

- a. improve quality
- b. reduce total costs
- c. improve delivery responsiveness
- d. reduce unit price
- e. increase supplier service/responsiveness
- f. improve supplier technical capability
- g. increase supplier product development capability
- h. increase supplier managerial capability
- i. reduce supply base
- j. increase supplier financial strength.

2. *Search for competitive suppliers* (p. 22). Global economics (e.g., currency risk from fluctuating exchange rates), intensified global competition, and domestic content laws and other protectionist actions in some countries are driving enterprises to seek global suppliers for their operations. Krause and Handfield highlight the following “substeps” as part of the search for competitive suppliers:

- a. Focused search in target country or region (p. 24). Once a buying enterprise decides to seek suppliers in a specific area, it uses various strategies to identify prospective suppliers, such as hosting conferences or meetings, establishing an international procurement office, or working with local government development agencies that may also provide local training.
- b. Narrow supply options (p. 26). Once a buying enterprise has contacted local suppliers, it should narrow its options to those that

can meet its specified requirements and help fulfill its strategy for a commodity.²²

3. *Establish performance metrics and assess suppliers* (p. 28). Many leading enterprises develop a performance measurement system to assess and track their suppliers' performance over time. This enables them to quickly identify any supplier problems that need immediate attention, target areas and suppliers for supplier development efforts, encourage supplier performance improvement, identify and phase out poorly performing suppliers that will not or cannot improve, and identify high-performing suppliers for more business. For example, Alltel issues scorecards to its 35 strategic suppliers,²³ which represent 65 percent of its spending, and looks for continuous improvement (Carbone, 2007). Ideally, performance measurement systems should be real-time and provide suppliers with immediate feedback, but many are less automated, with assessments performed on a quarterly basis. The specific metrics that enterprises use to measure supplier performance vary and often depend on their customers' and their own strategic goals. Most performance assessments include some measure of price/cost/total cost, quality, delivery, and cycle time, as well as other metrics that are important to the enterprise (e.g., product and process technology, engineering capabilities, management skills). Leading companies also develop a formal process for communicating with suppliers and providing feedback on their performance.

²² See, for example, Honda of America (undated), which outlines Honda's expectations for suppliers.

²³ Strategic suppliers are those that are embedded in Alltel's operations. Their failure would be costly because switching business to another supplier would be very high. Furthermore, Alltel believes that if it invests in relationships with these companies, it will gain a differential or competitive advantage. Thus, networking equipment billing systems or other efforts that result in revenue generation are strategic to Alltel (Carbone, 2007).

4. *Supply-base rationalization* (p. 29). Because supplier development efforts can require significant financial and personnel resources, there are benefits in eliminating incapable suppliers and concentrating on fewer, better-performing, more capable businesses (i.e., those with broader offerings of goods and services, including design and other product development services, and newer/better technology). Global suppliers can also hold an advantage for an enterprise, making this an important prerequisite for supplier development. Sawchuck (2007, Chart 24) reports that “supply-base rationalization . . . drives not only spend leverage savings, but reduces the cost of administration.” In addition, “[w]orld-class organizations have just 7.1% of their suppliers providing 80% of annual direct spend versus 9.0% for the peer group [and] . . . 3.4% of their suppliers providing 80% of annual indirect spend versus 6.0% for their peer group.”

A number of leading enterprises that have already significantly reduced their supply base report that their rationalization efforts are ongoing as they continually seek to replace poorer-performing and/or less capable suppliers with better-performing and/or more capable suppliers.²⁴ These efforts, which began earlier, in step 2b, are ongoing; they receive a more thorough review here.

The goal of the four steps in Stage 1 is to develop a *pool of potentially capable suppliers* (p. 19) for meeting the buying enterprise’s requirements.

Stage 2: Problem-Solving Development (p. 31).

The purposes of this stage are to identify supplier capabilities, strengths, and weaknesses/deficiencies; establish a baseline of suppliers’ core processes and

²⁴ Sawchuck (undated, chart 22) reports that 75 percent of world-class companies “formally review a significant portion (>25%) of their supply base annually for rationalization.” The Hackett Group defines world-class companies in its survey as those in the top decile in terms of effectiveness (quality, access to information, supplier leverage, economic return, and alignment with business) and efficiency (cost, cycle time, productivity, staffing, and technology leverage) (chart 9). The survey included 2,400 clients representing 97 percent of Dow Jones Industrials and 81 percent of Fortune 100 companies (chart 4).

outputs; and, where appropriate, work with suppliers to correct any deficiencies in current performance. This stage has two steps.

5. *On-site risk assessment by cross-functional teams* (p. 32). The purpose of this step is to gain a thorough understanding of a supplier's capabilities, strengths, and weaknesses/deficiencies, as well as its ability to meet future requirements. Buying enterprises often develop a risk assessment measurement protocol²⁵ that teams use during on-site supplier visits. Typical assessment areas include quality; cycle time; changeover; performance measurement; inventory management; cost-reduction, technical, ramp-up, and project management capabilities; purchasing and sourcing skills; sophistication of information systems; financial health; management vision; and labor and environmental performance. These assessments help suppliers understand the buying enterprise's requirements and are sometimes used to qualify a supplier's processes. One outcome of the assessment may be a continuous improvement plan for the supplier.
6. *Problem solving to eliminate suppliers' deficiencies ("reactive")* (p. 34).²⁶ The purpose of this step is to fix current supplier problems that are affecting the buying enterprise's production and require immediate attention. These problems are often identified by the buying enterprise's supplier performance measurement system or its on-site risk-assessment team.²⁷

²⁵ Some automotive companies use QS-9000 criteria, and some electronics/electrical companies use the Standard Supplier Quality Assessment criteria developed by SEMATECH for their assessment protocol (Krause and Handfield, 1999).

²⁶ For at least one-third of the companies represented in Krause and Handfield's (1999) interviews, this was their most advanced level of supplier development—reactive problem solving.

²⁷ Krause and Handfield's survey of U.S. purchasing managers found that supplier development teams were typically cross-functional and most often involved personnel from the purchasing, quality assurance, engineering, materials management, and manufacturing departments in descending order of participation.

Supplier problems or deficiencies not related to short-term production needs, such as efficiency and capabilities, are deferred for future improvement efforts.

The goal of Stage 2 is that *suppliers meet current production requirements* (p. 31).

Stage 3: Proactive Development (p. 35).

This stage has three steps.

7. *Establish open relationships through feedback and information sharing* (p. 35). This step sets the stage for proactive supplier development by targeting suppliers for proactive development. These are typically suppliers that produce a critical commodity (e.g., one with a high cost, value, or volume) but are not meeting current requirements for quality, delivery, or cost and also have managers who appear willing to discuss problems. Once suppliers have been selected for proactive development, buying enterprises initiate dialogue with suppliers' top management to communicate the buying enterprise's intent, understand any supplier reluctance to open its facilities to the buyer or improve its performance, and discuss future actions identified in steps 3 and 5 to improve supplier efficiency, capabilities, or performance. Ideally, a candid discussion of supplier problems takes place, with the supplier and buying enterprise agreeing on the need for improvement and both expressing a willingness to cooperate, get to the root causes of problems, and solve them.²⁸ The goal of these discussions is to identify a specific process for a joint improvement initiative with a high likelihood of quick success. The outcome is often a letter of agreement signed by both companies

²⁸ Buying enterprises can contribute to 40–60 percent of supplier problems through such actions as producing inaccurate forecasts, changing requirements without notifying suppliers, or making design changes at the last minute (Krause and Handfield, 1999).

specifying the time and resources each will commit to the joint improvement initiative.

8. *Systematic supplier development* (p. 39). While enterprises vary in their approaches to proactive supplier development, they typically use one or more of the following three practices to speed supplier improvements:²⁹
 - a. Direct involvement activities (p. 39). Some enterprises take a hands-on approach and send experienced personnel to supplier facilities to help them fix problems and develop capabilities. These efforts may include *kaizen* (i.e., continuous, incremental improvement) events, process mapping, work-in-process inventory reductions, total preventative maintenance, and other joint projects, as well as education and training for supplier personnel in improvement techniques, such as statistical process control and Pareto analysis, and in personnel, environmental, and supply-base management.³⁰
 - b. Incentives and rewards (p. 42). Some enterprises use incentives and rewards (“carrots”) to encourage their suppliers to continually

²⁹ Respondents to Krause and Handfield’s survey (1999, p. 41, Table 11) of U.S. purchasing managers reported that visits by personnel (supplier personnel to buyer and buyer personnel to supplier) were the most extensive form of direct involvement, followed by high-level meetings with supplier upper management, joint cost-saving projects, shared cost savings, and encouraging suppliers to improve management of their suppliers. Less used practices were regular visits by buyer engineering personnel to the supplier’s facilities, dedicated supplier development teams, allocation of buyer personnel to improve the supplier’s technical skill base, training/education of supplier personnel, and direct investment in supplier operations.

³⁰ Joint improvement projects, sometimes called *kaizen* events, breakthroughs, or blitzes, can last anywhere from 1 to 24 weeks. One objective of these projects is to demonstrate to supplier personnel the feasibility of improvement and tangible results that can be obtained through a basic continuous improvement model, such as “Plan-Do-Check-Act” cycle, which was introduced by W. Edwards Deming and is sometimes referred to as the Shewhart or Deming Cycle (Krause and Handfield, 1999).

improve, including providing financial assistance,³¹ increasing order volumes, steering more future business to suppliers that improve within a certain time frame, or hosting annual award ceremonies where superior supplier performance is recognized.³² These can also complement the buying enterprise's direct supplier development activities.

- c. Warnings and penalties (p. 43). Some enterprises use negative incentives in the form of warnings and penalties ("sticks") to indicate to suppliers the consequences of continued poor performance or failure to improve. These include withholding future business or introducing competition by putting the work out for bid or using multiple suppliers for the same good or service.³³

- 9. *Maintain momentum* (p. 45). Without proper reinforcement, there is a danger that lessons learned during initial proactive supplier development efforts will be lost and suppliers will return to their old behaviors and practices. Ideally, buying enterprises want suppliers to maintain high levels of performance and initiate operation improvements on their own. Many buying enterprises institutionalize the use of measurement-driven supplier performance metrics, incentives and rewards, and warnings and

³¹ Financial incentives, which are most likely to be used in regions experiencing economic duress, include paying supplier invoices early, providing access to loans at lower interest rates, and investing in supplier facilities and equipment (Krause and Handfield, 1999).

³² U.S. purchasing managers reported that the promise of future business if performance improves was the most used supplier incentive, followed by the promise of additional current volume if performance improves (unlikely for sole-source suppliers), and awards recognizing supplier performance improvements (Krause and Handfield, 1999, p. 44, Table 12).

³³ Krause and Handfield's (1999) survey of U.S. purchasing managers reported that verbal or written requests that a supplier improve its performance were among the warnings and penalties used most often, followed by putting the item out for bid and using two or three suppliers for the same good or service. Least reported was using four or more suppliers for the same good or service (p. 45, Table 13).

penalties (particularly the fear of losing business) in their supplier relationships to reinforce supplier development efforts and motivate suppliers to improve further. Some also use monthly supplier visits to prevent backsliding, maintain the initial momentum of supplier development efforts, and help suppliers become self-reliant.

The goal of Stage 3 is to have a *self-reliant supply base with continuous improvement* to meet evolving buyer needs (p. 35). Only about one-third of the companies in Krause and Handfield's study had developed their supply base to this stage, and many had done so only in one particular region. More importantly, these companies acknowledged that significant further progress could be made by better integrating suppliers throughout the supply network.

Stage 4: Integrative Development (p. 46).

Few buying enterprises have made progress in this area of supplier management, which builds on the previous three stages and has the potential to deliver the highest level of benefits. It has three steps.

10. *Supplier integration in new product/process development* (p. 47). The purpose of integrating suppliers early in new product/process development is to speed the new product development and production process, incorporate the latest technology into new products and services, and prevent costs from being designed into products³⁴—actions that make suppliers, and their customers, more competitive.³⁵ This enables buyers to influence suppliers' new product- and process-development efforts and

³⁴ Approximately 70 percent of a product's cost is determined in the design/development phase (Teague, 2005).

³⁵ U.S. purchasing managers reported to Krause and Handfield (1999) that supplier involvement in new product development was most often initiated during the product design phase, the next most frequent area of supplier involvement was during the concept phase, followed by supplier involvement at the production, prototype, and pre-production phases.

suppliers to influence the design of products to improve manufacturability, serviceability, standardization, and quality. Involving suppliers in new product development also enables them to better plan for facilities, capacity, and new production ramp-up, which is particularly important in products with short production life cycles. Suppliers are integrated into new product design through mechanisms such as collocation of buyer and supplier personnel, “guest engineers,”³⁶ sharing technology road maps,³⁷ and integrating information systems.

11. *Establish performance improvement among second-tier suppliers* (p. 51). Poor performance by second- or lower-tier suppliers can adversely affect supply chain performance. Design changes by a second- or lower-tier supplier can affect product or process performance. Poor products, late deliveries, or capacity problems at lower-tier suppliers can also adversely affect a first-tier supplier’s ability to meet the buying enterprise’s requirements. Consequently, some buying enterprises are beginning to develop maps of their end-to-end supply chains³⁸ and perform risk and capability assessments of key lower-tier suppliers to understand their impact on key supply chain processes and production capacities. In some cases, buying enterprises will leverage their total buying power for their smaller first- and lower-tier suppliers to purchase common commodities, such as steel. A few buying enterprises are encouraging or helping their first-tier

³⁶ Guest engineers are supplier engineers involved in product development working alongside the buying enterprise’s engineers at research and development facilities (Krause and Handfield, 1999).

³⁷ A technology road map details how an enterprise plans to incorporate new and emerging technologies into its goods and services or operations over time. Buying enterprises share their product technology road maps with key suppliers to help ensure that suppliers are capable of meeting future technology requirements and that they have the required capability prior to their involvement in new product development (Krause and Handfield, 1999).

³⁸ For a workbook outlining how to map the supply chain, see Jones and Womack (2002).

suppliers to better manage their lower-tier suppliers. Some are reaching out and forming relationships with key lower-tier suppliers themselves (Amaral, Billington, and Tsay, 2004; Carbone, 2001, 2004a, 2004b; Goodman, 2006). Some buying enterprises, such as Cisco, are trying to use the Internet to increase visibility, monitor performance, and coordinate plans over more than three tiers of their supply base (Lee, 2002).

12. *Establish an integrated supplier network* (p. 52). This was the most advanced supplier development strategy being deployed by a few of Krause and Handfield's case companies. Ideally, these buying enterprises want their suppliers to be able to supply any location worldwide, at a competitive price, with comparable quality, delivery, and technology performance, and to participate with them in global growth opportunities. To achieve this goal, buying enterprises are encouraging their best suppliers to grow and develop capabilities in regions where the buying enterprises are developing new production facilities. They are also encouraging their suppliers to set up associations for sharing information and educating each other on the latest technologies and best business practices.

The goal of Stage 4 is to develop a *globally aligned supplier network* (p. 46). Krause and Handfield note that even the most advanced automotive and electric/electrical enterprises in their study had not yet achieved this final level of integration.

Appendix C. Blank PPIRS Form

	CONTRACTOR PERFORMANCE ASSESSMENT REPORT (Source Selection Sensitive Information, See FAR 2.101 and 3.104)	SYSTEMS
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Contractor Name and Address

Company Name:

Division Name:

Street Address:

City, State, Zip Code:

CAGE Code:

DUNS+4 Number:

NAICS:

FSC:

SIC Code:

TIN:

Report Type: Initial

Period of Performance Being Assessed: From: To:

Contract Number:

Order Number:

DoD Business Sector & Sub-Sector:

Location of Contract Performance:

Contracting Office:

Contracting Officer:

Contract Award Date:

Contract Completion Date:

Contract Percent Complete:

Awarded Dollar Value: \$

Current Dollar Value: \$

Basis of Award:

Type of Contract:

Type of Availability:

Program Title and Phase of Acquisition:

Contract Effort Description:

Key Subcontractor(s):

Contractor

Name:

CAGE Code:

DUNS+4 Number:

Effort Performed:

Contractor

Name:

CAGE Code:

DUNS+4 Number:

Effort Performed:

Contractor

Name:

CAGE Code:

DUNS+4 Number:

Effort Performed:

DoD

DoD uses a common DoD assessment rating system to evaluate a contractor's past performance. Ratings range from "unsatisfactory" to "exceptional." On major system acquisitions, colors are used to rank assessments. The following table provides a breakdown of each category (with colors in parentheses).

Rating	Definition
Exceptional (dark blue)	Performance meets contractual requirements and exceeds many requirements to the government's benefit.
Very good (purple)	Performance meets contractual requirements and exceeds some to the government's benefit.
Satisfactory (green)	Performance meets contractual requirements.
Marginal (yellow)	Performance does not meet some contractual requirements. The element being assessed reflects a serious problem for which the contractor has not yet implemented satisfactory corrective actions.
Unsatisfactory (red)	Performance does not meet contractual requirements and recovery is not likely in a timely manner. Contractor's corrective actions to date are ineffective.

Area Rated

Past Rating Rating

Technical (quality of product)
Product performance
Systems engineering
Software engineering
Logistic support/sustainment
Product assurance
Other technical performance
Schedule
Cost control
Management

Management responsiveness
Subcontract management
Program/other management

Other areas

(1):
(2):
(3):
(4):
(5):

Variance (contract to date)	Current	Completion
Cost variance (%)	%	%
Schedule variance (%)	%	%

Assessing Official Comments

Technical (quality of product):
Product performance:
Systems engineering:
Software engineering:
Logistic support/sustainment:
Product assurance:
Other technical performance:
Schedule:
Cost control:
Management:
Management responsiveness:
Subcontract management:
Program/other management:
Overall comments:

Systems engineering:

Logistics support/sustainment:

Product assurance:

Schedule:

Management:

Management responsiveness:

Subcontract management:

Program/other management:

Assessing Official:

Name:

Title:

Organization and code:

Phone:

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Date:

Contractor Comments

Overall comments:

Contractor Representative:

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Phone:

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Date:

Reviewing Official Comments

Reviewing Official:

Name:

Title:

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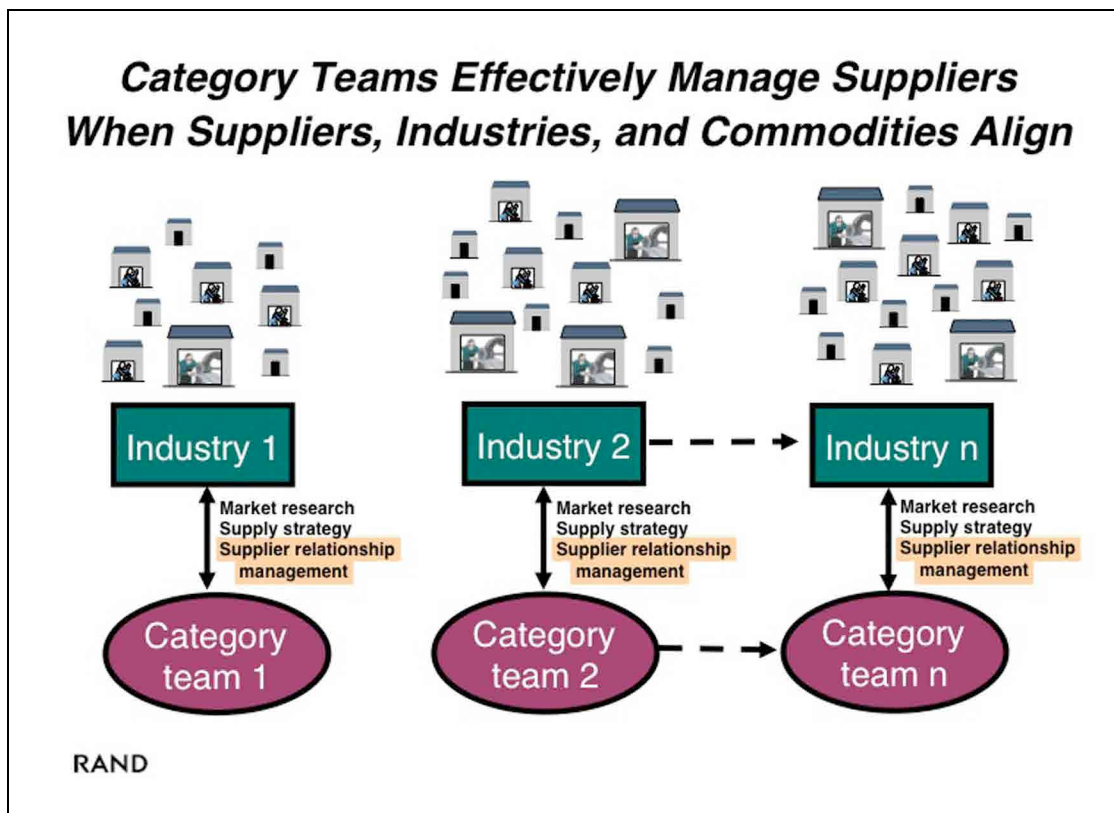
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Appendix D.

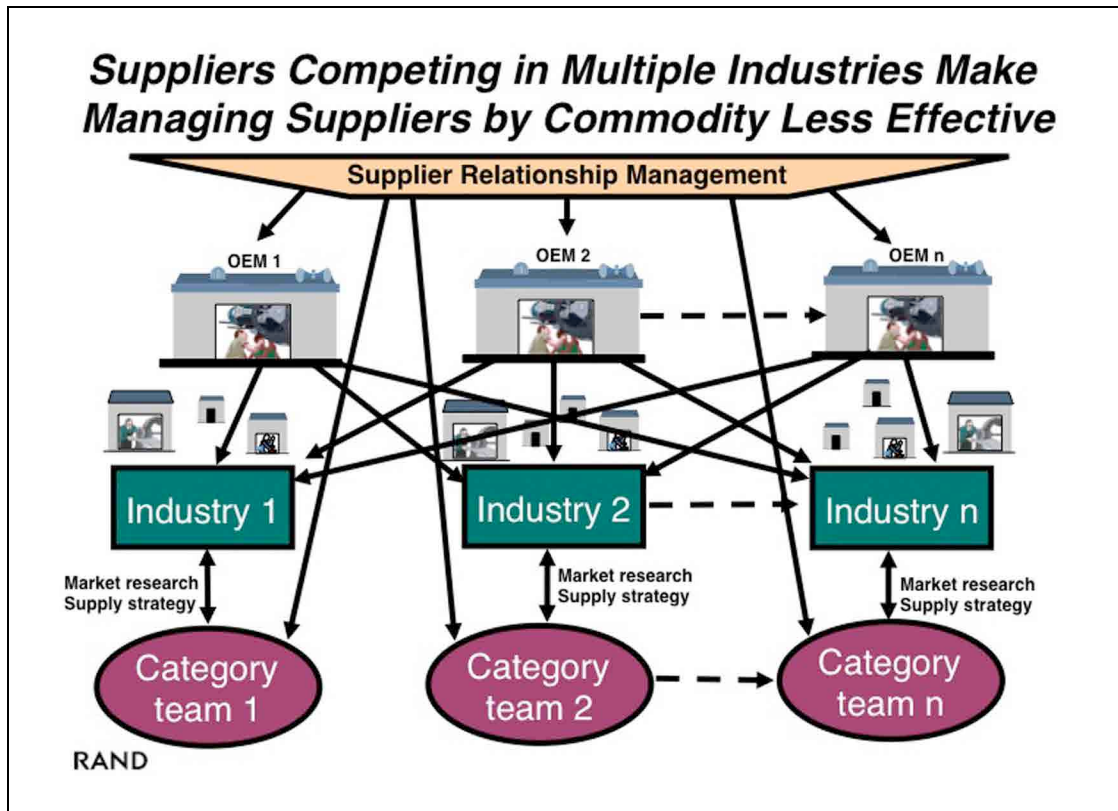
Organizational Impediments to SRM³⁹



Many suppliers provide goods or services within a specific industry, which can simplify SRM, and buying enterprises create category teams to centrally buy goods and services. These teams can often manage and develop suppliers for their category group because there is little or no overlap of business with other major category groups. For example, Nortel's supplier portfolio teams manage certain product commodities and are responsible for developing

³⁹ Much of this is also discussed in Nancy Y. Moore, Mark Wang, and Carol Fan, "Gaps in Purchasing and Supply Management Between Army Life-Cycle Management Commands and Best-Practice Organizations," Santa Monica, Calif.: RAND Corporation, DB-615-A, forthcoming.

strategies and evaluating the supplier's performance (Carbone, 2005a). Sun Microsystems' ten commodity teams are responsible for supplier evaluations (Carbone, 2005b). And Hewlett-Packard's (HP's) commodity teams manage supplier relationships and set supplier strategies (Carbone, 2004b).



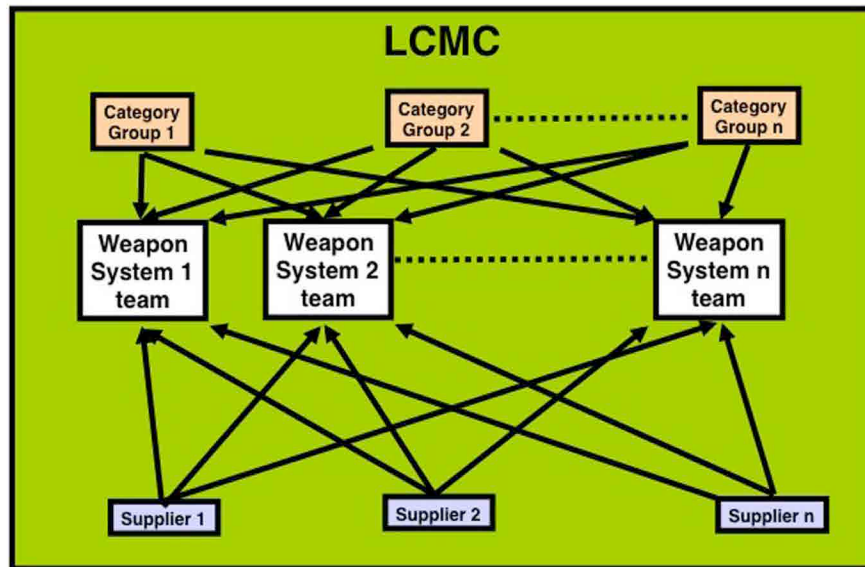
Not all suppliers provide goods within a specific industry or category group. Some suppliers provide multiple commodities to an enterprise. For such suppliers, buying enterprises may create centralized supplier managers. For example, IBM production procurement is developing “enterprise relationships” to manage the overall relationship between IBM and suppliers that provide multiple commodities (Carbone, 1999). At HP, suppliers often provide multiple commodities to multiple HP business groups. HP has about 45 executive sponsors (vice presidents or senior vice presidents) who meet with suppliers at least twice a year to review business issues. These sponsors are part of HP’s strategy to make its relationships with suppliers more synergistic and less transactional. Before the sponsor meets with a supplier, HP purchasers provide an extensive summary of that company’s business with the supplier and categorize spending and opportunities in every commodity (Carbone, 2004b).

SRM for the Army is much more complicated than it is for private-sector companies. The Army does not manufacture products and instead buys entire

weapon systems that are hugely complex. OEM suppliers of complex weapon systems, including the original prime contractors, provide a broad array of goods and services to support their products. The consolidation in the aerospace industry has made companies very diverse and capable of manufacturing products across multiple industries, e.g., electronics and armaments, auxiliary power units and communications equipment. The goods and services of these defense aerospace companies typically span a broad range of major commodity groups and industries, demonstrated by a review of spending on NIINs managed by the three LCMCs. Consequently, using category teams, such as TACOM's Team Track, which specializes in procuring and managing suppliers of track for Army vehicles, to manage these large OEMs would be less effective and lead to multiple contracts with the same supplier. For large suppliers that provide goods and services across industries and commodity teams, SRM needs to be elevated to a more senior management level above the commodity teams.

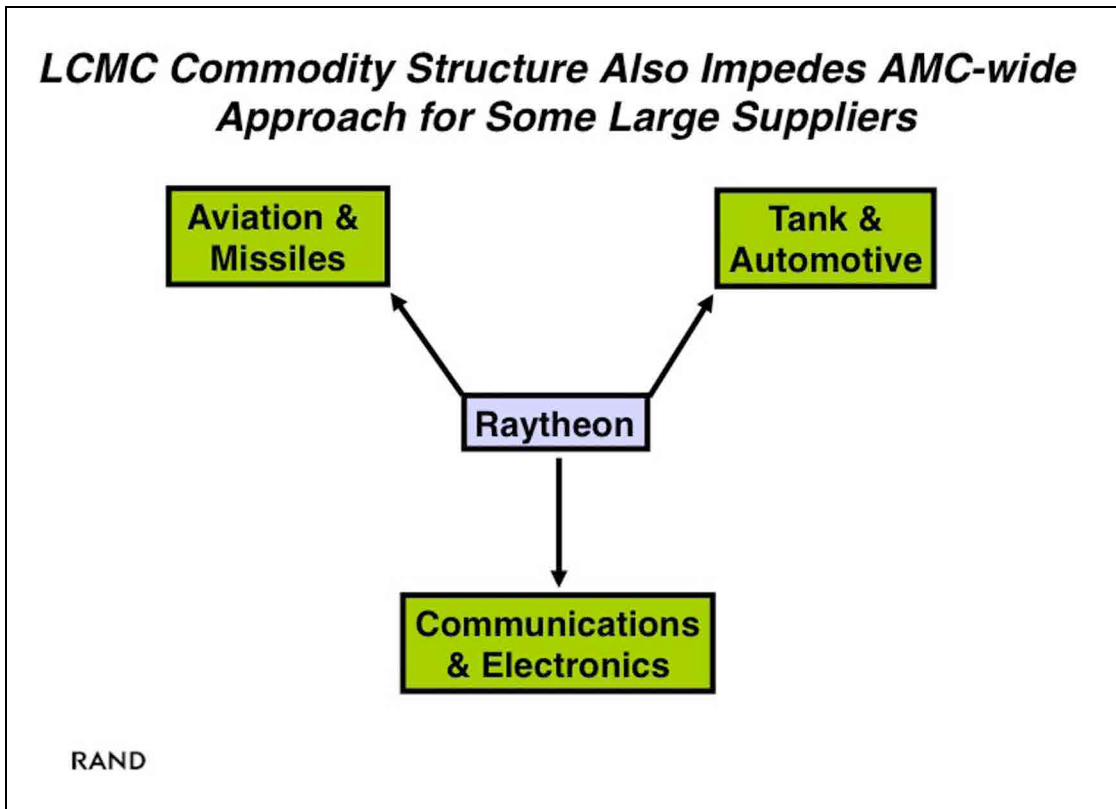
The goods and services required to support a complex weapon system span multiple commodity groups, suppliers, and industries. Our research found that 9 of the top 15 LCMC suppliers by dollar amount have considerable business spanning two or more LCMCs; many also have significant business with non-Army DoD components. This makes supplier management in the Army very challenging.

LCMC Weapon System Team Structure Impedes SRM When Suppliers Cross Weapon Systems



RAND

The Army currently manages weapons and sustainment by weapon system, as illustrated in the notional figure above. However, when suppliers span weapon systems, managing those suppliers by weapon system addresses only part of their business with the Army. Managing the Army's total business with that supplier would require managing suppliers at a level that spans weapon systems.



Because LCMCs are also structured along a type of weapon system/commodity, Army purchases from major OEM suppliers (such as Raytheon) must span LCMCs to supply all relevant weapon systems. This makes SRM with these suppliers problematic, unless their management is elevated to AMC HQ.

In organizing for purchasing and supply management, the LCMCs must be aware that their organizational structures can pose impediments. They need to organize as much as possible by commodities, particularly for competitive goods and services, as well as by supplier for sole-source goods and services. They can also use information systems to aggregate future similar requirements across weapon systems and organizations as well as sole-source contracts across suppliers. Finally, they can benefit by linking sustainment to acquisition, when purchasing leverage for sustainment items is greatest.

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