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An Exploratory Analysis of the Impacts of Acquisition Reform Initiatives on Small Business Participation in the Aerospace Industry

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AN EXPLORATORY ANALYSIS OF THE IMPACTS

OF ACQUISITION REFORM INITIATIVES

ON SMALL BUSINESS PARTICIPATION

IN THE AEROSPACE INDUSTRY

THESIS

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Bruce J. Miller

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Abstract

The United States Government is a major purchaser of goods and services within the nation and overseas. In addition to having the responsibility of acquiring goods and services for the direct benefit of the Government at a price, level of quality, timeliness and other terms and conditions that reflect the best value to the nation, the persons involved in procurement for the Government must also do so in way that reflects certain socio-economic goals set forth by the Congress.

The Small Business Act (15 USC § 637, Public Law 85-536 (1958) established the beginnings of a program to assist domestic small businesses in competing for Federal procurements. The small business act requires that small business concerns be afforded the maximum practicable opportunity to participate in Federal contracts and subcontracts.

This thesis looks the impact of acquisition reform and related developments in the last ten years on the participation of small business subcontractors in the aerospace industry through the window of six major aerospace weapon system programs.

The objectives of this research were to (1) research the buying practices of the defense aerospace industry to determine current trends relating to small business levels of participation by comparing acquisition programs, and (2) compare existing Air Force small business programs, policies, and techniques to developing trends for small business participation and identify strengths and weaknesses.

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I. Introduction

Background

The general area of interest for this thesis is Department of Defense (DoD) and United States Air Force (USAF) acquisition policy and more specifically the small business assistance program of the USAF. It is desired that an assessment be made of the impact acquisition reforms of the past decade have had on small business participation in defense programs at the subcontractor level.

The United States Government is a major purchaser of goods and services within the nation and overseas. In addition to having the responsibility of acquiring goods and services for the direct benefit of the Government at a price, level of quality, timeliness and other terms and conditions that reflect the *best value* to the nation, the persons involved in procurement for the Government must also do so in way that reflects certain socio-economic goals set forth by the Congress.

Mandates for Small Business Participation. In the 1950's concerns were raised that a disproportionate share of Federal procurement dollars were being awarded to large businesses at the exclusion of the small business community. These concerns led to the passage of the Small Business Act (15 USC § 637, Public Law 85-536, (1958), which established the beginnings of a program to assist domestic small businesses in competing for Federal procurements. The small business act requires that small business concerns

be afforded the *maximum practicable opportunity* to participate in Federal contracts and subcontracts.

Over the years, additional requirements were added to the small business program. One is a requirement that large business prime contractors negotiate a plan for subcontracting with small and small disadvantaged businesses for each new prime contract award over $500,000 that contained opportunities for subcontracting. For a number of very large contractors, this entailed negotiating individual subcontracting plans for hundreds of new awards each year with hundreds of different government Contracting Officers. For some of the very largest defense contractors, the administrative burden of this process was significant. In the early 1990's, a program was initiated that permits these large defense contractors to negotiate one comprehensive subcontracting plan for an entire plant, division, or corporation. One of the arguments made by advocates of the comprehensive approach was that time formerly spent on negotiating individual subcontracting plans could now be spent on increasing opportunities for small business.

Recent Trends. In the last several years the trend for small business participation in Air Force procurements has been in decline. Command goals for small business participation are set each year for each of the Air Force's major commands and for the Air Force overall. For AFMC, the major command responsible for acquiring and maintaining the Air Force's weapon systems, the percentage of dollars awarded directly to small businesses of all types fell from 12.6% to 10.3% in the period from 1995-2000. Perhaps more important is the fact that whereas AFMC's actual awards frequently exceeded command goals they are no longer doing so consistently. There also is a

perception that small business participation as subcontractors is also declining and that prime contractors are not meeting the goals set forth in their subcontracting plans. These trends have caused concern for the Air Force Office of Small and Disadvantaged Business Utilization (SAF/SB).

SAF/SB Interest. SAF/SB is the office of primary responsibility within the Air Force for ensuring that the *maximum practicable opportunity* mandate of 15 USC § 637 is met. Continued erosion of opportunity will come under scrutiny by the small business committees of the Congress. It is important that the reasons for the decline be explored in order to determine the most appropriate response.

In the area of small business participation as subcontractors on major programs, the Director of SAF/SB prepared a memo that stated, in part:

> The enhanced utilization of small business in Air Force procurements is a goal that we continue to pursue. Yet the optimum level of small business use as well as the optimum areas for opportunities which small business can be provided remain the issue which will dictate our course of policy and execution. Recently, several initiatives have been launched to raise small business participation. However, recognizing the procurement practices associated with acquisition reform, aerospace industry consolidation and the push for an integrated industrial base it remains unclear if these initiatives are properly targeted. It is now necessary that we initiate a review of the procurement practices and the related processes of both the Air Force and the private sector to ensure the vector we are taking and the resources we are expending are properly focused and our policies are in alignment with industry practices and targets of opportunity.

Based on this memo, the research objectives were established with the first goal of identifying the trends related to small business participation as subcontractors and the second goal of comparing these trends to existing SAF/SB program initiatives.

Research Objectives

The objectives of this research are as follows: (1) Research the buying practices of the defense aerospace industry to determine current trends relating to small business levels of participation by comparing acquisition programs, and (2) Compare existing Air Force small business programs, policies, and techniques (including MTAPP) to developing trends for small business participation and identify strengths and weaknesses.

Research Scope

The scope of this effort is limited to the discernment trends in small business subcontractor participation in aerospace programs through the window of six major weapon systems: F-16, F-22, C-17, JSTARS, AMRAAM, and SBIRs. The prime contractors for these programs are Lockheed Martin (for both the F-16 and F-22), Boeing, Northrop Grumman, Raytheon, and TRW, respectively. The results should be representative of the type of contractors that provide the majority of the aerospace subcontracting opportunities to small business.

Thesis Structure

Chapter 2 of this thesis will discuss current literature regarding the research objectives and also provide background information on the DoD small and disadvantaged business utilization program. Chapter 3 will discuss the research methodologies employed. Chapter 4 will provide data analysis and results. Chapter 5 will provide conclusions and recommendations for further research.

II. Literature Review

The purpose of this chapter is to review the literature relevant to the research objectives of this thesis and provide additional background information relative to the DoD Small and Disadvantaged Business Utilization program.

The Small Business Statutes

The Federal Government enforces a number of what are termed *socio-economic* programs on its contractors as a condition of being awarded a Federal contract. These include, but are not limited to, terms and conditions relating to equal employment opportunity, occupational health and safety, prevailing wages, environmental protection, and small business participation. As the size of Federal Government procurement budgets grew during the period around World War II and the Korean War, concerns were raised that a disproportionate share of Federal procurement dollars were being awarded to large businesses at the exclusion of the small business community. These concerns led to the passage of the Small Business Act (15 USC § 637, Public Law 85-536 (1958), which established the beginnings of program to assist domestic small businesses in competing for Federal procurements. The policy of the Federal government is explicitly set forth in the following excerpt (15 USC § 637, no pg.):

> It is the policy of the United States that small business concerns, small business concerns owned and controlled by service-disabled veterans, qualified HUBZone small business concerns, small business concerns owned and controlled by socially and economically disadvantaged individuals, and small business concerns owned and controlled by women, shall have the maximum practicable opportunity to participate in the performance of contracts let by any Federal agency, including contracts and subcontracts for subsystems, assemblies, components, and related services for major systems. It is further the policy of the United States

> that its prime contractors establish procedures to ensure the timely payment of amounts due pursuant to the terms of their subcontracts with small business concerns, small business concerns owned and controlled by service-disabled veterans, qualified HUBZone small business concerns, small business concerns owned and controlled by socially and economically disadvantaged individuals, and small business concerns owned and controlled by women.

Over the years, additional requirements were added to the small business program, including one that large business prime contractors must negotiate a plan for subcontracting with small and small disadvantaged businesses for each new prime contract award over $500,000 that contained opportunities for subcontracting. For a number of very large contractors, this entailed negotiating individual subcontracting plans for hundreds of new awards each year with hundreds of different government Contracting Officers. The administrative burden of this process was significant, so the regulations were changed to permit a "Master Plan" for a particular contractor plant or location, but individual subcontracting goals for each contract still had to be negotiated with each Contracting Officer. For some of the very largest defense contractors, this was still a significant administrative burden.

The Comprehensive Test Plan Program**.** In the late 1980's, a plan was developed to create a pilot program to test whether or not it would be better for the very largest defense contractors to negotiate one subcontracting plan for all contracts with a particular plant, division, or the entire corporation. The end result of this plan was the creation of the Comprehensive Test Plan Program, hereinafter, the "Program". Section 834 of Public Law 101-189, the National Defense Authorization Act for Fiscal Years 1990 and 1991 instructed the Secretary of Defense to establish a test program to determine whether

negotiation and administration of comprehensive subcontracting plans would both lessen the administrative burden on prime contractors and increase the subcontracting opportunities for small businesses (PL 101-189, no pg.). The test program was originally to have been terminated at the end of Fiscal Year (FY) 1995, but has been extended twice. Section 817 of Public Law 106-65 recently extended the termination date for the end of the test program to 30 Sep 2005 (PL 106-65, no pg.). As of FY99, there were eleven prime contractors in the test program and twenty-one separate comprehensive plans (ASC/BC website, no pg). Recall that plans may be established at the facility, division, or corporate level. Some companies have plans for each facility, some for each division, and others have one plan for the entire corporation. There are a number of other companies that do not participate in the test program but do negotiate individual contract subcontracting plans or master subcontracting plans.

The Comprehensive Plan program is of particular interest to this thesis effort because all of the prime contractors on the six major aerospace programs of interest (F-16, F-22, C-17, JSTARS, AMRAAM, and SBIRS) are participants in the Comprehensive Plan program. According to a recent report about the top 100 defense contractors for FY2000 (in terms of dollar value of awards), the eleven companies in the test program received combined DoD contract awards totaling $49,144,173,000.00 (GovExec.com, no pg.). This sum is for only one fiscal year, but these large companies approach this level of awards each year. The potential leverage of these test plan participants on the opportunities for small business subcontractors is enormous. Even a 1% improvement in the dollars subcontracted to small business by these large firms equates to new opportunities of nearly a half a billion dollars a year.

The Comprehensive Plan Process. The prime contractors that participate in the Program must submit an annual proposed subcontracting plan to the divisional Administrative Contracting Officer (ACO) having cognizance over the prime contractor location for which the subcontracting plan is being submitted. The plan is reviewed by the ACO with input from Small and Disadvantage Business Utilization Specialists (SADBUS) at the ACO and DoD component level. The ACO is an employee of the Defense Contract Management Agency (DCMA). DCMA is the DoD organization responsible for field administration of contracts at the prime contractors physical location or within a geographic region. The SADBUS is considered to be an expert in the area of small business participation. At the end of this coordination process, subcontracting goals for small, small disadvantaged, women-owned, Native American owned, HUBZone, and veteran-owned small businesses are negotiated with the prime contractor and a comprehensive plan for the next fiscal year is approved.

Plan enforcement for the Government is the responsibility of the ACO. The contractor submits semi-annual reports on their actual achievement towards the subcontracting goals of the program and holds quarterly meetings with the ACO and the SADBUS. Plan execution for the contractor is the responsibility usually of the Small Business Liaison Officer (SBLO), a contractor employee who specializes in small business source development. The SBLO has insight into the contractor's supplier selection and management process. It is this supplier selection and management process that is of interest to this thesis effort, since the first objective is an attempt to discern trends relating to small business participation in aerospace programs.

Acquisition Reform, Aerospace Industry Consolidation, and a National Industrial Base

The trends in aerospace acquisition relating to small business levels of participation, which are the first objective of this thesis, are not immune from the impact of other, larger forces affecting defense acquisition as a whole. Three major forces have been exerting influence on the process of acquiring and maintaining major defense systems over the past ten to fifteen years. These three are (1) the impetus for reform in the acquisition process itself, (2) the continuing consolidation of the aerospace industry, and (3) the push towards a unified national industrial base instead of separate defense and commercial industrial bases.

Acquisition Reform. After the end of the Cold War and the Gulf War the defense budget went into a period of decline in real terms. The free spending climate of the Reagan administration defense build-up ended. Since there was less room for waste and inefficiency, senior DoD leadership came to the conclusion that the way that DoD went about acquiring its weapon systems had to change. After some analysis and study, the road towards Acquisition Reform was begun during an appearance by then Secretary of Defense William Perry before the Congress in February 1994. Secretary Perry described why change was necessary and set out a plan of action to improve the acquisition process.

Initial Acquisition Reform Measures. As part of his case for why reform was necessary, Secretary Perry gave some examples to illustrate why change was so important. Three conditions were highlighted, as follows: (1) DoD is unable to acquire state of the art commercial technology, (2) DoD's is often unable to buy from commercial companies, and (3) DoD's cost of doing business are too great (Perry,

1994:1-2). Secretary Perry noted that in order to meet its national defense mission, DoD had to maintain technological superiority through a strong national industrial base and reduce acquisition costs through the adoption of world-class business practices (Perry, 1994:3). This national industrial base would consist of commercial companies and companies producing dual-use products. Dual-use products have both military and commercial applications. His remarks further said that DoD should also encourage its suppliers to adopt these improved business processes. One of the key terms that came out of Secretary Perry's statement was the concept of *acquisition streamlining.* Continuous process improvement was emphasized, along with encouraging innovation in product and practices. Dissemination of lessons learned through frequent training was encouraged. Flexibility and agility were to be praised; rigidity and unthinking adherence to rules and regulations, criticized. Sources were to be selected on the basis of best value to the Government, not lowest price. Good past performance should be rewarded during the source selection process (Perry, 1994:11-14). Secretary Perry's remarks kicked off a flurry of activity in the area of acquisition reform and led to, among other things, two legislative acts by the Congress, the Federal Acquisition Streamlining Act (FASA) of 1994 and the Federal Acquisition Reform Act (FARA).

FASA/ FARA. One of the results of Sec. Perry's appearance was the passage of the Public Law 103-355, the Federal Acquisition Streamlining Act of 1994, which is commonly referred to as FASA. FASA made a number of changes to the way the Federal government and DoD conduct acquisition. The intent was to improve and streamline the acquisition process. Several DoD acquisition programs were selected as acquisition reform pilot programs. The pilot programs were encouraged to test out

acquisition streamlining concepts and practices. Division D of Public Law 104-106, the National Defense Authorization Act for FY 1996, contained the reform measures now commonly know as the Federal Acquisition Reform Act (FARA). FARA continued and expanded the emphasis on improving Government acquisition processes.

Lean Manufacturing. As part of a related effort to determine the impact of acquisition reform on aerospace program cost savings, researchers at Project Air Force discovered trends in the way that large DoD prime contractors manage their supplier base that are of direct interest to this thesis effort. The trend of interest is the widespread adoption of what has been termed *lean manufacturing*. Lean manufacturing is not an acquisition reform initiative per se, but it is an innovation in supplier management that appears to have an enormous potential impact on small business subcontractors. The publication of the book *The Machine That Changed the World* in 1990 led to significant changes in the way that U.S. manufacturing companies develop and manufacture their products and the way that they deal with their suppliers and customers (Cook and Graser, 2001:7). In an attempt to keep pace with Japanese companies, American automobile firms adopted *lean* concepts used by Toyota to improve their competitiveness and their products. A primary goal of lean manufacturing is to add value by eliminating waste and inefficiency while improving quality and reducing costs (Cook and Graser, 2001:8). The success of these efforts and the shrinking defense budget led the Air Force to sponsor the Lean Aircraft Initiative (LAI) in 1993. LAI was a consortium of the Air Force and industry to jointly fund research into lean aerospace by researchers at MIT. The purpose of LAI was to determine whether or not these lean principles could be applied to the defense aerospace industry. Results of the study were disseminated to the defense

industry and the Department of Defense. Companies began implementation of lean concepts in several areas, including on their own factory floors and in their relationships with their supply base. The implementation of lean techniques in the supply base is of direct interest to this research effort.

Lean Purchasing and Supplier Management (PSM). According to some estimates, purchased materials and parts make up anywhere from 50% to 70% of the total cost of military weapon system costs (Cook and Graser, 2001:87). This high proportion of final cost makes purchased parts a key area for review and implementation of lean practices, since the potential for payoff is significant. There are two areas for cost savings if these lean PSM concepts are adopted: (a) savings in internal purchasing costs through a reduction in the within-company resources assigned to purchasing, and (b) improvement of supplier performance and reduction of costs through closer, more intimate relationships between the prime and strategic suppliers (Cook and Graser, 2001: 88). The authors identify nine supplier management techniques and practices that are associated with lean PSM, as follows: (1) supplier qualification and certification, (2) long-term relationships, (3) communications with suppliers, (4) electronic data interchange (EDI) with suppliers, (5) continuous improvement (*kaizen*) events at suppliers, (6) target costing, (7) just-in-time (JIT) delivery, (8) supplier management of inventory at customer, and (9) supplier kitting (Cook and Graser, 2001:92-99). Implementation of Lean PSM has implications for small business subcontractors, and as such, is important to meeting research objective 1 of this thesis effort.

Supplier Qualification and Certification. In order to make certain that the parts they purchase are of high quality, the primes put their suppliers through a

qualification step that examines their internal processes and practices. Certification is the next step in which a supplier becomes one of the primes favored suppliers on the basis of good performance, high quality, and timely delivery (Cook and Graser, 2001:92).

Long-Term Relationships. If a supplier's performance is excellent enough, they may qualify for longer-term contracts that turn them into the supplier of choice for particular items or a range of items. This can lead to volume price breaks for the prime, which the supplier is willing to offer for the guarantee of a longer-term agreement. (Cook and Graser, 2001:93).

Communications with Suppliers. Another aspect of lean PSM involves regular, formal communication with the supply base in the form of newsletters and supplier councils. These serve as a forum for exchanging industry best practices and receiving feedback on the prime's purchasing practices (Cook and Graser, 2001:94).

Electronic Data Interchange (EDI) with Suppliers. The adoption of EDI has brought greater efficiencies to the process of exchanging information between the primes and their supply base. What was once a voluminous flow of paper for technical data packages, offers, purchase orders, invoice, receipts and checks is now handled over direct data links or the internet. This has sped up the order process and improved information flow both up and down the supply chain (Cook and Graser, 2001:94). Some of the largest contractors have even banded together to create an information exchange system called Exostar for use by multiple companies. This joint venture of Lockheed, Boeing, Raytheon, and BAE Systems is an electronic marketplace for the purpose of increasing supply chain transaction efficiency and improving the ability of the aerospace industry to collaborate on design activity (Exostar, 2001: Home page).

Continuous Improvement (Kaizen) Events at Suppliers. One of the tenets of lean manufacturing is that effort towards improving cost and quality should be continuous. The primes help with this process by sending their own lean PSM experts out to the supplier's facility to work collaboratively to find areas for improvement. Any savings that result from these *kaizen* events are shared between the supplier and the prime (Cook and Graser, 2001:95).

Target Costing. One of the lean concepts employed by Toyota is the idea of arriving at a target cost for a new vehicle and then working backward from the total price to determine the costs of the individual components. Toyota determines what the price for a particular component will be and then works with its suppliers to determine the best method to meet the individual component price that will fit within the overall target cost. This process may involve tradeoffs of functionality against price, which is similar to what DoD tries to do now in the CAIV (Cost and an Independent Variable) process. The target costing process is aided by the longer term relationships between the prime and supplier that get the supplier involved up-front and early in the design process, instead of the old method that has been described as "build-to-print", where the supplier was not involved in design and only had an opportunity to bid on drawings that were already finalized (Cook and Graser, 2001:95).

Just-In-Time (JIT) Delivery. JIT is the concept that suppliers should deliver products to their customer just-in-time for its use in the assembly or manufacturing process. Inventories of parts awaiting assembly is kept to an absolute minimum. It is another concept pioneered in the Japanese auto industry. It creates savings for the manufacturer thanks to reduced costs of carrying inventory, a reduction in

the plant space given over to inventory, a reduction in the costs spent on inventory management, and other savings. It is not possible without the close interaction between supplier and prime that are permitted by the EDI, long-term relationships, and frequent communication noted above (Cook and Graser, 2001:97).

Supplier Management of Inventory at Customer. Related to the concept of JIT is the emerging concept of supplier management of inventory at customer, or what some have called *vendor-managed inventory*. Some prime contractors require their suppliers to own and manage the inventory of commodity-like parts such as fasteners at the prime contractor's facility. When fasteners are needed on the production line, the prime contractor's employees pick up the needed items from the vendor's representatives and a charge is made against the account that the prime has with the vendor. This has the benefit of reducing inventory carrying costs for the prime while still having the needed parts in a timely manner (Cook and Graser,2001:98).

Supplier Kitting. Instead of the prime gathering together all of the parts and fasteners need for assembly of a particular item into a self contained kit, some suppliers are now performing this function at their own facility and delivering the entire kit directly to the prime's production line for assembly. This is related to the JIT and vendor-managed inventory concepts. One of the reasons for going to supplier kitting is the concept of core competencies, in which the prime contractor only keeps in-house those activities or functions that it is best at. If a supplier is identified that can perform the same activity or function at a lower price with the same value, that function should be subcontracted or outsourced (Cook and Graser, 2001:99).

Aerospace Industry Consolidation. The number of large U.S. companies performing defense-related work has declined significantly in the past dozen or so years. In 1990 there were more than ten large companies in the U.S. that were competing for the right to produce aerospace and other military equipment. As of 2001, this number had been cut more than in half to five. Those five companies were formed by the consolidation, merger, or some other combination of around four dozen formerly independent firms (Druyan, 2001:3). One of the primary factors driving this consolidation has been the reduction in the budget available for what is called defense modernization, or the combination of spending on research and development and procurement. This modernization budget declined 30 per cent between 1987 and 1997 (Druyan, 2001:2). Defense firms combined or acquired to stay alive, but the end result is a shrinking pool of suppliers from which to choose for the Air Force and for DoD. The chart in Figure 1 at the top of the next page is from a report entitled *A Blueprint for Action*. Figure 1 graphically depicts this consolidation trend.

National Industrial Base. A third trend facing those involved in the acquisition process for DoD is the move towards a unified national industrial base, instead of separate defense and commercial industrial bases. From the end of the Second World War to the end of the Cold War, DoD relied on an extensive military industrial base for the development and production of the weapon systems that it needed to defend the nation. This military industrial base was maintained through high levels of procurement and research and development (R&D) funding. The heavy investment by DoD in R&D once served to keep defense programs at the cutting edge technologically, but this has

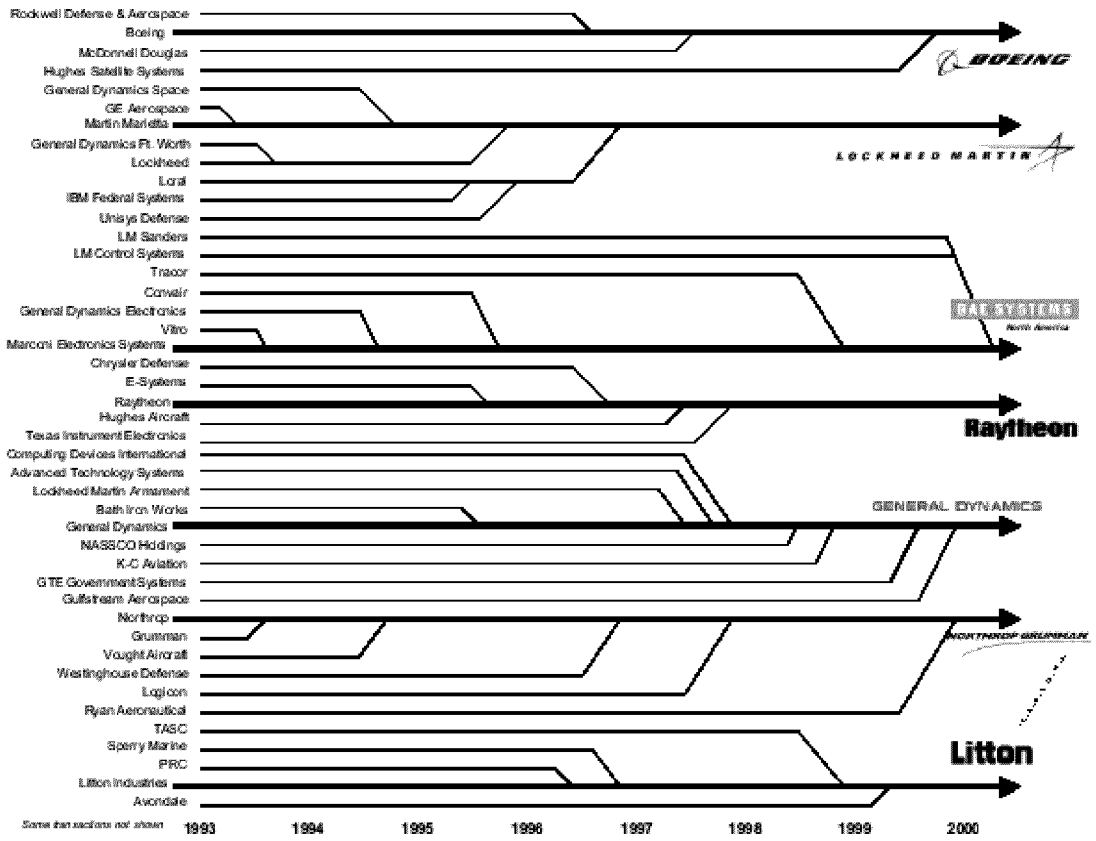

Figure 1 – Defense Industry Consolidation (1993-2000)

changed. Commercial advancements in the underlying technology that is key to future military superiority, such as advanced materials, integrated circuits, software and hardware, are now advancing faster than DoD investments in related technology (Perry, 1994:3). The best of the new technologies are being developed outside of the defense industrial base. Many of the companies that perform advanced commercial technology development refuse to do business with DoD because of a perception that the Government acquisition process is too intrusive and cumbersome to deal with. DoD leaders have stated that the laws and regulations covering how DoD does business are impediments to the ability of DoD to purchase state-of-the-art technology and the

integration of the commercial and defense industrial bases (Perry, 1994:3). It is a stated goal of the DoD acquisition regulations that commercial or non-developmental items are preferred as a means of satisfying a documented need over a more traditional defense developed item. Socio-economic programs, like the small business subcontracting program, are not a commercial practice. Government acquisition of commercial items is subject to the prescriptions of Federal Acquisition Regulation (FAR) Part 12. Small business subcontracting plans are not applicable to FAR Part 12 acquisitions.

SAF/SB Program Initiatives

The second objective of this thesis effort is to compare the identified trends to current SAF/SB programs, policies, and techniques intended to maximize small business participation in Air Force programs. SAF/SB is the office of primary responsibility within the Air Force charged with fostering the participation of small business firms in DoD procurement as both prime and subcontractors. SAF/SB has a number of duties in this area. First, it collects data from the various Air Force major commands (MAJCOMs) regarding small business participation in Air Force procurement as prime contractors. It does this by measuring the number, dollar amount and type of direct awards to small business by the Air Force. SAF/SB also is involved in the review and coordination process for individual, master and comprehensive small and small disadvantaged business subcontracting plans. SAF/SB has also started a number of initiatives over the last few years to target specific types of small businesses for additional efforts. These program initiatives include the following: Women Owned Business, Native American, the Air Force Outreach Program Office (AFOPO), Historically Black College and

University/Minority Institutions (HBCU/MI), Manufacturing Technology Assistance Pilot Program (MTAPP), and Mentor-Protégé (SAF/SB website, no pg.). Another program of interest for building future small business prime and subcontractors is the Small Business Innovation Research (SBIR) program and its companion program, the Small Business Technology Transfer (STTR) program. SBIR/STTR is not of interest to this thesis because they result in direct awards from DoD to small contractors for the conduct of innovative research. SBIR/STTR is not affected by changes in the levels of subcontracting by the major prime contractors.

Women Owned Business (WOB). SAF/SB maintains outreach efforts targeted specifically at small businesses that are owned or controlled by women. There are web pages with information on selling a product or service to the Government, links to a database of WOB firms, research and reports on topics of interest to WOB companies, and information about assistance programs developed for WOB's. The Air Force set a goal of spending $1 billion with WOB's in FY2000 (SAF/SB website, no pg.).

Native American Initiative. Due to the difficult economic conditions faced by a number of Native American communities, special emphasis has been placed by SAF/SB on identifying and assisting Native American businesses. The Air Force announced in 1998 the Air Force Montana/Wyoming Small Business Native American initiative. Its goal was to increase revenues for Montana and Wyoming Native American businesses to $50 million in FY99 (SAF/SB website, no pg.). This initiative is being conducted as a joint effort between SAF/SB, the AFOPO, and the Native American Development Corporation (NADC) of Montana and Wyoming. The Air Force plans to use the AFOPO too match specific requirements to firms, to attempt to enhance the ability of Native

American firms, and make better use of the existing statutory preferences for Native American firms in Federal government procurement.

Air Force Outreach Program Office (AFOPO). The AFOPO, located at Brooks AFB TX is a direct reporting unit of SAF/SB. Its charter is to develop innovative, proactive methods for increasing the participation of small businesses in Air Force procurement (SAF/SB website, no pg.). The AFOPO has identified five special emphasis areas, as follows (SAF/SB website, no pg.):

1. Assisting Air Force buying activities through market research techniques.
2. Identifying opportunities for Small Businesses in the A-76 process.
3. Develop a best practices repository.
4. Facilitate joint ventures and teaming alliances
5. Examine emerging commercial practices.

HBCU/MI. The HBCU/MI program is an initiative intended to increase the participation of historically minority institutions of higher education in the Government research and development process. Each year, AFRL sponsors and issues a Broad Agency Announcement (BAA) soliciting unique and innovative research proposals from HBCU/MI's in response to a number of research areas of interest to the Air Force.

MTAPP. MTAPP is an alliance between the Air Force and the National Women's Business Council (NWBC) for the purpose of increasing Government awards to women owned manufacturing firms. The Air Force has awarded a contract to the Midwest Manufacturing Technology Corporation in St. Louis MO to develop the MTAPP. The intent of MTAPP is to improve and develop the skills of underutilized and women-owned manufacturers so that they might compete for and win contracts with the Air Force and its large prime contractors. The end result should be more competitive

pricing for the Air Force and its primes and improved supplier capabilities. MTAPP has the potential for assisting small manufacturers that are feeling the impact of current trends relating to small business participation as subcontractors in aerospace programs. As such, it is of interest to this thesis effort.

Mentor-Protégé**.** The mentor-protégé program is to provide incentives for Air Force prime contractors to act as a mentoring firm to a small disadvantaged business that desires to become a subcontractor. The protégé SDB firm will require more involvement by the large prime than in a normal customer-supplier relationship, but the mentor firm receives financial incentives to do so and the protégé firm enhances their capabilities. Higher levels of participation in Air Force procurement should result.

Summary

This chapter provided information on the DoD Small Business program and discussed current initiatives. Congress has mandated that small businesses receive a fair opportunity to compete for DoD contract awards at both the prime and sub level. Part of the process of assuring fair opportunity is a requirement that large businesses negotiate a formal plan for involving small business suppliers. For the very largest DoD contractors this process can involve the negotiation of a comprehensive plan for the entire enterprise. The major contractors that negotiate these comprehensive plans provide significant potential opportunities for small businesses. Discerning the trends related to these opportunities is the first objective of this research effort. Impacting these trends are changes in the way DoD acquires weapon systems, consolidation of the military and aerospace industry, and a push towards a unified national industrial base. One of the

ways that prime defense contractors have responded to these changes is the application of lean purchasing and supplier management concepts adopted from the international automobile industry. The second objective of this thesis effort is to answer the question of how these changes in opportunities for subcontracting interact with programs sponsored by SAF/SB to improve the opportunities for small firms of all types.

III. Research Methodology

The purpose of this chapter is to explain the research methodology employed in the conduct of this thesis effort. A mixed methods approach of combining a quantitative analysis of existing contractor data with qualitative information taken from several case studies was used. The quantitative data, while useful, may benefit from corroboration or elaboration provided by the qualitative data. Convergence of the data gathered by more than one method can provide corroboration. The greater detail and richness of the qualitative data can provide elaboration upon the trends identified in the quantitative data. The end goal of this approach was the triangulation of findings.

Quantitative Analysis

Initially, a quantitative analysis of archival data provided by six large prime defense contractors will be performed to determine trends relative to small business participation in major aerospace weapon system programs. Acquisition reform, aerospace industry consolidation, and the move towards a national industrial base were all events from the early 1990's to the present day. Longitudinal data will be sought going back 15-20 years so that any trends in the last ten years can be examined to see if they actually started prior to acquisition reform or if they were a post-reform change. Put another way, we must know what the trends were prior to the reform movement in order to determine what impact, if any, reform has had. The quantitative data will be

supplemented by qualitative information from illustrative case studies for the purpose of triangulation of the findings.

Sample. Gathering quantitative information from all of the major aerospace programs over the last 20 years was deemed to be impractical. Instead, six major programs were selected as being representative of the types of programs that the United States Air Force manages. They include a mature fighter program, a fighter program just ending development, an airlifter program, a satellite program, a missile program, and a C^3I program. The six programs were F-22, F-16, C-17, SBIRS, AMRAAM, and JSTARS. In addition, the six programs provide the variety of having five different prime contractors. These programs permit us to conduct comparative analyses between older and newer programs of the same type (e.g., F-15 vs. F-22), and between different types of programs (e.g., aircraft vs. missiles, aircraft vs. satellites, missiles vs. satellites). By including a broad spectrum of program types, if the results do converge it will improve the ability to generalize to other weapon system programs.

Data Collection. The prime system contractors were asked to provide data for the last 15-20 years relative to subcontract awards at the first tier. Data items reported included the name and address of the subcontractor, it's business status, the dollar value of the subcontract, and a brief description of the type of goods/services procured from the subcontractor. Contractors were asked to describe the types of good/services being subcontracted for on the basis of North American Industry Classification (NAIC) codes, in order to provide a uniform basis for comparison between and among companies. The NAIC codes recently replaced the old Standard Industrial Classification (SIC) codes

formerly used by the Government to define industries categories. A meeting to enlist the contractor's help in collecting this data was held at SAF/SB in August 2001. Those in attendance included the Director of that office, members of his staff, representatives of six major defense contractors, and the researcher. One of the purposes of the meeting was to explain to industry the nature of this effort and to solicit their assistance in data gathering. SAF/SB issued a request for the data to designated points of contact at the contractors in late August 2001. Contractors were to provide the data in electronic format, if possible, to the researcher. If by chance the prime contractor had no first tier small business subcontractors, a second round of requests were sent to the first tier subs requesting the same type and level of data. This process took more than two rounds for some programs.

Data Analysis. Data from over a decade of subcontracts provided visibility into the nature of what was being subcontracted. The data provided was analyzed to identify NAIC codes common across programs and also to determine if those common codes change over time. The purpose of the subcontract was to be described by six-digit NAIC code. The six-digit NAIC code was then grouped together by three-digit NAIC subgroup. The three digit subgroups include categories like "Fabricated Metal Product Manufacturing", "Computer and Electronic Product Manufacturing", "Wholesale Trade – Durable Goods", and "Wholesale Trade – Nondurable Goods". Reported subcontract purposes clustered in a few subgroups. The level of small business subcontracting relative to overall subcontracts was examined, again to discern if trends over time were due to a change in what is being acquired or due to natural changes in the program as it matures and spending peaks overall before a decline. Of interest will be the differences

or similarities between different contractors and different programs. Since the programs were all of different types or stages of development, some differences between them were expected. It is this discernment of similarities and differences that will assist in the answering of the first research question, which looks to find current trends affecting the small business subcontractor. Among the supporting questions to be answered were: (1) what skills were the subcontracting dollars spent on, (2) what categories of skills explain the types of work subcontracted to small business, (3) what levels were subcontracted in each category, and (4) what were the trends in the data.

Validity and Reliability. The data collected in this quantitative step could be described as being archival in nature. It consists of routine entries into the contractor's accounting and purchasing systems that have been made over time in a consistent manner. In order to be able to withstand later audits by DCAA, the contractor has a strong incentive to enter the data accurately and completely. The prime contractor needs to be able to account for all of the dollars obligated and expended on individual programs. The contractor also needs to know what subcontractors were being used for what purposes in order to reduce the time spent finding a source should a need for the subcontracted item or service arise in the future. For these reasons the validity of the data was expected to be high, although some data entry errors may have entered the database. Reliability is assured if another researcher, repeating the same steps taken in this effort, reaches the same conclusions. For the quantitative analysis, grouping of the data into NAIC subgroups was straightforward for that data described by six-digit NAIC code. For subcontracts not described by NAIC code, another student with knowledge of contracting

independently coded a sample of the data and assigned it to NAIC code and/or subgroup. Similar results to the initial coding documented reliability in the coding method.

Qualitative Analysis

Sample. Case studies can be structured as single- or multiple-case analyses. One advantage of a multiple-case design is that its evidence and conclusions may be considered to be stronger than the single-case design (Yin, 1994:45). Related to this idea is the fact that multiple cases improve the chances that the observed conditions were not rare or an exception. The key may be to consider the multiple cases as an attempt to replicate results from a previous study. The multiple cases were not assumed to be predictive of an entire population, as they would be in the sampling logic of a quantitative study (Yin, 1994:45).

According to Yin, a single case study approach is most valuable when extreme, unique, or revelatory cases can be identified to test the theory. In the population of aerospace small business subcontractors, finding one company that could be said to represent the entire population was unlikely. One of the primary purposes of the qualitative portion of this thesis effort was to provide confirmatory context to the data developed in the quantitative portion. Multiple case studies were considered the best method to achieve that goal.

The unit of analysis for the case study was the aerospace small business subcontractor. The intent was to confirm the trends in small business participation identified by the quantitative analysis and provide more depth and richness.

The sample for this portion was developed in two ways. First, members of the Small Business Liaison Officer (SBLO) at each of the five prime contractors were identified. Each of the contractors has more than one person involved in SBLO matters so the initial contact was with the SBLO that was part of the data collection process in the Quantitative Analysis portion. These persons were selected because their job duties include the nurturing and locating of small business subcontracting sources for their employers. As such they were in the best position to identify the current trends facing the small business subcontractor.

The second sample of small businesses was developed by gaining input from persons in the SADBU function for the Air Force at the product centers, air logistics centers, the Air Force Outreach Program Office and SAF/SB. They identified small businesses in the aerospace industry that had at least 15 years of experience as a subcontractor. Small companies that have experience with SAF/SB initiatives such as MTAPP were also sought. In order to supplement the quantitative data it was desired that small businesses interviewed during the case study process have enough experience so that their involvement with aerospace also predates the acquisition reform and other changes of the 1990's. Approximately fifteen small businesses of this type were identified.

The interview subjects were key personnel at the small business, often the founder/proprietor or other senior leadership of these very small companies. All of the companies selected had a history of working with one or more of the major contractors involved in the study. Those interviewed had been in a position of strategic importance with the small company long enough that they had important insight into the current

environment from the perspective of small business. In the sense that the interviewees were at similar levels of authority and insight at each company, the chance that variances between companies were due to differences in the interview subject's position were minimized. The interview subjects also had been in the industry for at least a minimum of 10 years, so that differences were not due to one subject's inexperience.

Data Collection. Data was collected by conducting interviews with the key persons noted in the previous paragraph. The interviews were conducted either face-to-face, over the telephone, through an exchange of emails, or via a combination of the first three methods. The interviews followed a protocol that is outlined below. During the interview the researcher took notes to record the comments of the interview subject. After the interview was completed, the researcher prepared a more extensive transcript of the interview from his notes. This transcript was sent to the interview subject for confirmation of its content.

Protocol. The purpose of the protocol was to guide the researcher in the conduct of the case study and increase the reliability of the results (Yin, 1994:63). Participants in the study were informed at the start of the purpose of the study and the identity of the sponsoring organization. Letters of introduction or emails of introduction were issued by the sponsoring office (SAF/SB) or its subordinate offices to the individual firms that were potential participants in the study. Two uniform sets of case study questions were used, one for the small companies and the other for the large firms. The questions were open-ended to encourage a full and open exchange of information. The interview questions were constructed in an attempt to support the two primary research questions/tasks. A linkage between the research questions/objectives, the information

needed to answer the research objectives, and the interview questions for the small businesses in the study follows below:

Research Objective 1: Research the buying practices of the defense aerospace industry to determine the current trends relating to small business levels of participation by comparing programs.

In order to achieve the trend identification that was vital to meeting objective 1, various types of information were needed. Question 1 below gathers information relative to what programs and what large businesses the interview subjects had worked with in the past, in case this was a source of variation. Question 2 provides an assessment of the trends in the perception of the interviewee, which was desired. A need to interpret the changes in the business relationship between primes and subs and the causes of changes led to Question 3 below. Changes in the business relationship may be due to the impact of acquisition reform (AR) or other factors. Question 4 attempts to identify the types of skills these small businesses provide, and whether or not a Government run database of small business capabilities was accurate. Another item of interest was whether the subcontractor's experiences vary depending on the level that they provide their good or service to, which was the reason for Question 5. Part of the data collected in the quantitative portion of this research effort produced the listing of NAIC codes subcontracted for by one large prime. Question 6 was designed to pull out important data relative to what skills were being outsourced and to check the generalizability of the categories seen in one program to others. Questions 7 and 8 were repeat attempts to develop a sense of trends over time and whether opportunities and subcontract awards were growing or declining for the interview subject. It will be good to know whether

positive or negative comments about the subcontracting trends have any relationship to an interview subjects current business prospects.

1. **What aerospace defense prime contractors has your company worked with during the time that you have been associated with it, and what programs (e.g., F-16, F-22, C-17, JSTARS) have you provided goods and/or services for?**

2. **What do you think are the current trends relative to small business participation as subcontractors in major aerospace defense programs?**

3. **How has your company's business relationship with prime contractors or higher-level subcontractors changed over the years? What aspects have remained the same? What is causing these changes, in your opinion? Why are some aspects unchanged?**

4. **Your company is listed on the SBA's PRONET website as having a primary North American Industry Classification System (NAICS) code of _____, which corresponds to "_____". Does this NAICS code accurately describe the categories of skills/abilities/competencies your company providing to the prime contractors or higher-level subcontractors? If not, what codes would provide a more accurate description? Has this changed over time?**

5. **At what level in the major defense program are you selling your products/services? (e.g., to the prime contractors, first-tier subcontractors, or lower tier subcontractors)**

6. **A recent analysis of the types of purchases made by a large defense contractor from small business subcontractors/suppliers showed that most of purchases were in the eleven NAIC categories/subsectors listed below. In your perception, is this an accurate listing of the types of goods and services that large contractors acquire from small businesses? Can you think of any that were left out?**

Subsector	Title
326	Plastics & Rubber Products Mfg.
331	Primary Metal Mfg.
332	Fabricated Metal Product Mfg.
333	Machinery Mfg.
334	Computer & Electronic Product Mfg.
335	Electrical Equipment, Appliance and Component Mfg.
336	Transportation Equipment Mfg.
421	Wholesale Trade – Durable Goods
422	Wholesale Trade – Nondurable Goods

541	**Professional, Scientific, and Technical Services**
999	**Miscellaneous – Not Elsewhere Listed**

7. **How have opportunities for small subcontractors in the listed industries changed/stayed the same over the past 10-15 years?**

8. **How has the average dollar value level of your subcontracts changed over the past 10-15 years?**

Research Objective 2: Compare existing AF SB programs policies and techniques (including MTAPP) to developing trends for SB participation and identify strengths and weaknesses.

Question 9 was added to gauge familiarity with SAF/SB and it initiatives.

9. **What experiences, if any, has your company had with the small business liaison offices at SAF/SB, AFMC/BC, the product or logistic center small business offices (e.g., ASC/BC), the Air Force Outreach Program office at Brooks AFB, TX, or the Manufacturing Technology Assistance Pilot Program (MTAPP) for small businesses in St. Louis, MO?**

After the initial round of interviews and data analysis was completed, the results indicated that Lean Purchasing and Supplier Management (Lean PSM) was a strong trend in the industry. This trend identification will be discussed in Chapter 4. As a result, a second round of interviews was conducted to verify the strength of the identified Lean PSM trend. All interviewees were re-contacted.

Thanks again for participating in my research study last month. Since we last talked, I've come across some additional literature on the subject of prime contractors and the relationship with their suppliers.

The literature has sparked a few additional questions that I'd like to ask you, as follows:

1) Are you qualified relative to certain standards such as ISO-9000 or AS-9000? Were they a requirement for doing business with your primary customers?

2) Does your primary customer have a certified supplier program and is your company a participant? Again, was this a condition of doing continued business with your customer?

3) Does your primary customer have a supplier council and is your company a member?

4) Has your company participated in continuous improvement or "kaizen" events where someone from your primary customer's supplier development office has come to your facility to help train your company in what might be called "lean manufacturing" concepts?

5) Does your primary customer encourage or require suppliers to "kit" parts for easier use by its assembly line workers?

6) Does your primary customer employ any kind of "target costing" technique during the design of a new system where your company is given a price target for the part it supplies and then asked to tradeoff technical and quality features in order to meet the target?

7) What has your company done to adapt to the trend towards the adoption of these and other "lean manufacturing" concepts?

Your help in answering these additional questions will greatly help me in filling in some gaps in my data. Please feel free to contact me with any questions or concerns that you may have. If you like, just send me an email in response, or if it is easier for you, please let me know when I could call and talk to you over the phone about these questions.

Let me emphasize that, as always, only my thesis advisor and myself will know the true source of my information. You and your company name will be masked from all other readers and described in only the most general terms.

A linkage between the interview questions for the large businesses in the study and the research questions/tasks follows below:

Research Objective 1: Research the buying practices of the defense aerospace industry to determine the current trends relating to small business levels of participation by comparing programs.

As in the protocol for the small businesses, the questions were developed with an eye towards the trend identification that was part of meeting objective 1. Question 2 provides an assessment of the trends in the perception of the interviewee, which was

desired. Changes in the business relationship between prime and sub were a potential trend of the post-AR aerospace industry, thus the inclusion of Question 3 below. Since a similar question was asked of the small businesses, it will be interesting to note if the large businesses interpret things differently. Question 4 attempts to identify how opportunities for small businesses vary by time, by type of business, or by type of skill provided. Another item of interest was whether subcontract values tend to vary by time, by the nature of the program, or by its stage in the systems acquisition lifecycle. This was the purpose for Question 5. Question 6 was designed to confirm what was discovered relative to the types of skills outsourced in the data provided by one large contractor in the Quantitative Analysis and find out if this applies to other programs.

2. What do you think are the current trends relative to small business participation as subcontractors in major aerospace defense programs?

3. How has your company's business relationship with small business subcontractors changed over the years? What aspects have remained the same? What is causing these changes, in your opinion? Why are some aspects, if any, unchanged?

4. How have opportunities for small business subcontractors changed over the years? Are they increasing or decreasing? Do they vary by type of small business (e.g., SDB vs. WOSB) or by the nature of the goods/services purchased (e.g., technical services vs. sheet metal fabrication)?

5. How has the average dollar value level of the subcontracts your company awards changed over the past 10-15 years? Does it vary by the nature or size of your prime program (e.g., ACAT I vs. ACAT II)? Does it vary by the stage that your prime program is in the acquisition lifecycle (e.g., EMD vs. production)?

6. A recent analysis of the types of purchases made by a large defense contractor from small business subcontractors/suppliers showed that most of purchases were in the eleven North American Industry Classification (NAIC) categories/ subsectors listed below. In your perception, is this an accurate

listing of the types of goods and services that large contractors acquire from small businesses? Can you think of any that were left out?

Subsector	Title
326	**Plastics & Rubber Products Mfg.**
331	**Primary Metal Mfg.**
332	**Fabricated Metal Product Mfg.**
333	**Machinery Mfg.**
334	**Computer & Electronic Product Mfg.**
335	**Electrical Equipment, Appliance and Component Mfg.**
336	**Transportation Equipment Mfg.**
421	**Wholesale Trade – Durable Goods**
422	**Wholesale Trade – Nondurable Goods**
541	**Professional, Scientific, and Technical Services**
999	**Miscellaneous – Not Elsewhere Listed**

Research Question/Task 2: Compare existing AF SB programs policies and techniques (including MTAPP) to developing trends for SB participation and identify strengths and weaknesses.

Question 1 was included to measure information related to the Comprehensive Plan program, which, strictly speaking, is not a SAF/SB initiative but does involve input from SAF/SB during the review and approval of the plans. Question 7 was intended to measure familiarity with SAF/SB and its initiatives.

1. Does your company participate in the Comprehensive Subcontracting Plan Program? If so, is your company's plan developed on a plant-wide, division-wide, or company-wide basis?

7. What experiences, if any, has your company had with the small business liaison offices at SAF/SB, AFMC/BC, the product or logistic center small business offices (e.g., ASC/BC), the Air Force Outreach Program office at Brooks AFB, TX, or the Manufacturing Technology Assistance Pilot Program (MTAPP) for small businesses in St. Louis, MO?

As noted above, after the initial round of interviews was completed some additional research on Lean Purchasing and Supplier Management (Lean PSM) was discovered. An additional set of interview questions was generated to gauge the

prevalence of Lean PSM among the case study firms. The questions were structured to determine if Lean PSM was a trend affecting small business levels of participation and thus help answer Research Objective 1. All interviewees were re-contacted.

Thanks again for participating in my research study last month. Since we last talked, I've come across some additional literature on the subject of prime contractors and the relationship with their suppliers. The literature has sparked a few additional questions that I'd like to ask you, as follows:

1) Does your company require its suppliers to be qualified relative to certain standards such as ISO-9000 or AS-9000?

2) Does your company have a certified supplier program? Again, was this a condition of doing continued business with your company or do certified suppliers receive first consideration?

3) Does your company have a supplier council?

4) Has your company participated in continuous improvement or "kaizen" events where someone from your company's supplier development office goes to a vendor's facility to help train the vendor in what might be called "lean manufacturing" concepts?

5) Does your company encourage or require suppliers to "kit" parts for easier use by its assembly line workers?

6) Does your company employ any kind of "target costing" technique during the design of a new system where a vendor is given a price target for the part it supplies and then asked to tradeoff technical and quality features in order to meet the target?

Your help in answering these additional questions will greatly help me in filling in some gaps in my data. Please feel free to contact me with any questions or concerns that you may have. If you like, just send me an email in response, or if it is easier for you, please let me know when I could call and talk to you over the phone about these questions.
Let me emphasize that, as always, only my thesis advisor and myself will know the true source of my information. You and your company name will be masked from all other readers and described in only the most general terms.

Data Analysis. The case study interviews were masked to maintain the confidentiality of the interview subject and company. After several readings of the transcripts, individual case analyses were prepared to note the trends facing small business identified during the interview. Items that were identified later as trends were not always given as responses to initial interview question #2, but were sometimes contained in the responses to other questions. The first purpose was to identify themes contained in the interviewee's comments. These identified themes were then tied back to higher-level construct or concepts, but only after all of the initial within case analyses were completed. For this thesis effort the intent was to develop constructs related to small business participation in the aerospace industry. It was only after all of the case study reports were done that common themes were identified. The common themes appeared to fall into one of two categories: (1) overall changes in the aerospace industry, and (2) changes in the way that subcontractors of all sizes interact with the large contractors to conduct business. Themes in category 1 include the way that the two largest primes, Boeing and Lockheed Martin, have become more assemblers and integrators. In category 2 a strong trend towards what later was described as Lean PSM emerged. After the within-case analyses were completed, a view was taken looking at all the cases to identify patterns that appear to exist across all, or several, cases. At this point, exceptions and contrary trends were also identified, with some hope of determining the cause of these differences. As will be shown in Chapter 4, not all of the small business cases identified all of the same Lean PSM trends. There were other differences between small cases and among the large cases. This all was done to bolster the results of the quantitative analysis.

Validity and Reliability. Three types of validity have been said to apply to the qualitative research involved in the case study portion of this research (Johnson, 1997). First, descriptive validity relates to how factually accurate the account of the interview was when documented by the researcher. Second, interpretive validity was established when the interview subject's views, ideas, experiences and intent were understood and reported accurately. Third, theoretical validity was established if the theoretical explanation developed from multiple case studies fits the data and thus is defensible and maintains credibility. The first two types of validity were established by use of a consistent interview protocol, careful and accurate note taking and transcript preparation, and confirming the content of the transcript with the interview subject. Theoretical validity will be established by not only showing that the theory developed fits the data but that competing explanations do not fit the data as well or are less credible.

Reliability for the case study portion of this thesis effort will be established if another researcher using the same set of cases, the same data, and following the same procedures would come to similar conclusions. Although it is unlikely that any researcher will desire to replicate what has been done here, such an effort will be aided by the existence of a case study protocol and maintenance of a case study database. The protocol has been discussed above. The case study database has been established to document the steps taken from the initial genesis of the research idea by SAF/SB through to the two rounds of interviews, with separate data files for each of the case study firms. Replication would, in theory, be possible.

Combining Perspectives

The purpose for combining a quantitative analysis and qualitative analysis in this thesis effort was to improve the quality of the results. This combining of methods in a single study has been termed as *triangulation*, which permits the researcher to improve the accuracy of her conclusions by gathering data from more than one method (Rossman and Wilson, 1995:632). There was concern at the start of this research effort that employing only one method of analysis, either quantitative or qualitative alone, would produce results that were less than optimum. Rossman and Wilson propose that combining methods permits corroboration, elaboration, or initiation of findings. For this thesis, corroboration of the results of the quantitative analysis was desired. Corroboration is achieved when the results garnered from different methods converge, thus strengthening the conclusions. The data gathered through the quantitative methods were expected to be somewhat straightforward. To supplement this, the qualitative data was expected to provide the richness of detail needed to elaborate on the quantitative results. Elaboration has been described as the process of putting meat on the bare bones of statistical results (Rossman and Wilson, 1985:636). For this thesis effort, to answer more completely the question of what the current trends facing the aerospace small business community are, both quantitative and qualitative results were sought. This combination of methods was expected to provide both convergence and richness to the results.

Summary

This chapter set forth the research methodology employed in this thesis effort. Quantitative analysis of archival data at five major defense contractors covering six

aerospace programs was supplemented by qualitative multiple case studies of several large defense companies and small aerospace subcontractors. The purpose of combining methods was to increase the potential for triangulation of findings, which will strengthen the research results. The next chapter will provide the results and analysis of the data collected.

IV. Results and Analysis

This chapter presents the information gathered and the detailed analysis performed for this exploratory research effort. This research identifies some of the key trends facing the aerospace small business subcontractor community and the implications of those trends for Air Force Office of Small and Disadvantaged Business Utilization (SAF/SB) initiatives. The chapter is divided into two major sections describing the quantitative results and then the qualitative results. Within each section is an overview of the data collected and analyzed. The qualitative section includes within case analyses for each of the twelve cases and concludes with a cross case analysis.

Quantitative Results and Analysis

The initial data request from SAF/SB was sent to the prime contractors for the six representative programs selected for inclusion in the study. As noted in previous chapters, the six programs were selected because they represented the following types of programs that cross the spectrum of what the Air Force is acquiring: 1) a mature fighter aircraft system (F-16), 2) a fighter aircraft still in development (F-22), 3) an airlifter (C-17), 4) a missile program (AMRAAM), 5) a C^3I program (JSTARS), and 6) a satellite program (SBIRS). The six programs also represented five different prime systems contractors. The contractors were requested to provide data on subcontract awards at the first tier, the name and address of the subcontractor, the dollar value of the subcontracts, and the type of product/service subcontracted. If the subcontract was to a small business firm, the prime contractor was asked to provide 15-20 years of subcontract data or data back to the start of the program, whichever was longer.

Data was received from three of the programs, however none of the submissions were in the format requested or for the full time period of interest. The JSTARS submission contained data for the years 1991-2001, by year, by contractor, and by type of small business, but did not have a description of the types of goods/services subcontracted for. The data was for small business awards of all types. No data relating to other first tier subcontract awards by the JSTARS program was included. Analysis of trends over time relative to the skills or competencies that are being contracted out was not possible. The prime contractor advised that information regarding the type of goods and/or services that was subcontracted for was not kept in their record system. The data was first separated by year, then by type of small business supplier before summary values for each year were computed. Figure IV-1 at the top of the next page shows the values of subcontracts by year by small business type. The types are: small business (SB), small disadvantaged business (SDB), woman-owned small business (WOSB), and woman-owned small disadvantaged business (WOSDB). JSTARS was approved for full-rate production of 19 aircraft in 1996.

A second set of data from the F-22 program did include a description of the types of goods/services subcontracted for along with the name, address, and business size status of open purchase orders for both the EMD and PRTV (production representative test vehicle) contracts. However, this data was only as of September 2000, with no breakout possible by year, nor any method to determine what year the purchase order had been issued. This data also did not permit analysis of trends over time.

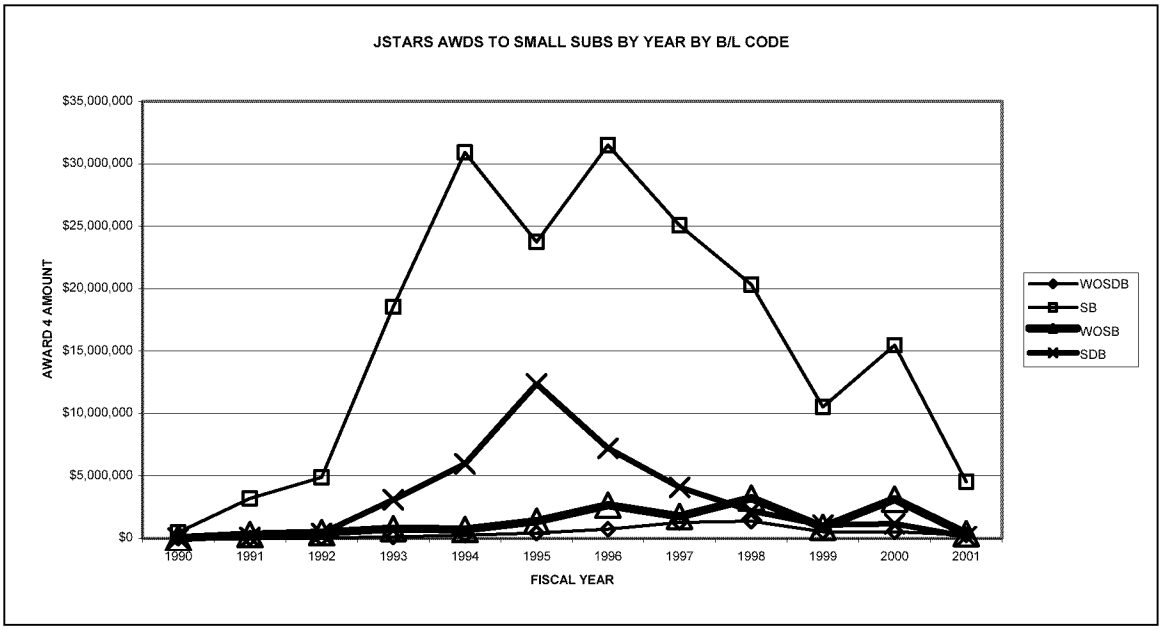

Figure 2 - JSTARS Subcontract Awards to Small Businesses

The F-22 data was sorted to find only those open orders that were made to small businesses. The description of what was purchased was then compared against a listing of North American Industry Classification (NAIC) codes. NAIC codes are a method for describing the industry that firms are in and range from Agriculture, Forestry, and Fishing to Manufacturing to Not Elsewhere Identified. The researcher then further broke down the F-22 data by assigning it to categories corresponding to NAIC major groups. At the end, the F-22 data was grouped into twelve NAIC subsectors representing five sectors. The sectors and subsectors are identified in Table 1 at the top of the next page. Although trends over time were not identified, the analysis of this data developed a listing of NAIC subsectors that were used to construct part of the interview protocol for

the qualitative effort. A bar chart showing the dollar value of F-22 open orders by NAIC and by phase, either EMD or Production Representative Test Vehicle (PRTV) follows.

Table 1 - NAIC Sectors and Subsectors Identified

NAIC Sectors and Subsectors
Sector 15 - Construction
Subsector 152 - Construction
Sectors 31-33: Manufacturing
Subsector 326: Plastics and Rubber Products Mfg.
Subsector 331: Primary Metal Mfg
Subsector 332: Fabricated Metal Product Mfg
Subsector 333: Machinery Mfg
Subsector 334: Computer and Electronic Product Mfg
Subsector 335: Electrical Equip., Appliance and Component Mfg
Subsector 336: Transportation Equip. Mfg.
Sector 42 - Wholesale Trade
Subsector 421: Wholesale Durable Goods
Subsector 422: Wholesale Nondurable Goods
Sector 54 - Professional, Scientific, and Technical Services
Subsector 541: Professional, Scientific, and Technical Services
Sector 99 - Not Elsewhere Identified
Subsector 999: Mfg Not Elsewhere Identified

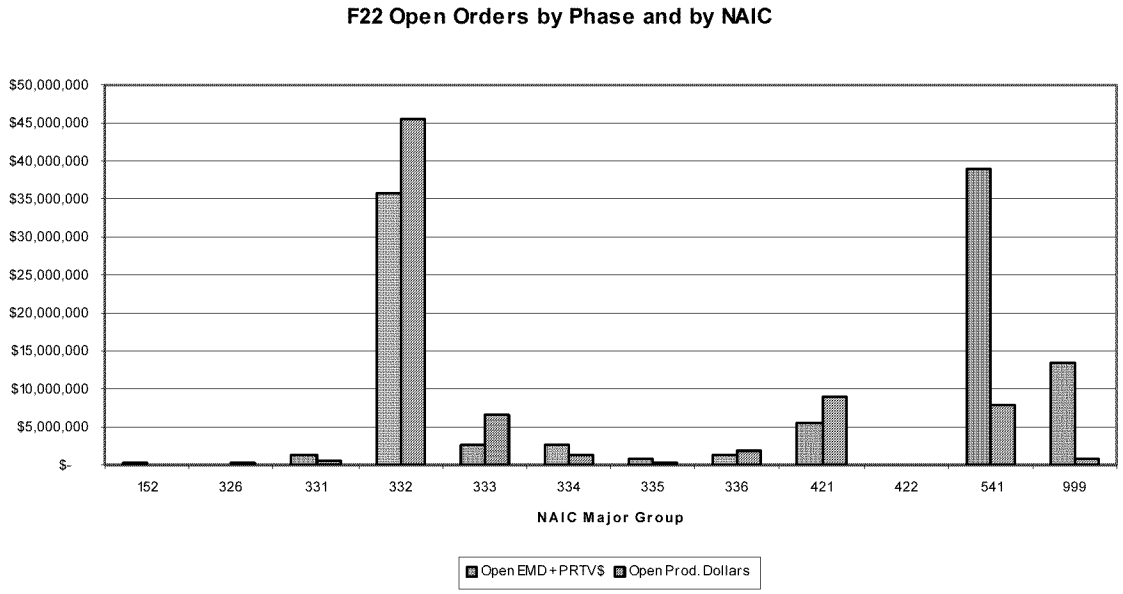

Figure 3 - F-22 Open Orders By NAIC Subsector

Finally, a third set of data was received relative to the SBIRS-Low program. However, this data only extended back three years and thus was not sufficient for development of any trends. The remaining programs did not provide data for various reasons. Incompatibility of legacy data systems dating back to before a series of mergers and consolidations was among the reasons cited for an inability to submit the requested data. While the quantitative data received did not permit the researcher to achieve the desired results, it was useful in preparing the interview protocol and getting a sense of what types of products and services are outsourced to small business subcontractors on one major defense program.

Qualitative Results and Analysis

Specialists from the offices charged with implementing the Small and Disadvantaged Business Utilization program were queried for names of small business firms and a point of contact at the small business that would make good case study candidates. The businesses were expected to have been involved in defense subcontract work for at least ten years and the points of contact were expected to have been in senior positions with some insight into the strategic business decisions the company faced. Twenty companies were identified in this manner. Eleven expressed an interest initially in being subjects of a case study. Eight small companies eventually were studied. Interviews were conducted over the phone or in person. The individuals ranged in levels of responsibility from the president or chief executive officer to a senior manager. Because of the nature of the small businesses, several interviewees were the company's founder or owner. Interviewees were provided in advance with a copy of the standard set of interview questions for this research effort. Basic information about the companies was confirmed through independent sources such as the Small Business Administration's (SBA's) PRONET website.

Case studies were also conducted with four large defense prime contractors, who were among the prime contractors on the six initial programs of interest. Interviews were conducted with members of their small business liaison office (SBLO), the corporate office responsible for compliance with and monitoring of small business subcontract program requirements. Large business interviewees were provided with an advance copy of a set of questions tailored for their different role in the buyer/seller relationship between prime contractor/small subcontractor.

Within Case Analysis

This section contains individual case summaries for the twelve cases. The identities of the companies and individuals involved were masked to maintain confidentiality. The masked studies were labeled with a two character alphanumeric designator with the first character identifying the business size (S = small; L = large) and the second character a consecutive number (1 – 8). Case numbers were assigned in no particular order of importance.

Case S1

Background. Firm S1 is a small designer and manufacturer of electronics/ avionics systems for aerospace systems. They are self-described as a job shop with the ability to change quickly from one product to another depending on the needs of the customer. They do not have long production runs of any item. The design and manufacturing aspect of its business primarily results in sales to first and second tier large business defense contractors. S1 has been in business since 1984 and is located in the southeastern United States. S1 has average annual revenues of $40M and around 380 employees. S1 is a mentor/protégé program graduate. S1 sells primarily to the prime contractor when dealing with L1 or L2. When S1 sells to other large businesses, such as L3, it is usually to the first tier subcontractor level. Interviews were conducted with the CEO and the Executive VP/General Counsel. The CEO is the founder and owner of S1. The Executive VP is a retired Air Force JAG officer and has been with S1 since 1994.

Table 2 - Key Aspects of Case S1 Firm

Aspect	Description
Industry	Designs and mfgs. electronics/avionics systems for aerospace
Year Founded	1984
# of Employees	380
Avg. Revenue	$40M
SB Size Status	SB, Asian Pacific American, not SDB
Tier Selling To	Prime and 1st tier (mixed)
Other	L1 Gold certified supplier (1 of 15 and the only SB) Customers include firms L1, L2, L3
Interviewed	CEO, VP-General Counsel

Trends. *Defense Industry Consolidation.* One of the first trends mentioned was that some of the largest defense contractors are taking on more and more of a systems integrator and assembler role, and less of a role as a designer and manufacturer. A current trend is for these very large contractors to push the responsibility for the design and assembly of a key subcomponent down to a first tier large business subcontractor. Where in the past the prime systems contractor would take on the responsibility of designing and putting together whatever was required for subsystem A, this responsibility has been delegated to a first tier sub. In the perception of S1, the first tier subs are generally other very large businesses. There are few small businesses (SB's) at the 1st tier

and those that are have design capability or some other way to add value. This trend is noted in other interviews (L1, L2, L3), where it is noted that the big primes are now acting as assemblers and integrators. They buy complete subsystems from the first tier and put all of the subsystems together into a total system. Only small firms that can provide a complete subsystem can attain the status of a first tier sub. We have classified this trend as part of the consolidation of the aerospace industrial base.

Lean PSM Practices. The remainder of the trends identified by S1 relate to the concept of lean purchasing and supplier management described in Chapter 2. As an example of the move towards *long-term relationships*, those SB subs that are still at the 1st tier get fewer contracts (in number) but of greater $ value (on avg.) due to the increased complexity of what they do and that they are being given more responsibility. The increased use of *just-in-time delivery* is demonstrated in the comment that pressure is on small subs to provide value, quality, timely delivery while cutting prices/cost. Delivery times are very tight. S1can deliver parts up to 5 days early but 0 days late, or their supplier rating will take a hit. The importance of *electronic data interchange* (EDI), another Lean PSM technique, is highlighted by the comment that "…lean manufacturing techniques are vital for survival along with investment in EDI capability." A lack of either forces SB's out or keeps SB's from getting into the defense subcontract business in the first place. *Supplier qualification and certification* is important. S1 is going through a qualification process for AS-9100 certification. S1 is part of L1's certified supplier program and is rated at the top tier, or "gold" level. The use of *supplier councils* is a Lean PSM way for prime contractors to communicate with their supply base. S1's primary customer, L1, has a supplier council of which S1's CEO is a member. The

conduct of *training in lean concepts* at the subcontractor is another Lean PSM practice. L1 staff members visited S1 several times to conduct continuous improvement events at S1. A less common Lean PSM practice is the *kitting* of parts by the supplier. S1 kits parts prior to delivery to the assembly line at L1. A final Lean PSM practice that S1 has experienced is the use of *target costing.* S1 participates in cost tradeoff studies with L1 during the design of new systems or redesign of existing systems. Eight different practices that could be identified as Lean PSM were noted by S1. These practices have all become common practice in the last 10 years or less. It appears that Lean PSM is a significant trend affecting the business environment for S1.

Initiatives. S1 has no experiences with the MTAPP office in St. Louis, and so had no comments relative to the effectiveness of this initiative. The Native American (NA) initiative is seen as having the potential to benefit NA firms while taking business away from small business subcontractors that don't qualify for NA status. S1 feels that the comprehensive test plan program has decreased opportunities for small businesses overall because enforcement of the plan goals by the Government has not been as vigorous as it should be.

Case S2

Background. Firm S2 is an electronic parts and equipment wholesaler and distributor located in the northeastern United States. S2 was founded in 1984 and has 12 employees. S2 is a small minority owned business. S2 sells to companies like L3 and

L2. Sometimes their customer is the prime contractor and sometimes the customer is a first tier subcontractor. The interview was conducted with the President of S2.

Table 3 - Key Aspects of Case S2 Firm

Aspect	Description
Industry	Electronic parts and equipment wholesaler
Year Founded	1984
# of Employees	12
Avg. Revenue	Did not reveal
SB Size Status	SB, minority owned, not SDB
Tier Selling To	Prime and 1st tier (mixed)
Other	Customers include firms L2, L3
Interviewed	President

Trends. *Defense Industry Consolidation.* Some of the trends noted by S2 may tie back to the consolidation of the defense industry overall. S2 perceives that the primes are gravitating towards large business (LB) suppliers who can handle consolidated requirements. S2 also feels that small businesses (SB's) are perceived as the weak link because they lack extra capabilities, like value engineering, that LB's can offer. S2 believes that the push by LB's towards fewer and larger suppliers is driven by "lean", which encourages them to consolidate requirements.

Lean PSM Practices. S2 noted several items that have been identified elsewhere as Lean PSM practices. S2 mentioned that the LB primes want suppliers to take on more responsibility and cost. S2's President said, "They want their suppliers to set up a supply of items in the prime's facility and use their own resources and people to keep it stocked. Most SB suppliers don't have this capability." This is the Lean PSM practice identified as *supplier management of inventory at customer.* Opportunities are more difficult to find and less plentiful for SB suppliers. The S2 President has heard "…from similar companies to S2 that they are also struggling to even be considered for new business." *Supplier qualification and certification* is identified when it is noted that S2 is qualified to MIL-STD-45208A and is a certified supplier for its primary customers. S2 is a member of the supplier council for Hamilton-Sundstrand (HS) and S2's President is on the board. The use of *supplier councils* is a Lean PSM practice. The President noted, "One of the roles of the board is to act as a messenger for the supplier base to HS and vice-versa. The board passes out information to the top 200 suppliers regarding seminars and other programs that HS is offering to the supply base. The supplier council is also used as a means for suppliers to share information and lessons learned, such as common problems related to payment or quality." S2 has had help with *kaizen events at the supplier* from HS and has conducted some *kaizen* events on their own. S2's President remarked, "HS came out and helped with an improvement of S2's purchasing function. They looked together at the processes involved and found ways to streamline or improve." S2 also regularly employs part *kitting* techniques for Raytheon. If a suppliers quality and reliability is good enough they can "ship to WIP" or ship directly to the work-in-progress area of the assembly line. The penalty for a slip up can be severe. S2's

President stated, "S2 has earned a reputation for a high level of quality and thus is permitted to 'ship to WIP'. The key, however, is don't make a mistake, or the reputation will be lost." *Supplier kitting* is one of the Lean PSM techniques noted previously. Overall, S2 made mention of five Lean PSM practices as having become common for their business.

Initiatives. S2 had no comments relative to SAF/SB initiatives, including the MTAPP program.

Case S3

Background. Firm S3 is a small manufacturer of precision machine parts and fabricated sheet metal products. They have been in the aerospace subcontract market for 40 years and are located in one of the mid-Atlantic states. The average number of employees is 85 and the firm has annual revenues of approximately $9M. S3 is a small business without any further designations. The firm sells to prime contractors like L3, sometimes at the prime and sometimes at the first tier subcontractor level. An interview was conducted with the Vice President of manufacturing, who has 40 years of experience in the industry.

Table 4 - Key Aspects of Case S3 Firm

Aspect	Description
Industry	Manufacturer of precision machine parts and fabricated sheet metal products
Year Founded	1961

# of Employees	85
Avg. Revenue	$9M
SB Size Status	Small Business
Tier Selling To	Prime and 1st tier (mixed)
Other	Customers include firm L3
Interviewed	VP of manufacturing

Trends. *High Entry Barriers.* S3's VP feels that the barriers to entry by very small machine shops (less than 40 employees) into the defense subcontractor world are becoming very high and difficult to breach. The reasons for this include a sense that LB primes have higher expectations as to the level of technical capability for their SB suppliers. The equipment investment by SB's is much higher. There are more stringent quality control requirements. Some type of CAD/CAM capability is expected. SB's that can't keep up, fall by the side. It appears that S3's primary customer is concentrating on their core competencies, outsourcing more, but also reducing their supply base and the number of suppliers that they deal with. The VP of S3 remarked, "The primes are concentrating on what could be called their core competencies. An example is L3 and their capabilities in the mechanical area. They did not invest in new technology, fell behind technically, and lost the capability to perform leading edge work. They now sub out almost all of their mechanical work. Over the years that S3 has been working with

them, L3 has reduced the number of vendors that they deal with from 121 to 13. This consolidation hurts the very small shops who have limited capabilities."

Lean PSM Practices. S3's relationship with their primary customer has evolved into more of a partnership that the old buyer/seller relationship, which is an example of the Lean PSM practice of *long-term relationships.* S3 is now brought in early in the design stage because they add value and provide a capability that the prime no longer has in-house. S3's VP noted, "Lately, the relationship with L3 has become more of a partnership than a simple buyer/supplier relationship. L3 is more respectful of S3's ideas, abilities, and expertise. L3 gets their key suppliers on board early in the design stage to make sure that they are designing something that their suppliers can make and make economically. L3 doesn't have the expertise within their own company that they used to and need to rely on S3 for certain matters." Subcontract values for S3 are much higher on average due primarily to the more complex requirements that are being outsourced to subs like S3. *EDI*, another Lean PSM practice, is used extensively to interact with the prime contractor. S3 builds parts from computer generated 3-D models, not from paper drawings, as was the case years ago. The parts S3 makes are more complex and cost per part, but S3 has had to invest heavily in equipment to handle the more stringent requirements. S3 is pursuing ISO-9002 qualification. S3 is a certified supplier to its primary customer and is a member of that company's supplier council. *Supplier qualification and certification* and the use of *supplier councils* are Lean PSM practices. S3's primary customer conducts lean improvement seminars for a group of local suppliers at a central location rather than conducting these events at each subs facility in turn. Training suppliers in *kaizen* methods is yet another Lean PSM practice.

S3 has not engaged in the kitting of parts for its primary customer. S3 has not participated in target costing techniques with their primary customer during the design of a new part or component. S3 feels that the world of the small business job shop working under fixed price contracts made them learn "lean" concepts and techniques years ago. Firms like S3 must improve to survive, and that includes investing in state-of-the-art tooling and EDI capability. S3 has experience with five of the nine Lean PSM practices.

Initiatives. S3 is the rare small business subcontractor that has had no interactions with Government personnel in the SADBU function. S3 has no experience with MTAPP. S3's relationship with their prime contractor goes back long enough ago that it was initiated without the help of a small business advocacy office. S3 feels that it is there record of good performance that keeps them in the ever-shrinking circle of vendors to their primary customer. S3 feels that companies that avail themselves of the services of the SADBU offices need help breaking into the world of Government subcontracting. S3 doesn't need that kind of help.

Case S4

Background. S4 is a small manufacturer of precision-machined metal and plastic aircraft parts located in the southwestern United States. S4 is a Native American woman-owned small business with 25 employees. It was started in 1981 and has average annual revenues of $1M. S4 works with prime contractors like Lockheed Martin, Bell Helicopter (Textron), and Boeing on programs including F-16, F-22, C-130, and V-22. The interview was conducted with the General Manager via an exchange of emails.

Table 5 - Key Aspects of Case S4 Firm

Aspect	Description
Industry	Manufacturer of precision machined metal and plastic aircraft parts
Year Founded	1981
# of Employees	25
Avg. Revenue	$1M
SB Size Status	Native American Woman-owned SB
Tier Selling To	Primes
Other	Customers include firms L1, L2
Interviewed	General Manager

Trends**.** S4 feels that the primes are going to subs for parts and assembly because it is more cost effective to do so. The ability to provide quality parts on time at a good price is important and has led to a strengthening of the business relationship with their primary customer. S4's GM noted, "Our business relationship has strengthened over the years due to the fact that we can supply quality parts in a timely order and at a reasonable cost. Also we have proven that we are able to supply machined parts that the prime contractor and other subs have not been able to produce." The opportunities have improved for those willing to change with the times. The average dollar value of

subcontracts is up and the quantity of contracts/orders is up also. S4 is AS-9000 compliant. S4 is a certified supplier with their primary customer. Certification was a condition of continued business. *Supplier qualification and certification* are Lean PSM practices. S4 has participated in *kaizen* events with assistance from their primary customer, and has been requested to kit parts for the primary customer before delivery. Conducting *kaizen* events at the supplier and *supplier kitting* are Lean PSM practices. S4 has not experienced any target costing techniques with its primary customer. S4's Lean PSM experiences appear to have been more limited than those of other case study firms.

Initiatives. S4 has had experience with MTAPP in the past, but had nothing further to add relative to SAF/SB initiatives.

Case S5

Background. S5 is a manufacturer of precision-machined metal parts for space flight hardware and ground support equipment located in the southeastern United States. S5 is a family run Native American woman-owned small business with 24 employees and average annual revenue of $3M. S5 has been in business for 26 years. S5 has worked as a subcontractor to L1, L2, and L4 at both the prime and 1st tier subcontractor levels. The interview was conducted with the General Manager (GM) who joined S5 after high school in 1981. The GM's father started S5 in 1975. The current principals for S5 are the GM's mother and wife.

Table 6 - Key Aspects of Case S5 Firm

Aspect	Description
Industry	Manufacturer of precision metal machined parts for space flight hardware and ground support equipment

Year Founded	1975
# of Employees	24
Avg. Revenue	$3M
SB Size Status	Native American Woman-owned SB
Tier Selling To	Primes and 1st tier subs (mixed)
Other	Customers include firms L1, L2, L3
Interviewed	General Manager

Trends**.** *Lean PSM Practices.* S5's defense subcontract business increased significantly after it was taken under the wing of one of the major primes. This prime has helped S5 extensively with learning the paperwork and administrative process of being a Government sub. S5's first attempt at wooing large primes was a failure. S5 didn't have the internal business processes or paperwork processes in place to handle Govt. subcontract work. The prime (L1) visited and left disgruntled. S5's response was to make the changes necessary to learn the paperwork process. L1 came back a couple of years later, liked what they saw and the business has grown from there. Closer, more *long-term relationships* are a Lean PSM practice. One of the changes S5 made was to add EDI capability for exchange of information back and forth in the supply chain. S5's GM noted, "Most of the information exchange with L1 takes place online or through EDI." The use of *EDI* to communicate with the supply chain is a Lean PSM practice.

S5 is family run and always adapting to improve the business and its employees. They feel that a small company has to have a distinctive capability to attract prime contractors. S5 is ISO 9002 compliant, but it is not a requirement of the primary customer. S5 is a certified supplier to L1. *Supplier qualification and certification* is another Lean PSM practice. S5 is unaware of a supplier council. Their primary customer has not held kaizen events at S5's facility. S5 is not required to kit parts for the prime's assembly lines. S5 engages in target "pricing" with L2. When S5 cannot meet the target price for a component, they may be asked what trade-off could be made in order to achieve the target. This is similar to the Lean PSM practice of *target costing*. S5 has used lean concepts to redesign the setup and workflow around their shop machines and tools. The GM said, "The ability to use EDI capability and work on the internet has been key to working with the L1s and L2s of the world." S5 has encountered four of the Lean PSM practices described in the literature.

Initiatives. *Woman-owned and Native American.* The push by the Govt. in support of the Native American (NA) initiative has caused primes to look for NA-owned firms to give business to. S5 was able to adapt by incorporating as a Woman owned and now as a Native American owned small business. This has made S5 even more attractive to L1 and L2. *MTAPP helps small manufacturers.* S5 has had very positive interactions with the MTAPP program. The MTAPP program and its people have been very proactive in their dealings with S5. MTAPP helped S5 with the business side of Govt. programs, including a DCAA audit and pointing out the need for a safety program. MTAPP sponsored conferences that S5 has attended have been very informative. MTAPP will help companies that are willing to help themselves. Just having someone to explain some

of the intricacies of Govt. contract work, which MTAPP has done for S5, is a great benefit.

Case S6

Background**.** Firm S6 is a woman owned small business involved in the wholesale distribution of hardware and small parts like fasteners. S6 is not listed on the SBA's PRONET website. S6's employees number 12. S6 has average revenue of $4M annually and has been in business since 1973. S6 is located in a mid-Atlantic state. S6 sells primarily to L3 at both the prime and 1st tier subcontractor level, depending on what system is involved. The interview was conducted with the President of S6.

Table 1 - Key Aspects of Case S6 Firm

Aspect	Description
Industry	Wholesale distribution of small parts
Year Founded	1973
# of Employees	12
Avg. Revenue	$4M
SB Size Status	Woman-owned SB
Tier Selling To	Primes and 1st tier subs (mixed)
Other	Customers include firm L3
Interviewed	President

Trends**.** *Industry Consolidation.* Similar to aerospace industry consolidation, S6 has noted consolidation in the wholesale distribution business. While not mentioned by other case study firms, S6 mentioned that their industry is going through a consolidation from thousands of small distributors competing against each other to 7 or 8 large distributors and a few small business (SB) distributors like S6. Only one other case study firm is in the business of wholesale distribution.

Lean PSM Practices. The second major trend is that "lean manufacturing" initiatives have impacted the way that large business (LB) primes run their business. Primes are introducing six-sigma as a way to reduce costs. In the opinion of S6's

President, "The primes want to place their business with more progressive suppliers." In response, S6 has had to broaden its capabilities, invest in computers and internet for EDI, and learn to manage large amounts of data while tracking LB orders. The use of *EDI* in the supply chain is a Lean PSM practice. Another practice that S6 has had to embrace is *vendor-managed inventory*, which involves shipping the parts they supply directly to the production line at NGES. The President notes, "There is lots of complexity. It is not as easy as it looks because there is a lot of data management activity in the background." One of the offshoots of these trends is that S6's relationship with the prime has become closer, more long-term. S6 supplies a range to product with price and delivery guidelines. S6 is plant certified to deliver directly to the primes production line. The prime inspects S6 processes, not parts. The President stated, "It requires a level of sophistication by the supplier not seen in the past." *Longer-term relationships* with suppliers are a Lean PSM practice. In response to trends, S6 has cut out general ads in trade mags. S6 targets customers that will benefit from a long-term relationship and has actually reduced its number of customers. The average dollar values of S6's subcontracts are up due primarily to the changed relationship with the prime. Instead of one purchase order for $150, S6 now has a long-term contract for a range of product. As the President explained, "It's not a 'one box at a time' relationship anymore." S6 is a certified supplier to its primary customer, and has had this customer conduct kaizen events at its facility. S6 also kits parts for its customers as a service. *Supplier kitting, kaizen events at the supplier,* and *supplier certification* are all further examples of Lean PSM.

Initiatives**.** S6 does not have any experiences with SAF/SB initiatives and was unaware of the MTAPP program. The latter aspect is not perhaps surprising because S6

is not a manufacturer, but is instead a distributor. MTAPP is designed to help the small manufacturing company.

Case S7

Background. S7 is a small manufacturer of complex and precision-machined parts. S7 has been in business for 10 years and has 59 employees. S7 is located in the midwestern United States and has annual revenues of approximately $5M. S7 is a woman-owned SB that sells to primes like L1, L3, and others at both the prime and 1st tier subcontractor levels. The interview was conducted with the Manager of Sales and Business Development.

Table 1 - Key Aspects of Case S7 Firm

Aspect	Description
Industry	Manufacturer of complex and precision-machined parts
Year Founded	1991
# of Employees	59
Avg. Revenue	$5M
SB Size Status	Woman-owned SB
Tier Selling To	Primes and 1st tier subs (mixed)
Other	Customers include firms L1, L2
Interviewed	Manager, Sales and Bus. Development

Trends. *Lean PSM practices.* S7's management mentioned four trends, which are all part of Lean PSM. The first is that the primes are interested in subs that can do "kitting" and "assembly". They are more involved processes putting more responsibility on the supplier. The SBD Manager noted, "As an example of "kitting", S7 puts 28 parts into a ship set. They are similar in design but different in size. The parts go 7 per box and there are 4 boxes in a kit. When the prime uses the kit, they send the empty box back and that signals S7 to start another set." *Supplier kitting* is a Lean PSM practice. Another trend is that the primes have change to "monolithic" machining, making a part out of one solid block of aluminum. In the past these parts were made out of a build up of several separately machined parts. Minimizing material use and waste is more of a lean manufacturing concept overall than just Lean PSM. The third trend is the way that the primes have converted to e-commerce methods, including information exchange via the net, including 3-D models and purchase orders. S7's Manager said, "L1 is part of Exostar, a joint venture of Boeing, Lockheed, BAE, Rolls Royce and Raytheon, intended to develop a common standard for information exchanges up and down the supply chain." This use of *EDI methods* for communicating with the supply chain is another Lean PSM practice. A final trend is the way that primes are emphasizing lean manufacturing to reduce costs. The primes will help with training in "lean concepts". S7 employees have attended training. Conducting *kaizen or lean training* at suppliers is a Lean PSM concept. It was not listed another trend, but the Manager noted that S7 is more involved in the design stage than in the past. Their primary customer recently had them involved

in the design of a new monolithic part. This is a closer relationship than in the past, but has its rewards. S7's manager remarked that, "This type of relationship is more satisfying, but it can be hard to make happen in the first place." *Longer-term relationships* are part of Lean PSM. S7 is ISO *qualified* and is a *certified supplier* to L1 at the Silver level. S7 has experienced several Lean PSM practices. While not a Lean PSM concept, per se, the formation of the online trading exchange, Exostar, appears to have a significant potential to alter the business relationship for all aerospace industry suppliers, not just the small business ones.

Initiatives. *MTAPP helps small manufacturers.* S7 has only had experiences with MTAPP, and this has been since the summer of 2001. Thanks in part to MTAPP, S7 is probably going to be placed on L2's list of approved suppliers. This should increase business for S7. MTAPP also helped with an understanding of internal Government procurement processes at Oklahoma City Air Logistics Center (OC-ALC), Tinker AFB, OK. S7 is considering an attempt to win some direct awards in the future.

Case S8

Background. Firm S8 is a manufacturer of complex and precision-machined parts and is skilled at sheet metal fabrication. S8 was founded in 1976 and is located in a midwestern state. S8 has 90 employees and annual revenues of $13M. S8 is a Native American owned small business. Key customers of S8 include L2, and several others at both the prime contractor and 1st tier subcontractor levels. The interview was conducted with the CEO of S8 who is also the founder and owner.

Table 1 - Key Aspects of Case S8 Firm

Aspect	Description
Industry	Manufacturer of complex and precision-machined parts
Year Founded	1976
# of Employees	90
Avg. Revenue	$13M
SB Size Status	Native American owned SB
Tier Selling To	Primes and 1st tier subs (mixed)
Other	8(a) program graduate Customers include L2
Interviewed	President

Trends. *This supplier went commercial.* S8 was part of the 8(a) program from 1984-1994 when it did lots of work for the F-16, KC-10, C-5 and other programs. Since the end of its 8(a) status, S8's business base went from an 80%/20% Government/Commercial split to 20%/80% Government/Commercial split today. The senior management took S8 in a different direction after the end of its 8(a) status. Overall employment has dropped, but the retained employees are much more efficient. S8 perceived that direct Government business would be hard to come by after 8(a). Government work encourages lax business practices. S8 had to get lean and sharpen its focus to survive in the commercial world, but the senior management felt that this was

the best chance for success in the long run. The CEO stated, "After the strategic decision, 90% of the existing employees had to leave due to an inability to adapt to the highly competitive commercial culture." The primes are constantly on S8 to reduce costs by 6-10% per year. If S8, or any other SB supplier, is unable to meet the cost reduction goal, their portion of the prime's business will be given to another supplier. This is how S8 has gained business recently due to the failure of other suppliers to meet the cost reduction goals. S8 has trained three employees in six-sigma with the help of the prime. This is a continuous improvement or lean manufacturing concept. Lean PSM calls it conducting *kaizen events at suppliers.* S8 is a graduate of the 8(a) program for small disadvantaged businesses and at one time was part of a successful mentor/protégé relationship with L2. S8's owner/proprietor felt that Govt. work made the company more inefficient. S8 had a lot of catching up to do relative to commercial industry practices when it came out of the 8(a) program. The CEO noted that he "thinks that the worst thing that he has ever done for S8 was possibly the entry into the 8(a) program. Business was good, but it came in lumps and then was over." S8's CEO feels that one trend in engine manufacturing has been for the two large primes, General Electric and Pratt & Whitney to take back some work that was going to subcontractors, and that small subs are being pushed down to lower tiers. In response to the second round of questions, S8 confirmed that *supplier qualification and certification, lean training at the supplier, supplier kitting*, and *target costing* are currently being experienced as part of S8's relationship with their customers. This is not surprising given S8's commercial focus.

Initiatives**.** S8 has had no recent experiences with SAF/SB initiatives or the MTAPP program. Since S8 left the 8(a) program their focus has been on gaining

additional commercial business, not Government business as either a direct award or as a subcontractor.

Case L1

Background. Firm L1 is a large manufacturer of a broad range of aerospace systems. They have multiple locations around the country. L1 is the prime contractor on a number of major defense system programs. L1 has been in business for over 50 years. L1 has average annual revenues in the tens of billions of dollars. L1 has over 50,000 employees. The interview was conducted with a member of L1's Small Business Liaison Office (SBLO) staff.

Table 7 - Key Aspects of Case L1 Firm

Aspect	Description
Industry	Major aerospace and defense prime contractor
Year Founded	More than 60 years ago.
# of Employees	> 50,000
Avg. Revenue	> $10B
Comp. Plan participant?	Yes
Interviewed	SBLO

Trends. *Requirements consolidation.* The L1 SBLO staffer perceives decreasing opportunities industry wide for small subcontractors, primarily due to the overall decline in the DoD procurement budget. Another factor acting to decrease opportunities is the

trend towards bundling and consolidating requirements across the entire L1 firm. L1 also desires to unify their supply base, to have common suppliers for their military and commercial programs. L1 makes a continuous effort to reduce costs. L1 has embarked on a strategy to outsource all activities that are not part of L1's core competencies. This can lead to increased opportunities for those SB's who perform the outsourced function, if they are competitive in terms of price, quality, and delivery.

Lean PSM practices. Supplier development is important. As the SBLO noted, "SB's that don't keep up to date with capabilities like ISO and 5-axis machining are left behind." L1 perceives that their company strength is engineering and supply chain management. L1 has a *supplier council* for the exchange of information between L1 and its supply base. The SBLO remarked that, "One of it's roles is to identify the most critical suppliers and bring them together at supplier conferences to bring them up to date on changes in the program that they are supplying parts to." L1 also works hard on supplier development and improvement, which is part of *supplier qualification and certification.* This may involve *conducting kaizen events at the supplier*, but certainly involves a review of the supplier's capabilities and processes. It was stated that, "…L1's quality and supplier development staff work together to develop and improve a particular supplier. It is a six-step process that may include "lean" visits depending on the assessed needs of the supplier. The end of the process is a trained supplier." *Supplier kitting of parts* is becoming more prevalent for L1. L1 uses target-pricing techniques to reduce costs on some of the major programs by considering the substitution of commercial-grade parts in lieu of military-grade ones. This is similar to the Lean PSM practice of *target costing.* L1 is using many of the Lean PSM practices.

Initiatives. L1 has participated in SAF/SB sponsored initiatives relative to special emphasis areas like woman-owned small businesses and Native American owned small businesses. The SBLO had no further comments relative to the initiatives. L1 has experiences dealing with AFOPO on Mentor/Protégé and have attended presentations on MTAPP.

Case L2

Background. Firm L2 is a large manufacturer of a broad range of aerospace systems. They have multiple locations around the country. L2 is the prime contractor on a number of major defense system programs. L2 has been in business for over 60 years. L2 has average annual revenues in the tens of billions of dollars. L2 has over 50,000 employees. The interview was conducted with a member of L2's Small Business Liaison Office (SBLO) staff.

Table 8 - Key Aspects of Case L2 Firm

Aspect	Description
Industry	Major aerospace and defense prime contractor
Year Founded	More than 60 years ago.
# of Employees	> 50,000
Avg. Revenue	> $10B
Comp. Plan participant?	Yes
Interviewed	SBLO

Trends. *Supply Base consolidation.* L2 perceives that the entire aerospace industry is downsizing their supply base. The SBLO noted that, "Those specializing in tooling/machining have been through the quality standards, invested in new equipment, and survived the downturn in the defense business base." Another trend noted by L2 is the tendency for indirect service and supply requirements to be consolidated across the entire corporation. Where in the past a good deal of the indirect services purchased at one L2 facility or another went to small disadvantaged businesses and was used to meet L2's SDB subcontracting goals, these indirects are now being leveraged for the entire corporation. The result is that it is almost impossible for small distributors of electronic items, or computer sellers, or raw material suppliers to compete against major national distributors and office supply houses. The SBLO says, "I call it the Home Depot purchasing philosophy." A further example of this trend is that several large firms, including L1 and L2, are all part of the trading exchange "Exostar". These companies are banding together to buy in bulk for common items and services.

Lean PSM Practices. Along with the move towards a smaller supply chain is the trend towards *longer-term agreements* with their suppliers. L2 also feels that those SB's that had enough capital to invest in new technology have endured. The SBLO perceives that new opportunities for small subs will be few because of the lack of major new programs. The many mature programs already have established supply bases that they are reluctant to alter. L2 sees a relation between adoption of ISO standards for global competitiveness and the need for SB's to invest in software, statistical process control, and other lean manufacturing techniques. The SBLO remarked that, "…Our industry will not accept or do business with a machining firm with less than 5 axis capability, approved

quality standards, and previous history. The small business must deliver 98-100% on schedule." These are examples of the Lean PSM practices of the use of *EDI* to communicate with the supply chain and *J-I-T delivery.* Longer-term agreements between prime and supplier are now common. L2's Super Star quality program requires that any manufacturing firm supplying L2 must comply with ISO 9000-2 and MIL-STD-9858A. This is *supplier qualification and certification.* The Super Star program also is a recognition program for suppliers who excel. L2 has a *supplier council* for exchange of information with its supply base. L2 conducts *kaizen events at some of its suppliers*. *Supplier kitting* will be a requirement on two new L2 production programs. L2 shares information about its best suppliers with other large prime contractors. Lean PSM practices noted included longer-term relationships, use of EDI, J-I-T delivery, supplier qualification and certification, supplier councils, kaizen training, and supplier kitting.

Aerospace Industry Consolidation and Teaming. L2 has become an integrator and assembler of aircraft with major subcontractors providing most of the subsystems and hardware. There is more outsourcing and most of the opportunities for SB subs are at the 2nd and 3rd tier levels. Another trend limiting the opportunities for SB subs is the way that contractor teams are formed prior to a competition for a major program. It was noted by the SBLO that, "part of organizing a contractor team to compete and win during DEM/VAL includes a promise to keep those same companies involved during the Production phase. There is a substantial investment required on the part of the team members to prepare for the chance to win. This limits what could be available for SB's of all types and many SB's are not willing or able to make that large investment up front."

Definition of SDB status has changed. L2 pointed out that part of why industry's subcontracting goal achievement has been declining is that the Government has changed the definition as to what is an SDB. SDB's now cannot have a net worth greater than $750K and the SDB must be certified as such by the SBA. Subcontract dollars awarded to these firms are counted towards small business goals only. For L2, this means that, "Last year $10 Million could not be counted in the SDB category, because they were not certified by SBA or could not meet new certification requirements."

Initiatives. *MTAPP helpful to LB's also.* L2 termed its involvement with SAF/SB, the subordinate SADBU offices, the AFOPO, and the MTAPP office as outstanding.

Case L3

Background. Firm L3 is a large manufacturer of a broad range of aerospace systems. They have multiple locations around the country. L3 is the prime contractor on a number of major defense system programs. L3 has been in business for over 60 years. L3 has average annual revenues in the tens of billions of dollars. L3 has around 50,000 employees. The interview was conducted with a member of L3's Small Business Liaison Office (SBLO) staff.

Trends. *Aerospace Industry Consolidation and Teaming.* L3 perceives that finding small business (SB) sources is becoming increasingly difficult because fewer SB's are doing aerospace work. L3 feels that the capital investment required for a SB to stay at the state-of-the-art in equipment may be too great for some SB's to make. L3

states that the dollars available for SB subs are declining in part due to the teaming arrangements dictated by the Government

Table 9 - Key Aspects of Case L3 Firm

Aspect	Description
Industry	Major aerospace and defense prime contractor
Year Founded	More than 60 years ago.
# of Employees	Approximately 50,000
Avg. Revenue	> $10B
Comp. Plan participant?	Yes
Interviewed	SBLO

(for certain LB subs) that is a condition of award. Stated another way, winning an award from the Government may be predicated on L3 keeping the team that they have gathered for a new program together. Most of the team members are other LB's that bring special capabilities the Government wants, which effectively limits what could be considered for subcontracting to SB's. L3 has had the unfortunate experience of assisting a SB sub to the point where the do well enough to grow into a LB or to the point where they are bought out by a LB and thus no longer qualify as a SB for subcontracting plan goal attainment purposes.

Lean PSM Practices. L3 has developed a list of 22 SB preferred suppliers that L3 continues to nurture. L3 plans to maintain a *close relationship* with these key suppliers

as a means of increasing SB subcontract dollars rather than cast a net far-and-wide to find more SB suppliers. The L3 SBLO said, "L3 has abandoned the "shotgun" approach to finding potential SB suppliers and is continuing to nurture the preferred SB suppliers L3 has identified." It is the perception of L3 that L1 and L2 are now acting more as program integrators, with other large consolidated defense companies taking up the first tier. L3 and other big primes are looking for companies that can do more than just supply parts of a subsystem. The SBLO noted that, "L3 is looking for more high tech companies and companies higher up the food chain of products and there are very few companies at this level." L3 was unable to respond to the second round of interview questions.

Initiatives. *Woman-owned and Native American programs may cause "game-playing" by small business.* L3 has worked with SAF/SB in the past and has dealt with the AFOPO and the MTAPP office on supplier development issues. Relative to the WOSB initiatives, L3 perceives that there are more WOSB's out there now, but it may be the result of game playing. The SBLO stated, "Companies that were not woman owned are changing their corporate structure to become WOSB or Native American Owned SB."

Comp Plan a benefit. For L3's Location A, the comprehensive subcontracting plan test program has been beneficial. The SBLO remarked, "The L3 Location A facility has over 450 programs/platforms. No one individual program makes up over 7% of the total business base. There are over 5,000 contracts being managed by the procurement office. The comprehensive plan allows L3 to consolidate these requirements and manage

them in a less administratively burdensome way verses a large number of individual plans."

Case L4

Background**.** Firm L4 is a large manufacturer of a broad range of aerospace systems. They have multiple locations around the country. L4 is the prime contractor on a number of major defense system programs. L4 has been in business for over 60 years. L4 has average annual revenues in the tens of billions of dollars. L4 has around 50,000 employees. The interview was conducted with a member of L4's Small Business Liaison Office (SBLO) staff.

Table 10 - Key Aspects of Case L4 Firm

Aspect	Description
Industry	Major aerospace and defense prime contractor
Year Founded	More than 60 years ago.
# of Employees	> 50,000
Avg. Revenue	> $10B
Comp. Plan participant?	Yes
Interviewed	SBLO

Trends**.** *Lean PSM Practices.* The first major trend noted by L4 is the increased emphasis on the use of *electronic communication technology* up-and-down the supply chain. Having *EDI capability* is becoming a requirement for doing business. Quoting the

SBLO, "If you're not able to do EDI, you're out of the game or will be soon." Another trend is that the LB's expect their SB subs to be able to handle more complex requirements and perhaps pull together all of the parts of an important subsystem. The SBLO noted, "In the past, the prime pulled all of the parts together, but now the sub does it. This requires small businesses that are able to handle a larger piece of the pie." L4 is also looking for *longer-term relationships* with quality SB's that add value to the project team. Another change is the way that key L4 suppliers are involved earlier in the design process. The SBLO noted, "…where L4 used to just have their SB suppliers "build-to-print" without any input in how an item was designed, L4 now gets their best suppliers involved early in the design process so that they have input into how what they are going to make is designed and later built. This is a relationship that most of the companies who have evolved into this level find quite satisfying." L4 employs other Lean PSM practices, including *supplier qualification and certification, supplier councils,* conducting *kaizen events at suppliers*, and sometimes requires *supplier kitting* of parts.

More complex requirements. L4 sees a general trend towards more outsourcing, but the opportunities for small subs have not increased across the board. There are more opportunities in some ways because outsourcing has increased, but the opportunities are more complex. L4 perceives that the nature of the item being outsourced affects opportunities. The SBLO said, "If the need is for something relatively common like IT support or software development, there are a number of SDB sources or other SB sources for that. There are not many sources for some of the complex satellite work that L4 needs help with."

Supply Base Reductions. A related trend mentioned by L4 was that they are reducing their overall supply base, but those companies that remain are individually more capable than in the past.

Initiatives. L4 has worked successfully with SAF/SB, its subordinate offices, AFOPO, and the MTAPP office and perceives that they are doing a good job. L4 had no further comments relative to SAF/SB initiatives.

Cross Case Analysis

This section describes the between, or cross, case, analysis conducted to compare the results the individual cases. The purpose of the cross case analysis was to find patterns in the data that were used to develop theory about the impacts of acquisition reform on the participation of small business subcontractors in the defense aerospace industry.

In order to provide a reference point for the cross case analysis, a table describing important aspects of the case study small firms was developed. The first table on the following page provides summary information about all of the small companies relative to the aspects identified for them at the opening to each case. The aspects noted are as follows: (1) the industry that the small firm is in, (2) the year the small firm was founded, (3) the firm's number of employees, (4) the firm's average annual revenue, (4) the firm's small business size status, (5) the tier in the aerospace industry that the firm sells it's products to, (6) which of the case study large firms the small firms sells to, and (7) the self-reported trend in sales for the last few years. The small business size status categories are as follows: SB = small business, WO = woman owned small business, NA

= Native American owned small business, and NA-WO = Native American woman owned small business.

Table 11 - Matrix of Small Case Aspects by Company

Aspect	Company							
	S1	S2	S3	S4	S5	S6	S7	S8
Industry	Electronics Design and Mfg.	Parts Whole-sale	Machined Metal Parts	Machined Metal Parts	Machined Metal Parts	Parts Whole-sale	Machined Metal Parts	Component Design and Mfg.
Year Founded	1984	1984	1961	1981	1975	1973	1991	1976
# of Employees	380	12	85	25	24	12	59	90
Avg. Revenue	$40M	DNR	$9M	$1M	$3M	$4M	$5M	$13M
SB Size Status	SB	SB	SB	NA-WO	NA-WO	WO	WO	NA
Tier Selling To	Mixed	Mixed	Mixed	Prime	Mixed	Mixed	Mixed	Mixed
Large Case Customers	L1,L2, L3	L2, L3	L3	L1, L2	L1, L2, L3	L3	L1, L2	L3
Sales Trend	Rising	Mixed	Rising	Rising	Rising	Rising	Rising	?

Lean PSM Trends

The first finding from the cross case analysis is that Lean PSM practices are changing the nature of the prime/sub relationship for the firms studied. The term Lean PSM was developed by Cook and Graser in their recent report for Project Air Force entitled Military Airframe Acquisition Costs: The Effects of Lean Manufacturing. The trends that make up Lean PSM include the following: Supplier Qualification and Certification, Long-term Relationships, Communications with Suppliers, Electronic Data

Interchange (EDI) with Suppliers, Continuous Improvement *Kaizen* Events at Suppliers, Target Costing, Just-In-Time (JIT) Delivery, Supplier Management of Inventory at Customer, and Supplier Kitting. The table on the next page is a matrix of Lean PSM practices by case study firm.

The second finding from the cross case analysis is that the larger small manufacturing firms are more likely to have adopted Lean PSM practices when compared to the smaller small manufacturing firms. S1, S3, and S7 all have at least 50 employees, revenues of $5M or greater, and have experienced at least six Lean PSM practices. The smaller small manufacturing firms (S4, S5) have a lesser rate of adoption of Lean PSM (four or fewer), have 25 employees or less and revenues of $3M or less. Firm S8 is a larger small manufacturer, but was not considered relative to this pattern because its business base is primarily commercial. Cases S2 and S6 are not manufacturing businesses. Studies have shown that the diffusion of innovation tends to be greater in larger firms than in smaller ones. One researcher notes that a measurement of an organization's size is actually a surrogate measure of other organizational aspects that impact innovation levels, such as total resources, slack resources, and the technical proficiency of an organization's employees (Rogers, 1995:379). This may explain the relatively greater level of Lean PSM practice for the larger small manufacturing firms. The larger firms usually have more resources overall and more slack resources that could be moved to help adopt an innovative practice.

A third finding from the cross case analysis is that Lean PSM practices affect small distributors/wholesalers differently than they affect small manufacturing businesses. Small distributors are likely to experience the Lean PSM practice of supplier

managed inventory, while small manufacturers are not. This is due to the nature of what the small distributors provide: small replacement and wear parts, which at one time were maintained in an internal plant inventory by the large firm. These items often include things like drill bits, hand tools, and fasteners. The small manufacturers do not provide items of this type.

Table 12 - Matrix of Common Lean PSM Practices by Firm

Trend	Company											
	S1	S2	S3	S4	S5	S6	S7	S8	L1	L2	L3	L4
Qualification & Certification	√	√	√	√	√	√	√	√	√	√	√	√
Long-term Relationships	√		√		√	√	√		√	√	√	√
Communications with Suppliers	√	√	√						√	√		√
EDI with Suppliers	√		√		√	√	√			√		√
Kaizen Events at Suppliers	√	√	√	√		√	√	√	√	√		√
Target Costing	√				√			√	√	√		
Just-In-Time Delivery	√	√	√			√	√			√		√
Supplier Managed Inventory		√				√						
Supplier Kitting	√	√	√	√		√	√	√	√	√		√

A fourth finding from the cross case analysis is that more often, the very largest defense companies are assuming a role of program integrator/assembler/supply chain manager. These roles require the first tier suppliers to the large, consolidated defense

firms to be able to handle more complex requirements. The first tier supplier is responsible for an entire subsystem or subcomponent.

A fifth finding is that some large firms are seeking to reduce or consolidate the size of their supplier base. The move towards fewer suppliers also could be described as a best practice of lean purchasing (Cook and Graser, 2001:89). Combined with the start up of the electronic marketplace called Exostar, this will affect opportunities for small suppliers. Exostar member large firms will have the ability to consolidate requirements across their entire enterprise for some commodities and services. Interaction with the supply chain through Exostar will be via a common EDI standard and toolkit.

Unfortunately, many of the cases studied had little or no knowledge of SAF/SB initiatives. Several of the cases had never dealt with persons in the small and disadvantaged business utilization function for the Air Force. Those cases that had dealt with the small business function spoke highly of the efforts by persons at SAF/SB, the AFOPO, and MTAPP.

Table 13 - Matrix of Recent Experiences with SAF/SB Initiatives by Company

SAF/SB Initiative	Company											
	S1	S2	S3	S4	S5	S6	S7	S8	L1	L2	L3	L4
WOSB	Yes	No	No	No	No	No	No	No	Yes	Yes	Yes	Yes
NA	Yes	No	No	No	No	No	No	No	Yes	Yes	Yes	Yes
Mentor/ Protégé	Yes	No	No	No	No	No	No	No	Yes	Yes	Yes	Yes
MTAPP	No	No	No	Yes	Yes	No	Yes	No	Yes	Yes	Yes	Yes

Another finding from the cross-case analysis is that MTAPP appears poised to help small manufacturers adopt the Lean PSM practices that are becoming more prevalent. MTAPP was cited as very helpful by one case study firm in helping to understand and navigate the world of Government contracting. In order to help the small MTAPP-member firms adapt to DoD subcontract work, MTAPP has placed strong emphasis on the implementation of lean manufacturing at the small business level. This emphasis includes on line courses through MTAPP's Cyber University in areas like lean manufacturing, statistical process control, ISO standards, and more (Ward, 2002:no pg.).

Summary

This chapter presented the information and analysis for the twelve case studies of this exploratory research. Recall that the two Research Objectives of this thesis were to: (1) research the buying practices of the defense aerospace industry to determine current trends relating to small business levels of participation by comparing acquisition programs, and (2) compare existing Air Force small business programs, policies, and techniques (including MTAPP) to developing trends for small business participation and identify strengths and weaknesses.

The thesis was structured to combine the results of a quantitative analysis of subcontract data over the last two decades with the qualitative corroboration or elaboration of several case studies. Unfortunately, the quantitative data was not available in the level of detail and length of time required. Quantitative data that was received helped form the basis of the questions employed in the qualitative portion, and the qualitative portion did produce results.

The aerospace industry has been undergoing major change since 1990. One of the chief initiators of change has been the consolidation of the aerospace industry into a few very large prime contractors where there were once many independent companies. A second change agent has been the movement towards a single, national industrial base. A third force for change has been the increased emphasis by DoD on reform of the entire acquisition process. These forces have combined to affect the relationship between the prime contractors and their suppliers, including their small business suppliers.

The key trends facing the aerospace small business subcontractor community were identified. The major trend identified from the case studies was a movement towards what has been described elsewhere are lean purchasing and supplier management (Lean PSM). Lean PSM is an adoption of business-to-business techniques first pioneered in commercial industries like automobile production.

Other, more general trends identified included the tendency of the two largest primes to act more as program integrators and assemblers, the reduction by the primes in the number of firms in their supply base, and the consolidation of requirements for common items like office supplies across an entire corporation.

The effects of Lean PSM vary by whether the small company is a wholesaler of small parts or a manufacturing firm. They also vary by the amount of time that the small business has been performing aerospace subcontract work and by the number of employees. Generally, larger small businesses that have been in the aerospace industry for a longer time have experienced more of Lean PSM. A notional representation of the trends identified by this research and the way that SAF/SB initiatives help small businesses react to the trends is contained in the on the next page

The implications of those trends for Air Force Office of Small and Disadvantaged Business Utilization (SAF/SB) initiatives were also discussed. Lean PSM practices were identified in thesis as important by both large and small case study firms. Lean PSM was also identified by Project Air Force as a trend affecting prime/sub relationships. The MTAPP program appears to be preparing small manufacturers for the need to adopt Lean PSM practices. Through training both on-line and at MTAPP sponsored

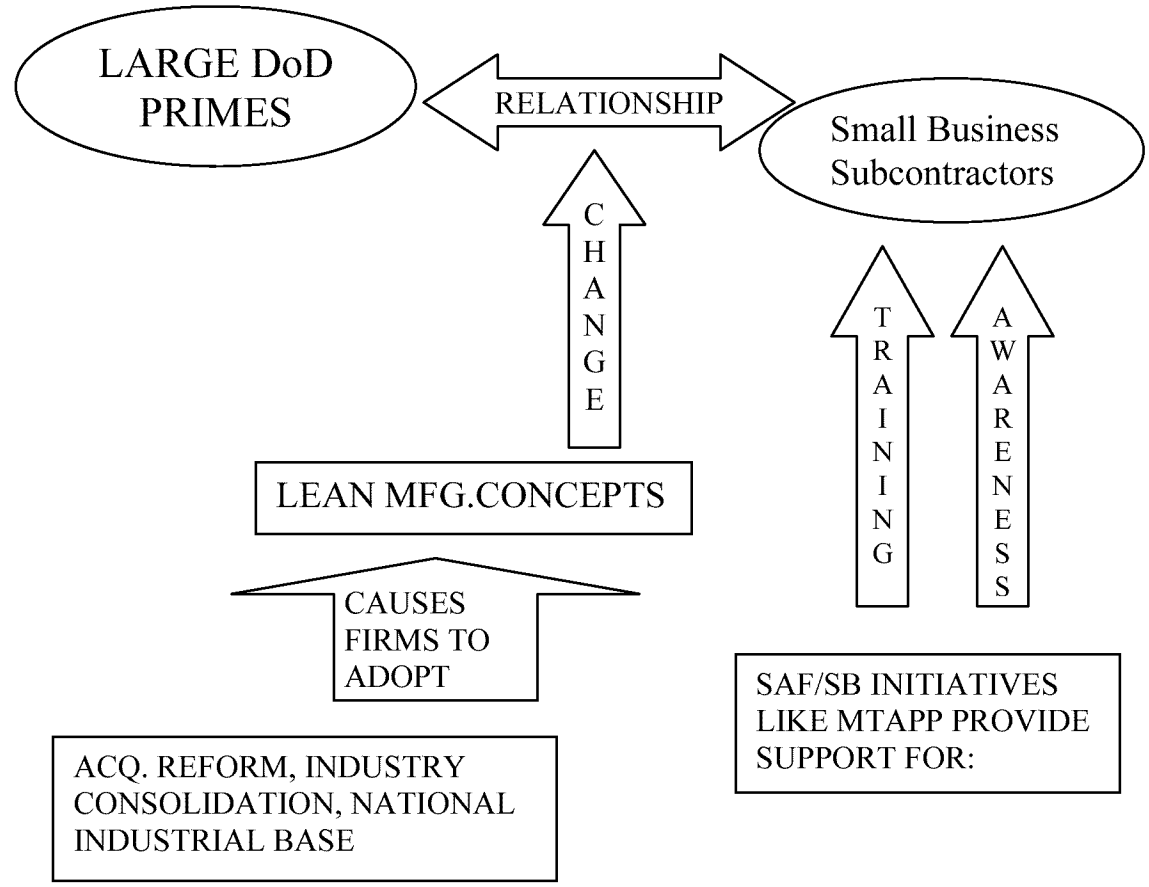

Figure 4 - Impacts on Prime/Sub Relationship since 1990

seminars, the MTAPP program increases the skills and awareness of their member firms. MTAPP helps the small firms respond to the changes brought on by Lean PSM. Small firms have responded by upgrading their facilities and investing in new equipment. The new equipment is for both improved manufacturing (5-axis machining) and improved business processes (computers for EDI, e-commerce). Lean PSM fosters a culture of continuous improvement in order to cut costs and improve efficiency. Some of the case study firms added engineering or design capability in order to make themselves more attractive to customers. Others added machining capability to an existing design capability. These are some of the ways that small firms have responded to the pressure on their relationship with primes brought on by Lean PSM.

V. Conclusions and Recommendations

The genesis for this thesis came out of a desire by SAF/SB to identify the trends facing the small aerospace subcontractor community. SAF/SB has implemented a number of initiatives in the past few years aimed at increasing small business levels of participation in defense programs. During roughly the same time period, changes in the acquisition process brought on by acquisition reform implementation by DoD, consolidation of the major defense contractors into fewer and fewer large firms, and the impetus towards a unified national industrial base were all affecting the business environment for small subcontractors. SAF/SB was concerned that the initiatives may not be in concert with the current trends, and sponsored this thesis effort to identify trends and determine the implications for SAF/SB initiatives.

The first objective of this research was to determine the trends relative to small business subcontractor participation in major aerospace defense programs. It was expected that the buying practices of the defense industry have changed in the last decade given the changes to the defense acquisition environment brought about by the forces of acquisition reform, aerospace industry consolidation, and the movement towards a national industrial base. A second purpose, once the trends were identified, was to assess their impact on existing SAF/SB programs, policies, and techniques.

A mixed methods approach was selected for the execution of the thesis methodology. This combined a quantitative analysis of archival subcontract data at prime systems contractors along with a qualitative analysis via several case studies to confirm or elaborate upon the information found in the quantitative analysis.

The quantitative portion required the collection and analysis of program subcontract data for six major aerospace programs: F-22, F-16, C-17, SBIRS, AMRAAM, and JSTARS. These programs represent a good cross section of the types of major systems that the Air Force acquires, and represent five different prime contractors. Archival data on subcontract awards by name and type of subcontractor, by dollar amount, and by purpose of subcontract for 15-20 years was requested. Unfortunately, archival data on types of goods/services subcontracted for over time by the large prime contractors on the six programs of interest is not available. One reason for this is that the prime contractors do not collect data at the level of detail desired by this effort as part of their Comprehensive Subcontracting plan. Another reason is that changes in data systems due to software upgrades or industry merger and consolidation make data older than the last few years difficult to obtain. Even the data that was received from three programs lacked one or more key elements desired. One set went back for the past eleven years, but had no description of what was purchased. Another set was only a snapshot in time of one year's open purchase orders, without the longitudinal aspect so important to identifying trends before and after acquisition reform.

The qualitative portion consisted of conducting case studies with twelve different companies in the defense industry. Eight of the case studies were with companies that are small business subcontractors. The types of small businesses ranged from wholesale parts suppliers to small precision machine shops to firms with design and engineering capability in addition to their manufacturing skills. The other four case studies were firms that are among the largest defense prime contractors in the world. The case study data was analyzed within-cases first and then across-cases to identify major trends, the

implications of those trends for SAF/SB initiatives, and the similarities and differences among the cases.

Conclusions

Research Objective 1. A clear trend identified by both the small and large businesses is the adoption of what has been called lean purchasing and supplier management (Lean PSM) techniques. The Lean PSM techniques identified in the case studies included: supplier qualification and certification, longer-term relationships, communications with suppliers, EDI with suppliers, lean training (or, kaizen) events at suppliers, target costing, just-in-time (JIT) delivery, supplier managed inventory at the customer, and supplier kitting of parts for customer. All of these techniques are supposed to improve, streamline, and make more efficient the supply chain structure that is supporting the prime contractor's weapon system production process. The Lean PSM techniques are a departure from the practices common in the industry prior to the early 1990's. Lean PSM is an outgrowth of the lean manufacturing concepts pioneered in the international automobile industry and adapted by many other industries. Not all of the Lean PSM practices were cited equally often in the case studies.

The Air Force and DoD have encouraged their prime contractors to adopt lean manufacturing concepts, to include Lean PSM, since the early 1990's. The primes have taken this push towards lean and diffused it into their supply base. Lean PSM makes extensive use of electronic technology for exchange of information with all levels of the supply chain. This improved, faster information flow is vital to many of the other Lean PSM techniques. Lean PSM also fosters a culture of continuous improvement in quality, delivery, and price. Small manufacturers will have to be ready to employ lean concepts

in order to either enter or remain in the aerospace industry. The implications for small suppliers of commodity type items or services are less clear. The case studies indicate a trend among large contractors to consolidate requirement for commodities across the firm or perhaps even an industry. A small business supplier of commodities may not be able to find opportunities in the aerospace industry even if they have adopted lean concepts.

The identified trends did seem to vary by size of the small business or its years of experience as a defense subcontractor. Larger small businesses with greater annual revenues, more employees, and that had longer histories of defense work had implemented more of the Lean PSM practices than had smaller small businesses. The diffusion of the Lean PSM innovations appears to have been faster in the larger small businesses.

The trends were also slightly different by the nature of what the small business did (i.e., machine shop vs. wholesale distributor). The wholesalers had experienced the Lean PSM practices of supplier (or vendor) managed inventory at the customer and supplier kitting of parts for ease of assembly by the production line workers at the customer. This is expected given the nature of what the small distributors supply to the large firm: small parts that the large firm used to keep in their internal inventory control system prior to being dispensed. Lean PSM adoption did not vary by geographical location of the firm or by type of small business (i.e., WOSB vs. SDB).

Other, more general, trends included a tendency for the very large defense prime contractors to act as a system integrator and assembler, with those firms at the first subcontract tier providing entire subsystems for inclusion into the overall weapon system. This requires the subs at the first tier to able to handle a more complex job of subsytem

integration. A second general trend was the perception that large prime contractors are reducing or consolidating their supply bases. This may impact the ability of new firms to join or enter the world of aerospace defense subcontractor. A third general trend for the major primes to consolidate requirements for what could be called commodity items across the entire corporation or among several corporations. The existence of the internet-based trading exchange Exostar is one indicator of this trend. Firms like Boeing, Lockheed Martin, and Raytheon created Exostar to develop common standards for EDI with their supply chains and to create a place where market exchanges can occur. Exostar was termed by one case study interviewee as the "Home Depot purchasing philosophy" of buying in bulk to cut costs.

Research Objective 2. One SAF/SB initiative that is poised to help the small manufacturing firms succeed in the Lean PSM environment is MTAPP. MTAPP has as a goal the development of reliable, technically advanced small manufacturing businesses. MTAPP emphasizes preparing small manufacturers for the world of aerospace work. Training in lean concepts is a primary goal of MTAPP. For the small business cases that had dealt with MTAPP, strongly positive comments were offered. No measurement was made of the effectiveness of MTAPP's assistance efforts. That is an area of future research that will be highlighted later.

SAF/SB has initiatives relative to woman owned small businesses (WOSB) and Native American owned small businesses (NAOSB). Businesses that fit these special categories have greater opportunities if they have adopted the Lean PSM concepts noted above. The key for the large primes that made up four of the cases is that whatever type

or size of supplier a company is, they must be able to participate using Lean PSM techniques or they will not be considered for award of a subcontract.

If the very largest defense contractors are truly moving towards a situation where their immediate subs must be able to deliver an entire subsystem it will affect those two companies ability to support SAF/SB initiatives. The two companies together represent a significant source of potential subcontracting opportunities given the large dollar value of their DoD prime contracts. If the large primes are consolidating their supply base, it will also impact their ability to support SAF/SB initiatives. Finally, if concepts like Exostar allow large primes to consolidate requirements among corporations it will change the opportunities for subcontracting. The large, consolidated requirements may be more than any one small business can handle.

Contributions of Research

This thesis effort identified that one of the major influences on the relationship between large business prime contractors and small business subcontractors in the aerospace industry is the Lean PSM trend. Lean PSM affects a number of aspects of the relationship between prime and sub and the use of Lean PSM practices is increasing. SAF/SB is already responding to this trend through the MTAPP program for small manufacturers, but case studies S2 and S6 show that Lean PSM is affecting wholesale suppliers of small parts like fasteners also.

Another contribution of this effort is the identification of the general trend of reduced opportunities at the first tier subcontract level with the largest primes. Opportunities are reduced because many small firms are not able to perform the

subsystems integrator role required to act as a first tier sub to some prime contractors. A second general trend identified include a desire by some primes to reduce the size of their supply base. A third general trend is the consolidation of requirements by some large firms into electronic marketplaces like Exostar. The SADBU community was already aware in some sense of these general trends.

The quantitative portion of this mixed methods approach identified that the use of archival subcontract data on major programs is problematic. The data required to track over a period of 15-20 years what was subcontracted for to what type of business and at what amount was not available.

Limitations

As noted above, the kind of long-term archival data from the prime contractors that would have been most useful for identification of subcontracting trends is not available. In part, this is because the exact data items needed to identify trends over time are not collected by contractors participating in the comprehensive subcontracting plan program. It may also be the case that the data was collected at one time but is contained in incompatible databases that predate a particular company's merger or consolidation. The lack of quantitative data limited the ability to triangulate the results of this effort. The original plan was to use the case studies to confirm or expand upon the data collected in the quantitative analysis. This may have affected the validity of the results by not providing independent confirmation of the data via the later case studies. The case studies did validate the types of products/services commonly outsourced by prime contractors as identified by one portion of the quantitative data that was received. The

lack of full quantitative data was partially compensated for by increasing the number of case studies from what would have been conducted had the quantitative data been available in the depth desired.

The small business cases were only eight companies out of a potential of thousands of small business subcontractors. The conclusions are applied to small manufacturing firms, which made up a large proportion of the cases. Validity is compromised by the inability to interview at least two persons at each firm for most of the firms and or a lack of documentation relative to some of the interview subject's assertions. This is tempered by the fact that for several firms, the interview subject was the founder/proprietor of the business. In such small firms, almost no one outside the founder's family has enough time with the company to be able to answer the interview questions completely. Time limitations prevented personal visits by the researcher to each of the case study firms who were dispersed geographically from southern California to the New England states and from the Great Lakes to the Gulf Coast.

Recommendations for Future Research

Project Air Force and the qualitative portion of this thesis identified Lean PSM trends in the aerospace industry. An area of future research would be to issue some sort of survey instrument to the small business subcontractor community and/or the ranks of large defense contractors to more completely gauge the depth of the Lean PSM trend.

Future research should improve on the limitations of this thesis effort. First of all, quantitative archival data is limited by what prime contractors are required to collect by their subcontracting plans. Before data can be collected, confirmation that it exists in the

format required is a necessary step. A potential source of data for follow on efforts are the Defense Contract Management Agency (DCMA) offices with responsibility for administering the Comprehensive Test Plan Program (CTPP) subcontracting plans. The CTPP member contractors must submit annual reports relative to goal accomplishment. This information may not be broken down by major weapons system program because the CTPP plans are not for one program alone, but for an entire facility, division, or corporation. Annual reports may also be available from first tier subcontractors that are also large businesses. The process of collecting this lower tier data will be time consuming.

For the case studies, the time and ability to travel to the various locations for the conduct of document reviews is important to overcome limitations as experienced in this effort and should be part of the research design. Some attempt to expand the scope beyond the small manufacturers that made up most of the case studies is desirable in future research. Small wholesalers represented two of the case studies but what they supply appears to be significant part of what is outsourced based on NAIC data from one major program. Other outsourced services include professional engineering/technical services, which were not part of the case study but may be another area of interest to determine if small engineering firms have a different experience from small manufacturers or small wholesalers.

A potential area for research is to study those prime contractors that are not part of the Comprehensive Test Plan (CTP) program. Less than twenty contractors participate in the CTP program. A comparison of these contractors vs. the CTP contractors would identify other differences. There are around ninety companies in the

list of the top 100 defense contractors for 2000 that are not CTP participants. Collectively they received tens of billions of dollars in Federal awards and represent significant subcontracting opportunities. Within this cadre of non-CTP firms are not-for-profit research institutions and major American universities. These entities may have a different method of dealing with their small business subcontractors.

A comparison of MTAPP member firms versus non-MTAPP member firms is yet another area for future research. How MTAPP membership and training affects the ability to compete as an aerospace subcontractor as compared to those small manufacturing firms that have not had MTAPP training has not been examined.

Other potential areas of future research include an analysis of how the recently created trading exchange Exostar will impact the aerospace and defense subcontractor ranks. Several of the largest defense contractors have banded together to establish standards for information exchange throughout the supply chain. This stands to affect all firms that desire to work as subcontractors for the large primes. Related to this trend is the reduction in the supply base sought by some large firms. How will subcontracting opportunities change if the number of subcontractors that a large firms deals with is reduced in number?

Another potential area for research relates to the claim made by one of the case study firms that the comprehensive subcontracting plan test program has acted to diminish opportunities for small subcontractors due primarily to weak enforcement of comprehensive plan goals. This claim cannot be examined by use of any of the data collected for this thesis effort.

Appendix A: Masked Interview Responses

Interview Protocol for: **S1**

Interviews with: CEO, Executive VP and General Counsel
Company location: Southeastern U.S.
In business for: 17 years
Average number of employees: 380
Average annual revenue: $40M
SB size status: SB, Asian Pacific American; Mentor/Protégé Program graduate
Primes/1st tier subs worked with: Boeing-St. Louis, Raytheon, Smith Industries, Lockheed Martin, and Northrop Grumman
Business category: Electronic/avionics design and manufacture

Responses in **BOLD**

1. What aerospace defense prime contractors has your company worked with during the time that you have been associated with it, and what programs (e.g., F-16, F-22, C-17, JSTARS) have you provided goods and/or services for?

Boeing-St. Louis, Raytheon, Smith Industries, Lockheed Martin are the primary ones S1 deals with, along with Northrop Grumman. The overall total is between 10 and 14 large primes. Some of the programs include F-15, F-16, F-18, F-22, AV8, C17, T45 and others. FCOM services for the Army.
S1 started in 1984 as a small company manufacturing cables and circuit boards. They later grew into the avionics area, due to their ability to do a lot of reverse engineering. It is difficult for a SB to compete against large contractors in the area of design work because it takes a lot of resources, human and physical. After a few years of success in reverse engineering, S1 decided to add engineering expertise and set up a design engineering capability of their own. S1 has entered into the DMS (diminishing mfg. sources) program because of the expanding repair market. The DMS work is done as a prime contractor for locations like WR-ALC. DMS is a growing concern for the Govt. due to the number of aging systems. S1 developed a database for tracking old parts with layers of information. S1 is helping the AF develop a database for subsystems like the APG radar on the F-15. They will be able to tell the AF what parts are going obsolete in the next few years and provide a system analysis of potential maintenance problems. This is of great interest to the AF.

VP has been at S1 since 1994. L1 is their largest customer. S1 supplies parts for a number of systems, including C-17, F-15, T-45, AV8B, and some missiles. Their business with Lockheed Martin (LM) is much smaller, supplying parts for the F-16, F-22, and C-130. They also supply parts for missile programs to Raytheon. VP termed S1 as a "job shop, not a production line". S1 changes

it's production set-up to match the current job that they're working. S1 also does some services work, especially in the area of Diminishing Manufacturing Sources (DMS). The DMS work is done directly for WR-ALC and the F-15 office. S1 has set up a database to track which electronic parts on the F-15 are becoming more difficult to acquire due to obsolescence or some other reason. In the past, the Govt. item managers were good at executing Life-of-Type (LOT) buys for items that were going away, but usually only for the PROJECTED life of a system. Unfortunately, new systems are not coming along as frequently as they used to so items are staying in the inventory longer than projected. DMS is a key issue for system maintainers and this part of the business is growing at 100% per year. On a totally different business model, S1 has the engineering capability to reverse engineer "orphan" parts that no longer are made, and then product form-fit-function replacements.

2. What do you think are the current trends relative to small business participation as subcontractors in major aerospace defense programs?

SB participation has been declining in the past few years. CEO believes that this is due to the existence of the comprehensive test plan for subcontracting plans, which has reduced opportunities overall for SB's. Their appears to be no significant penalty for a LB when they fail to meet SB subcontract goals.

The major primes (Boeing, LM) are more and more integrators of work done by other large primes and medium to small sized subs. The next tier down from the primes are companies like Smiths Industries, BAE Systems, and Raytheon. This tier might do something like pull together all of the components for a radar, which Boeing then installs in their aircraft. SB's are being pushed down a tier or two from where they used to be commonly. 15 years ago Boeing would have acted as the design authority for most of the components that made up the total system. Now they farm some of the design for major subsystems to the Northrop's and Raytheon's of the world. Those SB's that still deal directly with Boeing are fewer and farther between, but they also have larger subcontracts, on average, than they used to. S1 is among the companies at this top edge and still gets some of these direct awards from Boeing. VP's belief is that the preference of the Boeings and LM's would be to give most of the first tier work to the Northrop's, Raytheon's, etc. There are fewer contracts from the primes, they are bigger and harder to get, the competition to get them is greater and the margins lower. Lean or high efficiency manufacturing is very important. If a small company is not highly lean, it may "win" contracts at a loss. Currently, S1's pre-tax profit is between 0% and 5%. VP questions the current trend towards reverse auctioning and the claim that this method can save 20% on price. If they cut prices by just 10%, most SB's will be out. A few years ago the primes could squeeze 10% of the price out just by forcing "lean" concepts on their suppliers. For example, S1 is already doing 50% more business with the same G&A and O/H as before the lean concepts were applied. The primes trained the SB's on how to be "lean". The F-18 is an example where Boeing

promised to lower the per unit cost from $80M to around $40M based on "lean" concepts and redesigning for commercial components. For example, S1 makes two units for the F-18. After a redesign, the cost went from$32K to $8K for each, a savings of $48K per plane. The redesign primarily changes "mil-grade" to "commercial-grade". This is fine, but the commercial grade items don't withstand extreme temperature conditions as well.

3. How has your company's business relationship with prime contractors or higher-level subcontractors changed over the years? What aspects have remained the same? What is causing these changes, in your opinion? Why are some aspects unchanged?

The relationship has changed for S1 from a more collaborative relationship to one that seems to be based primarily on who is the "Low-cost" producer. He thinks this is true for most SB's that he knows. The primes are not interested in the long term history of a small company, just who can provide them the needed part or service at the lowest cost. What is unchanged is an expectation that whatever product is provided by the SB, it must be of high quality. CEO feels that the competition at the prime and first tier level has intensified. Lockheed and Boeing are the primes most of the time. Northrop, Raytheon, Hughes, and others are competing strongly for the first tier. At the lower tiers there are "many mouths to feed" and the large businesses are using this competition to lower prices while still getting high quality parts.

What has changed: there are fewer contracts with the large primes, competition among subs is higher, the dollar values are up, and the delivery times are tighter. For Boeing, S1 can't deliver more than 5 days early and 0 days late or it will take a hit in its supplier performance evaluation. Any rating drop could lose them a chance at future business. The primes will work hard with a SB to help them improve once they find a good one.

What is the same: Quality products are still a requirement. Since what S1 supplies are not "commodity" items, personal involvement by the leaders of such a small company in the day to day business is vital.

VP is also finding that some categories of SB's are now receiving special emphasis from the Govt., like Native American, or tribally-owned companies. He also feels that some work is staying in the US due to export control laws on technical data. Not that many parts for the F-16 and C-130 are made in the U.S. anymore, and LM would like to outsource more.

4. Your company is listed on the SBA's PRONET website as having a primary North American Industry Classification System (NAICS) code of 334511, which corresponds to "Search, Detection, Navigation, Guidance, Aeronautical, and Nautical System and Instrument Manufacturing". The PRONET site also lists other NAICS codes of 332439, 333319, 336414, and 541330. Do these NAICS

codes accurately describe the categories of skills/abilities/competencies your company providing to the prime contractors or higher-level subcontractors? If not, what codes would provide a more accurate description? Has this changed over time?

The listed codes are accurate. The high tech services aspect (541330) is becoming more important.

VP filled out S1's data entries on PRONET. By SBA rules, a company is supposed to include the NAIC code that equates to the highest $ value of sales. Radar has been the single NAIC code with the highest sales lately. This year it might be the one that relates to the DMS services. He also said that he doesn't think that a prime searching the PRONET for their code has won S1 a contract yet.

5. At what level in the major defense program are you selling your products/services? (e.g., to the prime contractors, first-tier subcontractors, or lower tier subcontractors)

To the primes and first tier large subs like Boeing, Lockheed, Raytheon, Northrop, and Hughes

Sometimes direct to the primes (like Boeing and LM) and sometimes to the next tier.

6. A recent analysis of the types of purchases made by a large defense contractor from small business subcontractors/suppliers showed that most of purchases were in the eleven NAIC categories/subsectors listed below. In your perception, is this an accurate listing of the types of goods and services that large contractors acquire from small businesses? Can you think of any that were left out?

Subsector	Title
326	Plastics & Rubber Products Mfg.
331	Primary Metal Mfg.
332	Fabricated Metal Product Mfg.
333	Machinery Mfg.
334	Computer & Electronic Product Mfg.
335	Electrical Equipment, Appliance and Component Mfg.
336	Transportation Equipment Mfg.
421	Wholesale Trade – Durable Goods
422	Wholesale Trade – Nondurable Goods
541	Professional, Scientific, and Technical Services
999	Miscellaneous – Not Elsewhere Listed

These appear to be accurate. None appear to have been left out.

7. How have opportunities for small subcontractors in the listed industries changed/stayed the same over the past 10-15 years?

The opportunities have stayed about the same due to the continuing requirement for some sort of SB subcontracting plan by the large primes, but CEO perceives that it has eroded lately due to the comprehensive test plan program and contract bundling.

See answers above also. VP feels that opportunities have shrunk in the past 10 years due to the presence of the Comprehensive Subcontracting Plan Test Program. When PCO's (10 years ago) began beating up on the large primes for not meeting the SB goals in their individual contract plans, the primes went to Congress and got the Comp Plan program as a result. He feels that enforcement of the Comp Plan goals are an issue.

8. How has the average dollar value level of your subcontracts changed over the past 10-15 years?

The dollar values have gone up because S1 has moved to a higher level in the food chain; S1 is doing more technically advanced work; over the years S1 has progressed from building cables and boards to providing complete subsystems.

The dollar values have increased dramatically. From an average job of $10K to an average of $100K to now where $100K is the smallest that S1 receives. The average value is approaching $500K and more if it's an Indefinite Delivery/Indefinite Quantity (ID/IQ) contract.

9. What experiences, if any, has your company had with the small business liaison offices at SAF/SB, AFMC/BC, the product or logistic center small business offices (e.g., ASC/BC), the Air Force Outreach Program office at Brooks AFB, TX, or the Manufacturing Technology Assistance Pilot Program (MTAPP) for small businesses in St. Louis, MO?

S1 has had pleasant experiences with all listed entities except for MTAPP, with which S1 has had no contact.

VP has never heard of the MTAPP program. He has dealt with SAF/SB and terms the staff there "outstanding". He had a productive relationship with Mr. Frangione, who was in the SB area at Eglin AFB, but he is now retired

Additional comments:
CEO feels that to be successful, a SB must focus on what they do best; they must be able to say "No" to a large business when they are asked by a large business to provide something that is outside their core capabilities. Without that focus, an SB may try to be all things to all people and in the end, fail because it has strayed outside the realm of what it does well.

S1 is a graduate of the Mentor/Protégé program with Boeing. They are now acting as a Mentor themselves to 2 other small businesses.

CEO stated that the AF is lately has been pushing for more business for Native American firms, and CEO accompanied Mr. DeLuca on a trip to visit some reservations in No. Dakota. S1 has found that there are three criteria that should be met before they will do business with a Native American business: 1) they like to deal with companies that are close to them (geographically), 2) the company should be in a similar line of business, and 3) they prefer to deal with tribal owned businesses because they are more stable and tend to be better run. S1 currently has a successful relationship with a tribally owned business in Alabama.

10. Thank you for participating in this study.

ADDITIONAL INFORMATION GATHERED AT A LATER DATE FOLLOWS:
Thanks again for participating in my research study last month. Since we last talked, I've come across some additional literature on the subject of prime contractors and the relationship with their suppliers. The literature has sparked a few additional questions that I'd like to ask you, as follows:

1) Are you qualified relative to certain standards such as ISO-9000 or AS-9000? Were they a requirement for doing business with your primary customers?

Answer: We are "ISO-9000 Compliant" which means that we comply with the ISO-9000 quality standard, but we did not bother to pay any certification company to come to S1 and give us a "certification". We did this because the Government dropped the military quality standards and we had to pick up some quality standard. The DoD and the military primes do NOT require "certification". However, now Boeing has told us that we have until the end of this year to become certified as AS-9100. We are currently paying a certification company to work with us on that certification and we will have it within a few months.

2) Does your primary customer have a certified supplier program and is your company a participant? Again, was this a condition of doing continued business with your customer?

Answer: Yes, Boeing is our primary customer and they do have a certified supplier program. Boeing has 25,000 suppliers and about 800 are in that "preferred supplier program" at the bronze, silver or gold level. There are only 15 companies at the top, gold, level and S1 is one of those top companies. Again, if you are not in that preferred supplier program, then it is much harder to win jobs.

3) Does your primary customer have a supplier council and is your company a member?

Answer: Yes, Boeing has a Supplier Advisory Council and the CEO/president of S1 has been a member of that council for about 8 years. There are about 20 members of the Boeing Supplier Advisory Council and that Council had their last quarterly meeting here at S1 last month for 2 days.

4) Has your company participated in continuous improvement or "kaizen" events where someone from your primary customer's supplier development office has come to your facility to help train your company in what might be called "lean manufacturing" concepts?

Yes, Boeing has been here about 10 times for those events. I lead a Kaizen last summer involving the streamlining of our supply room operation. We installed a kitting system with plastic trays with covers for the kitting of all the parts for the manufacturing floor. We have a "lean manufacturing" focal point person here on staff and we are constantly trimming our operations over and over. If you are not lean, you're soon dead in the current competitive environment.

5) Does your primary customer encourage or require suppliers to "kit" parts for easier use by its assembly line workers?

Yes, as stated above, we have always done that, and a recent Kaizen made it better.

6) Does your primary customer employ any kind of "target costing" technique during the design of a new system where your company is given a price target for the part it supplies and then asked to tradeoff technical and quality features in order to meet the target? Answer:

Yes, we do that on almost everything. Every time that it is possible, we provide the tradeoffs for the use of commercial grade electronic parts instead of military grade parts. The difference is in the temperature grade and sometimes the shock resistance. We designed the air pressure measurement and computerization system for the new F/A-18E/F and it cost $64,000 per airplane with military grade parts and sensors. Boeing asked us for a quote using commercial grade parts and it was $16,000 using the exact same case and doing the same job. Boeing accepted the new version and we no longer make the military grade version.

7) What has your company done to adapt to the trend towards the adoption of these and other "lean manufacturing" concepts?

Answer; Listed above. We do lean studies all the time. We chart all our processes. We have training all the time. Boeing comes here regularly to provide lean kaizens. We have a trained person on staff. We would be dead without it.

Your help in answering these additional questions will greatly help me in filling in some gaps in my data. Please feel free to contact me with any questions or concerns that you

may have. If you like, just send me an email in response, or if it is easier for you, please let me know when I could call you on the telephone

Interview Protocol for: **S2**

Interview with: The President
Company location: Northeastern U.S.
In business for: 17 years
Average number of employees: 12
Average annual revenue: $
SB size status: SB, minority owned, not SDB
Primes/1st tier subs worked with: Raytheon, Northrop Grumman, Lockheed Martin, sometimes at prime level, sometimes at 1st tier sub level
Business category: Electronic parts and equipment wholesaler; distributor

Responses in **bold**

1. What aerospace defense prime contractors has your company worked with during the time that you have been associated with it, and what programs (e.g., F-16, F-22, C-17, JSTARS) have you provided goods and/or services for?

Northrop Grumman for JSTARS, Raytheon for board level components for Patriot and Sidewinder, and Lockheed Martin, but unsure of what program. Often, S2 sells to one of the large primes but is not certain what program the part will be installed on.

2. What do you think are the current trends relative to small business participation as subcontractors in major aerospace defense programs?

The President has been in this line of business since 1984. There have been ups and downs over time for SB participation. PL 99-661 mandated that small minority owned businesses should be provided the maximum opportunity for defense subcontracts. Lately, the primes have been gravitating towards larger companies as their suppliers. The SBs like S2 may be perceived as being a potential weak link because they lack some of the extra capabilities that a large business may have like value engineering. He is seeing the AVNETs and ARROWs (both large electronic parts suppliers) get most of the business opportunities. The President tried to bring together an alliance of small suppliers to help the group stay on the "radar screens" of the large primes but without a great deal of success. The President perceives that the push towards fewer and larger suppliers is driven the leaner defense industry and the fewer dollars to go around. The primes MRP requirements change wildly from month-to-month, which makes forecasting difficult for the LB and planning more difficult for the SB supplier. The trend seems to have started about 5 years ago.

3. How has your company's business relationship with prime contractors or higher-level subcontractors changed over the years? What aspects have remained the same? What is causing these changes, in your opinion? Why are some aspects unchanged?

The primes are looking for their suppliers to take on more responsibility and cost with things like vendor-managed inventory. They want their suppliers to set up a supply of items in the prime's facility and use their own resources and people to keep it stocked. Most SB suppliers don't have this capability. There is also a perception among LB primes that the SB's can't handle it so the SB is not even considered as a source for it, even though it doesn't mean that an SB couldn't do it. They're usually not even given the chance.

4. Your company is listed on the SBA's PRONET website as having a primary North American Industry Classification System (NAICS) code of 421690, which corresponds to "Other Electronic Parts and Equipment Wholesalers". Does this NAICS code accurately describe the categories of skills/abilities/competencies your company providing to the prime contractors or higher-level subcontractors? If not, what codes would provide a more accurate description? Has this changed over time?

The code is accurate as it applies to S2 and it's the business that they've been in since the beginning.

5. At what level in the major defense program are you selling your products/services? (e.g., to the prime contractors, first-tier subcontractors, or lower tier subcontractors)

When selling to the Raytheon, Northrop Grumman, and Lockheed's of the world, sometimes it's as a first tier sub, sometimes as a second tier. Raytheon does prime work of its own but often is the first tier sub to Lockheed or Boeing. The whole process of a SB even getting considered for a new program is challenging. The President has had situations where he called on a company for two years and still was not given a chance to submit an offer.

6. A recent analysis of the types of purchases made by a large defense contractor from small business subcontractors/suppliers showed that most of purchases were in the eleven NAIC categories/subsectors listed below. In your perception, is this an accurate listing of the types of goods and services that large contractors acquire from small businesses? Can you think of any that were left out?

Subsector	Title
326	Plastics & Rubber Products Mfg.
331	Primary Metal Mfg.
332	Fabricated Metal Product Mfg.
333	Machinery Mfg.
334	Computer & Electronic Product Mfg.
335	Electrical Equipment, Appliance and Component Mfg.
336	Transportation Equipment Mfg.
421	Wholesale Trade – Durable Goods
422	Wholesale Trade – Nondurable Goods

541 Professional, Scientific, and Technical Services
999 Miscellaneous – Not Elsewhere Listed

The President perceives this as an accurate list of the types of items/services commonly purchased by large contractors from SB's, but wondered if "construction services" should be added to the list. He has heard lately that the large companies are outsourcing their construction needs to SB's in order to improve their overall SB numbers.

7. How have opportunities for small subcontractors in the listed industries changed/stayed the same over the past 10-15 years?

The opportunities are more difficult to come by and less plentiful. From what The President has heard from similar companies to S2 that they are also struggling to even be considered for new business.

8. How has the average dollar value level of your subcontracts changed over the past 10-15 years?

It has stayed pretty much the same overall. The trends are mixed, depending on the customer. Some have increased, others have decreased.

9. What experiences, if any, has your company had with the small business liaison offices at SAF/SB, AFMC/BC, the product or logistic center small business offices (e.g., ASC/BC), the Air Force Outreach Program office at Brooks AFB, TX, or the Manufacturing Technology Assistance Pilot Program (MTAPP) for small businesses in St. Louis, MO?

S2 has had no real experiences with these organizations.

10. Thank you for participating in this study.

Thanks again for participating in my research study last month. Since we last talked, I've come across some additional literature on the subject of prime contractors and the relationship with their suppliers.
The literature has sparked a few additional questions that I'd like to ask you, as follows:

1) Are you qualified relative to certain standards such as ISO-9000 or AS-9000? Were they a requirement for doing business with your primary customers?

S2 is qualified to MIL-STD-4520A.

2) Does your primary customer have a certified supplier program and is your company a participant? Again, was this a condition of doing continued business with your customer?

S2 is certified. Initially, the certification may be of a relatively low level, but a supplier will progress to higher levels as they become a more frequent supplier.

3) Does your primary customer have a supplier council and is your company a member?

S2 is on the supplier council for Hamilton Sundstrand (HS), one of their key customers. S2's president is on the board for the council. One of the roles of the board is to act as a messenger for the supplier base to HS and vice-versa. The board passes out information to the top 200 suppliers regarding seminars and other programs that HS is offering to the supply base. The supplier council is also used as a means for suppliers to share information and lessons learned, such as common problems related to payment or quality.

4) Has your company participated in continuous improvement or "kaizen" events where someone from your primary customer's supplier development office has come to your facility to help train your company in what might be called "lean manufacturing" concepts?

Yes, HS came out and helped with an improvement of S2's purchasing function. They looked together at the processes involved and found ways to streamline or improve. S2 has done some *kaizen* analyses on their own of other processes internal to S2.

5) Does your primary customer encourage or require suppliers to "kit" parts for easier use by its assembly line workers?

S2 does kitting for Raytheon for the commodity items that it supplies. It is done via a "ship to WIP" method. This means shipping to work-in-progress, or more commonly known as straight to the production line. S2 has earned a reputation for a high level of quality and thus is permitted to "ship to WIP". The key, however, is "don't make a mistake", or the reputation will be lost.

6) Does your primary customer employ any kind of "target costing" technique during the design of a new system where your company is given a price target for the part it supplies and then asked to tradeoff technical and quality features in order to meet the target?

No, S2 has not experienced this.

7) What has your company done to adapt to the trend towards the adoption of these and other "lean manufacturing" concepts?

S2's management has been considering a software program called "Intellimet" that helps look at the whole firm and identify areas of potential improvement.

Your help in answering these additional questions will greatly help me in filling in some gaps in my data. Please feel free to contact me with any questions or concerns that you may have. If you like, just send me an email in response, or if it is easier for you, please let me know when I could call and talk to you over the phone about these questions. Let me emphasize that, as always, only my thesis advisor and myself will know the true source of my information. You and your company name will be masked from all other readers and described in only the most general terms.

Interview Protocol for **S3**

Interview with: VP of Manufacturing
Company location: Mid-Atlantic U.S.
In business for: 40 years
Average number of employees: 85
Average annual revenue: $9M
SB size status: SB
Primes/1st tier subs worked with: Northrop Grumman, Raytheon, BAE Systems, sometimes at prime level, sometimes at 1st tier sub level
Business category: Manufacturer of precision machine parts and fabricated sheet metal products

Responses in **bold**

1. What aerospace defense prime contractors has your company worked with during the time that you have been associated with it, and what programs (e.g., F-16, F-22, C-17, JSTARS) have you provided goods and/or services for?

The main contractors that S3 deals with are the Northrop Grumman Systems (formerly Westinghouse) facility in Baltimore MD, Lockheed Martin, BAE systems, and Raytheon. The programs include radar programs for NGS, primarily the metal work in the antenna and chassis. They built all of the antennas for the B-1, F-16, along with support parts. They are now into their 2nd production run of F-22 radar parts and are the planned subcontractor for JSF radar from NGS. The F-22 program parts are long-lead items.

2. What do you think are the current trends relative to small business participation as subcontractors in major aerospace defense programs?

For very small shops (< 40 employees) the defense subcontractor industry is becoming very complicated to join. Due to the expectations by the large contractors relative to the level of technical capability that their subs are expected to have and maintain, equipment is much more costly to invest in than it used to be. The primes have more stringent requirements for quality control, CAD/CAM, etc.

Barrier to entry for new small firms is high. Those that don't keep up with the latest techniques fall behind and are left out. The primes are concentrating on what could be called their core competencies. An example is NGS and their capabilities in the mechanical area. They did not invest in new technology, fell behind technically, and lost the capability to perform leading edge work. They now sub out almost all of their mechanical work. Over the years that S3 has been working with them, NGS has reduced the number of vendors that they deal with from 121 to 13. This consolidation hurts the very small shops who have limited capabilities.

3. How has your company's business relationship with prime contractors or higher-level subcontractors changed over the years? What aspects have remained the same? What is causing these changes, in your opinion? Why are some aspects unchanged?

Lately, the relationship with NGS has become more of a partnership than a simple buyer/supplier relationship. NGS is more respectful of S3's ideas, abilities, and expertise. NGS gets their key suppliers on board early in the design stage to make sure that they are designing something that their suppliers can make and make economically. NGS doesn't have the expertise within their own company that they used to and need to rely on S3 for certain matters.

4. Your company is listed on the SBA's PRONET website as having a primary North American Industry Classification System (NAICS) code of 333512, which corresponds to Machine Tool (Metal Cutting Types) Manufacturing. Does this NAICS code accurately describe the categories of skills/abilities/competencies your company providing to the prime contractors or higher-level subcontractors? If not, what codes would provide a more accurate description? Has this changed over time?

The code is accurate for most of what S3 does, since most of what they do involves metals. They also have abilities in the areas of CNC machining, boring mill, brazing, fabrication, laser machining, waterjet, welding, and aluminum dip. Some of these capabilities are not their core competency, but often they need to be able to do things like paint a part because there's too much risk in sending out a part that S3 has $5,000 - $10,000 invested in for a $200 paint job.

5. At what level in the major defense program are you selling your products/services? (e.g., to the prime contractors, first-tier subcontractors, or lower tier subcontractors)

Mostly first tier to NGS, but sometimes second tier to Boeing or Lockheed when NGS is the first tier sub.

6. A recent analysis of the types of purchases made by a large defense contractor from small business subcontractors/suppliers showed that most of purchases were in the eleven NAIC categories/subsectors listed below. In your perception, is this an accurate listing of the types of goods and services that large contractors acquire from small businesses? Can you think of any that were left out?

Subsector	Title
326	Plastics & Rubber Products Mfg.
331	Primary Metal Mfg.
332	Fabricated Metal Product Mfg.
333	Machinery Mfg.
334	Computer & Electronic Product Mfg.
335	Electrical Equipment, Appliance and Component Mfg.
336	Transportation Equipment Mfg.
421	Wholesale Trade – Durable Goods
422	Wholesale Trade – Nondurable Goods
541	Professional, Scientific, and Technical Services

999 Miscellaneous – Not Elsewhere Listed

Only subsectors 331 and 332 apply to S3. The other categories seem to reflect what he expects that the large primes are outsourcing.

7. How have opportunities for small subcontractors in the listed industries changed/stayed the same over the past 10-15 years?

The very small subcontractors are being passed over now. As noted above, it is very difficult for new companies to break into the market, especially the large capital outlays required. For example, S3 is in the process of investing $1.8 M in new machinery, which is a large investment for a small company like S3.

8. How has the average dollar value level of your subcontracts changed over the past 10-15 years?

The dollar values are much higher than they were in the past, even adjusting for inflation. This is due to the higher level, more complex requirements that they are now receiving from the prime. S3 makes extensive use of CAD/CAM and receives their models electronically from the prime. S3 now frequently works from models, without drawings, which is a change from the past. Almost everything is an electronic transaction with the primes now, saving the primes time and paper, but increasing the printing load for subs. The parts S3 is making are more complex and are more costly per part, but S3 has had to invest heavily in order to handle the more stringent requirements.

9. What experiences, if any, has your company had with the small business liaison offices at SAF/SB, AFMC/BC, the product or logistic center small business offices (e.g., ASC/BC), the Air Force Outreach Program office at Brooks AFB, TX, or the Manufacturing Technology Assistance Pilot Program (MTAPP) for small businesses in St. Louis, MO ?

S3 has had no experiences with the listed offices. VP's perception is that companies that avail themselves of the services of these offices need help breaking into the world of Government subcontracting. S3 already has an established relationship with several large primes and has invested its own funds to keep their capabilities up to date.

10. Thank you for participating in this study.

Thanks again for participating in my research study last month. Since we last talked, I've come across some additional literature on the subject of prime contractors and the relationship with their suppliers. The literature has sparked a few additional questions that I'd like to ask you, as follows:

1) Are you qualified relative to certain standards such as ISO-9000 or AS-9000? Were they a requirement for doing business with your primary customers?

S3 is not currently ISO qualified, but they are pursuing ISO-9002 themselves. ISO qualification is not required by their primary customer. S3 is MIL-I-45208 qualified, which is the old MIL-STD quality standard.

2) Does your primary customer have a certified supplier program and is your company a participant? Again, was this a condition of doing continued business with your customer?

S3's primary customer does have a certified supplier program. S3 is a participant and it was a condition of doing continued business.

3) Does your primary customer have a supplier council and is your company a member?

Yes, S3's primary customer has a supplier council and S3 is a member.

4) Has your company participated in continuous improvement or "kaizen" events where someone from your primary customer's supplier development office has come to your facility to help train your company in what might be called "lean manufacturing" concepts?

S3's primary customer hasn't held a kaizen event at S3, but they do have lean improvement seminars for several local suppliers and S3 was among the invitees and attendees.

5) Does your primary customer encourage or require suppliers to "kit" parts for easier use by its assembly line workers?

S3 has not engaged in this practice as yet for their primary customer.

6) Does your primary customer employ any kind of "target costing" technique during the design of a new system where your company is given a price target for the part it supplies and then asked to tradeoff technical and quality features in order to meet the target?

S3's does not have any experience with target costing, as described here. S3 is sometimes given a target "price" by its primary customer for a part that S3 has provided in the past. It's a method to get S3 to reduce their price on parts that it has already supplied.

7) What has your company done to adapt to the trend towards the adoption of these and other "lean manufacturing" concepts?

S3 feels that they have been doing "lean" for a long, long time. S3 has been operating in the world of fixed price contracts for a long time, where S3 has to improve constantly to survive. S3 has made major investments in state-of-the-art tooling and EDI capability in order to keep pace with changes in the industry.

Your help in answering these additional questions will greatly help me in filling in some gaps in my data. Please feel free to contact me with any questions or concerns that you

may have. If you like, just send me an email in response, or if it is easier for you, please let me know when I could call and talk to you over the phone about these questions. Let me emphasize that, as always, only my thesis advisor and myself will know the true source of my information. You and your company name will be masked from all other readers and described in only the most general terms.

Interview Protocol for **S4**

Interview with: General Manager
Company location: Southwestern US
In business for: 20 years
Average number of employees: 25
Average annual revenue: $1M
SB size status: Native American Woman Owned SB
Primes/1st tier subs worked with: Lockheed Martin, Bell Helicopter (Textron), Boeing at prime level
Business category: Manufacturer of precision machined metal and plastic aircraft parts

Responses in **Bold**

1. What aerospace defense prime contractors has your company worked with during the time that you have been associated with it, and what programs (e.g., F-16, F-22, C-17, JSTARS) have you provided goods and/or services for?

The main prime contractors we do work for are:
Lockheed Martin, Bell Helicopter (Textron), and Boeing Aircraft.
The main programs we have supplied parts for are:
F-16, C-130, F-22 & V-22

2. What do you think are the current trends relative to small business participation as subcontractors in major aerospace defense programs?

I think that the current trend is for the prime contractors to go to their subcontractors for their parts and assemblies because it is more cost effective to do so.

3. How has your company's business relationship with prime contractors or higher-level subcontractors changed over the years? What aspects have remained the same? What is causing these changes, in your opinion? Why are some aspects unchanged?

Our business relationship has strengthened over the years due to the fact that we can supply quality parts in a timely order and at a reasonable cost. Also we have proven that we are able to supply machined parts that the prime contractor and other subs have not been able to produce.

4. Your company is listed on the SBA's PRONET website as having a primary North American Industry Classification System (NAICS) code of 333512, which corresponds to "Steel Investment Foundries". Does this NAICS code accurately describe the categories of skills/abilities/competencies your company providing to the prime contractors or higher-level subcontractors? If not, what codes would provide a more accurate description? Has this changed over time?

Our NAICS codes are 33271 (3599), 336411 (3728), 336412 (3714) & 336413 (3728) . We supply machined metal and plastic parts to our customers.

5. At what level in the major defense program are you selling your products/services? (e.g., to the prime contractors, first-tier subcontractors, or lower tier subcontractors)

We supply parts to the prime contractor.

6. A recent analysis of the types of purchases made by a large defense contractor from small business subcontractors/suppliers showed that most of purchases were in the eleven NAIC categories/sub sectors listed below. In your perception, is this an accurate listing of the types of goods and services that large contractors acquire from small businesses? Can you think of any that were left out?

Sub sector	Title
326	Plastics & Rubber Products Mfg.
331	Primary Metal Mfg.
332	Fabricated Metal Product Mfg.
333	Machinery Mfg.
334	Computer & Electronic Product Mfg.
335	Electrical Equipment, Appliance and Component Mfg.
336	Transportation Equipment Mfg.
421	Wholesale Trade – Durable Goods
422	Wholesale Trade – Nondurable Goods
541	Professional, Scientific, and Technical Services
999	Miscellaneous – Not Elsewhere Listed

This seems to be an accurate listing of categories that subcontractors supply to the primes. I would have to do more research to determine if any were left out.

7. How have opportunities for small subcontractors in the listed industries changed/stayed the same over the past 10-15 years?

The opportunities for small businesses and subcontractors have improved for those willing to change with the times.

8. How has the average dollar value level of your subcontracts changed over the past 10-15 years?

The average dollar value of individual purchase orders has steadily risen with the economy and the quantity of purchase orders has risen accordingly with our growth as a company.

9. What experiences, if any, has your company had with the small business liaison offices at SAF/SB, AFMC/BC, the product or logistic center small business offices (e.g., ASC/BC), the Air Force Outreach Program office at Brooks AFB, TX, or the Manufacturing Technology Assistance Pilot Program (MTAPP) for small businesses in St. Louis, MO ?

We have had contact with MTAPP in the past.

10. Thank you for participating in this study.

ADDITIONAL INFORMATION GATHERED AT A LATER DATE FOLLOWS:

Thanks again for participating in my research study earlier this month. Since we last talked, I've come across some additional literature on the subject of prime contractors and the relationship with their suppliers. The literature has sparked a few additional questions that I'd like to ask you, as follows:

1) Are you qualified relative to certain standards such as ISO-9000 or AS-9000? Were they a requirement for doing business with your primary customers?

a. We are AS-9000 Compliant
b. No

2) Does your primary customer have a certified supplier program and is your company a participant? Again, was this a condition of doing continued business with your customer?
a. Yes
b. Yes

3) Does your primary customer have a supplier council and is your company a member?
a. No
b. No

4) Has your company participated in continuous improvement or "kaizen" events where someone from your primary customer's supplier development office has come to your facility to help train your company in what might be called "lean manufacturing" concepts?

a. Yes

5) Does your primary customer encourage or require suppliers to "kit" parts for easier use by its assembly line workers?

a. Yes

6) Does your primary customer employ any kind of "target costing" technique during the design of a new system where your company is given a price target for the part it supplies and then asked to tradeoff technical and quality features in order to meet the target?

a. No

7) What has your company done to adapt to the trend towards the adoption of these and other "lean manufacturing" concepts?

a. We have implemented "Lean Manufacturing" principals in our organization where it would help reduce time and cost.

Your help in answering these additional questions will greatly help me in filling in some gaps in my data. Please feel free to contact me with any questions or concerns that you may have. If you like, just send me an email in response, or if it is easier for you, please let me know when I could call you on the telephone.

Interview Protocol for **S5**

Interview with: Gen. Mgr.
Company location: Southeastern US
In business for: 26 years
Average number of employees: 24
Average annual revenue: $3M
SB size status: Native American Woman Owned SB
Primes/1st tier subs worked with: Boeing, Lockheed Martin, TRW at both the prime and 1st tier subcontractor levels
Business category: Manufacturer of precision machined metal parts for space flight hardware and ground support equipment

Responses in **Bold**

1. What aerospace defense prime contractors has your company worked with during the time that you have been associated with it, and what programs (e.g., F-16, F-22, C-17, JSTARS) have you provided goods and/or services for? **S5 has worked with Boeing for 6 years (on programs like the International Space Station, National Missile Defense, and Delta IV). They've worked with Lockheed Martin (LM) for**

3 years on some "target" systems, and with TRW on a program to refurbish old Army trucks to be used as computer control centers in the field.

2. What do you think are the current trends relative to small business participation as subcontractors in major aerospace defense programs? **In S5's primary area of business (which was work for NASA on the international space station) spending has been cut under the Bush admin. More spending is going to military programs, less to NASA, so that side of S5's business will slow. S5 is still doing space work, but there are making a transition to more defense work and are attempting to get into satellite work with Boeing. The IMPAC card program will help S5 to get back into direct Govt. work with awards from the Army and USAF. It's their perception that the trend towards military work started in the Feb/Mar 2001 timeframe when the space lab module program at NASA was canceled. S5 is trying to position themselves where they could lessen the shock from a further reduction in space work, which they see as a likely occurrence.**

3. How has your company's business relationship with prime contractors or higher-level subcontractors changed over the years? What aspects have remained the same? What is causing these changes, in your opinion? Why are some aspects unchanged?
S5 has had a good relationship with Boeing in Huntsville AL on the space station and it is getting better all of the time. Boeing has taken S5 "under their wing". S5 is considered to be one of Boeing's best suppliers, as indicated by S5 winning an outstanding supplier award from Boeing in 1999. GM attributes much of their success with Boeing to a willingness by S5 to learn how to handle all of the paperwork that is inherent in being a supplier on a major Govt. program. GM wishes that S5's relationship with their other customers was as good as it is with Boeing, although the relationship with LM is getting better and better too.

4. Your company is listed on the SBA's PRONET website as having a primary North American Industry Classification System (NAICS) code of **332710**, which corresponds to "**Machine Shop**". Does this NAICS code accurately describe the categories of skills/abilities/competencies your company providing to the prime contractors or higher-level subcontractors? If not, what codes would provide a more accurate description? Has this changed over time? **GM has found the NAIC codes to be not particularly descriptive. He has found that buyers for the big primes look less to the code and more to the "Keywords" that are also input by the SBs at the PRONET site. The keywords are more indicative of what S5 can do. He termed the NAIC codes as accurate for about ½ of their business.**

5. At what level in the major defense program are you selling your products/services? (e.g., to the prime contractors, first-tier subcontractors, or lower tier subcontractors)
When S5 sells to Boeing or LM it is as a first tier sub. When they deal with other companies its usually as a lower-tier sub.

6. A recent analysis of the types of purchases made by a large defense contractor from small business subcontractors/suppliers showed that most of purchases were in the eleven NAIC categories/subsectors listed below. In your perception, is this an accurate listing of the types of goods and services that large contractors acquire from small businesses? Can you think of any that were left out? **The list categories are about the gist of it. None appear to have been left out to his knowledge.**

Subsector	Title
326	Plastics & Rubber Products Mfg.
331	Primary Metal Mfg.
332	Fabricated Metal Product Mfg.
333	Machinery Mfg.
334	Computer & Electronic Product Mfg.
335	Electrical Equipment, Appliance and Component Mfg.
336	Transportation Equipment Mfg.
421	Wholesale Trade – Durable Goods
422	Wholesale Trade – Nondurable Goods
541	Professional, Scientific, and Technical Services
999	Miscellaneous – Not Elsewhere Listed

7. How have opportunities for small subcontractors in the listed industries changed/stayed the same over the past 10-15 years? **Here GM provided a history of S5's business base. He started the business along with his father in the early 1980's. In the 1984-1986 period S5's interaction with Govt. requirements was as a direct seller to the Army's Redstone Arsenal. S5 didn't win much in the way of purchase orders or contracts. S5 found the Govt. procurement process difficult to understand and cumbersome. S5 put in lots of effort, often with little in the way of results. The Govt. either sole sourced items or required an involved synopsis of capabilities. Often the award of an item that S5 had not produced for the Army before included requirements for first article testing (even though S5 may have made virtually the same item for a commercial customer before) which added to the cost and made S5 product not cost competitive. The incumbent suppliers had a huge advantage. S5 submitted bids on 20-25 different items, but only came close to being selected on 2. In 1987, the folks at Redstone "turned a switch" and their needs dried up.**

S5 then emphasized commercial work from the late 1980's until the mid-1990's. By the mid-1990's, S5's reputation for quality work was great, but they still lacked the ability to understand and process the Govt. paperwork. This lack of skill was holding S5 back. An opportunity then arose through a mutual friend to work with Boeing. S5 brought in a knowledgeable person to teach them how to handle the paperwork. The proprietor's family saw this as a way to grow the company. They sought changes that were beneficial to their

company and their employees, because even if an employee was to leave, they want the good reputation of S5 to go forward with them. Once S5 learned the ropes relative to paperwork, it has been very simple to work with Boeing. Most of the information exchange with Boeing takes place online or through EDI. The last time they checked on direct Govt. RFQ's they were still confusing and difficult to understand.

S5 asked Boeing to come out in the early 1990's, when S5 was only doing commercial work, but Boeing took a look at their business systems, told S5 that they had a long way to go before becoming a Boeing supplier, and left. In the mid-1990's, after making the changes recommended by the consultant noted above, S5 begged Boeing to come out again, and Boeing was very impressed. This was the beginning of their now successful relationship with Boeing.

S5 has had to make itself more attractive to the Boeing's and LM's of the world by changing it's incorporation status so that it is now woman-owned (by GM's wife). They are now exploring whether they qualify for Native American owned status due to his wife's ancestry.

Recently, due to S5's history of good work for Boeing and the fact that Boeing and some of the other large primes share vendor info, LM and TRW solicited S5 for work. The Space division of LM solicited S5 after reading an article about S5's winning of the supplier award from Boeing in 1999.

GM noted that he and his Father try to find all angles to keep their company growing. A "machine shop" has to do something special or have a special capability in order to keep business coming in. The Govt. is now pressing the primes to look for 8(a) or HUBZone SB's for their supply base. GM hopes that this doesn't hurt S5.

8. How has the average dollar value level of your subcontracts changed over the past 10-15 years? **It has grown steadily since 1996 at an average rate of 12-15% per year. Their total business has grown from $2.4M (1999), $2.6M (2000), to a projected $3.0M this year (2001).**

9. What experiences, if any, has your company had with the small business liaison offices at SAF/SB, AFMC/BC, the product or logistic center small business offices (e.g., ASC/BC), the Air Force Outreach Program office at Brooks AFB, TX, or the Manufacturing Technology Assistance Pilot Program (MTAPP) for small businesses in St. Louis, MO ?**S5 has had lots of interaction with Army and AF buyers for those items that it chose to bid directly, but primarily with the buyers for the primes. They haven't had much in the way of interaction with the AF small business specialists. S5 has had very positive interactions with MTAPP. GM described MTAPP as a "super program" that has helped S5 a great deal. The MTAPP folks are very proactive, and have helped S5 with the business side of**

dealing with Govt. programs. MTAPP helped S5 get their audit by DCAA initiated and approved. MTAPP pointed out the need for S5 to develop a safety program of their own. S5 has attended MTAPP sponsored conferences with key Govt. people (like Tony DeLuca) that were very informative. GM believes that MTAPP will help companies that are willing to help themselves. Companies like S5 still have to work for their contracts. MTAPP has helped extensively with explaining the intricacies of Govt. contract work. Boeing also has been very helpful. For instance, when Boeing was considering a large subcontract award to S5, Boeing also checked on S5 financial capability because they didn't want to saddle S5 with a large subcontract that they couldn't handle. Boeing has always been there to help S5 and hold hands.

10. Thank you for participating in this study.

Thanks again for participating in my research study last month. Since we last talked, I've come across some additional literature on the subject of prime contractors and the relationship with their suppliers.
The literature has sparked a few additional questions that I'd like to ask you, as follows:

1) Are you qualified relative to certain standards such as ISO-9000 or AS-9000? Were they a requirement for doing business with your primary customers?

S5 is ISO 9002 compliant. It is not currently a requirement of their customer.

2) Does your primary customer have a certified supplier program and is your company a participant? Again, was this a condition of doing continued business with your customer?

Boeing has a certification program, and S5 is certified. Boeing also has an internal quality program/system.

3) Does your primary customer have a supplier council and is your company a member?

S5 is unaware of any supplier council.

4) Has your company participated in continuous improvement or "kaizen" events where someone from your primary customer's supplier development office has come to your facility to help train your company in what might be called "lean manufacturing" concepts?

No, not for S5.

5) Does your primary customer encourage or require suppliers to "kit" parts for easier use by its assembly line workers?

No, S5 has not been required to kit parts for assembly.

6) Does your primary customer employ any kind of "target costing" technique during the design of a new system where your company is given a price target for the part it supplies and then asked to tradeoff technical and quality features in order to meet the target?

S5 has done some "target pricing" with Lockheed, which is somewhat different, but it is somewhat similar in that S5 is given a target price to meet. If they can't Lockheed may solicit them for ideas as to how the "target" might be achieved.

Here a question was inserted about vendor-managed inventory: **S5 has been asked to keep Delta IV inventory at S5 for use as needed by the prime contractor. These are items that S5 has already produced under contract but that the prime doesn't want delivered until they are needed.**

7) What has your company done to adapt to the trend towards the adoption of these and other "lean manufacturing" concepts?

S5 has looked at lean manufacturing concepts and has attended seminars. S5 feels that some of the lean concepts have limited applicability to a "job shop" like S5, and are more applicable to long production runs. S5 has used lean concepts in the set up of their shop machines and tools. The ability to use EDI capability and work on the internet has been key to working with the Boeing's and Lockheed's of the world. If the primes have a good idea for cost savings, they bring it to S5 to implement, but generally don't want S5 to have to pick up the cost. The primes will often cover S5's costs of implementation for a change that the prime directed or instigated. S5 will make investments of their own funds for improvements that benefit the entire business and all of the customers, if the returns merit it.

Your help in answering these additional questions will greatly help me in filling in some gaps in my data. Please feel free to contact me with any questions or concerns that you may have. If you like, just send me an email in response, or if it is easier for you, please let me know when I could call and talk to you over the phone about these questions. Let me emphasize that, as always, only my thesis advisor and myself will know the true source of my information. You and your company name will be masked from all other readers and described in only the most general terms.

Interview Protocol for S6

Interview with: President
Company location: Northeastern US
In business for: 29 years (since 1973)
Average number of employees: 12
Average annual revenue: $4M
SB size status: Woman Owned SB
Primes/1st tier subs worked with: primarily Lockheed Martin at both the prime and 1st tier subcontractor levels
Business category: Wholesale distributor of hardware

Responses are in BOLD

1.What aerospace defense prime contractors has your company worked with during the time that you have been associated with it, and what programs (e.g., F-16, F-22, C-17, JSTARS) have you provided goods and/or services for?
S6's prime customer is Northrop Grumman ESS in Baltimore MD. They serve other prime contractor customers on a much smaller basis. Their fasteners have gone into radar systems that NG supplies as part of the F-16 and F-22.

2.What do you think are the current trends relative to small business participation as subcontractors in major aerospace defense programs?
Two major trends. S6's industry is the distribution of small parts. For the last several years this industry has been going through lots of consolidation. Where there were once 1000's of small distributors competing against each other there are now 7 or 8 major large distributors and fewer smaller companies like S6. The trend towards consolidation has slowed in recent years. The other major trend has been the effect that lean manufacturing initiatives have impacted the way that the large primes conduct their business. Primes are instituting 6-sigma and other programs, primarily as a way to reduce costs. The primes want to place their business with more progressive suppliers. For S6, this meant that they had to broaden their capabilities. They had to invest in more computers and internet access to employ EDI technology in order to interact with NGS. The supplier had to learn to manage large amounts of data while tracking NGS's orders. One concept that S6 has had to embrace is vendor managed inventory, which means that they bring the parts directly to the production line at NGS. There is lots of complexity. It is not as easy as it looks because there is a lot of data management activity in the background.

3.How has your company's business relationship with prime contractors or higher-level subcontractors changed over the years? What aspects have remained the same? What is causing these changes, in your opinion? Why are some aspects unchanged?
Instead of a process where NGS went out to 3 suppliers for a bid on the same item and then issued a P.O. to one of them, the current relationship is much more a negotiated one. S6 and NGS agree that S6 will provide a range of product items within certain pricing and quantity guidelines. The relationship is more long-term. It requires a level of sophistication by the supplier not seen in the past. S6 has become "plant certified" which means that they deliver their product to the line without any inspection by NGS. S6's quality process must be more rigorous. NGS now comes out and inspects S6's processes rather than inspecting the parts that are delivered at the end of the process. One cost of this new relationship is that the primes are much more able to influence S6's internal business practices than they were in the past. S6 has benefited greatly by being willing to align themselves with the needs and processes of their primary customer, NGS. For example, S6 used to advertise in a number of regional business directories hoping to spur customers into calling for a quote. S6 now targets their marketing and sales efforts at customers that they perceive S6 can add value to. S6 has actually reduced their number of

customers, but now focuses its efforts on customers that will benefit from a more long term, involved relationship. She feels that small businesses like S6 have to choose a business model and that this one is the one that held out the most promise for S6. NGS was first interested in S6 because they are a WOSB, but they have stayed interested because of S6's willingness and ability to adapt to NGS's new way of doing business.

4.Your company is listed on the SBA's PRONET website as having a primary North American Industry Classification System (NAICS) code of _____, which corresponds to "_____". Does this NAICS code accurately describe the categories of skills/abilities/competencies your company providing to the prime contractors or higher-level subcontractors? If not, what codes would provide a more accurate description? Has this changed over time?

Actually, S6 is not listed on PRONET, but the NAICS code that seems to best match what S6 does is "421710", which is titled "Hardware Wholesalers".

5.At what level in the major defense program are you selling your products/services? (e.g., to the prime contractors, first-tier subcontractors, or lower tier subcontractors)

When NGS is the system prime, S6 is a first tier sub; when the unit that S6's fasteners are used in is part of a larger system, S6 is a second tier sub to the first tier sub, NGS.

6. A recent analysis of the types of purchases made by a large defense contractor from small business subcontractors/suppliers showed that most of purchases were in the eleven NAIC categories/subsectors listed below. In your perception, is this an accurate listing of the types of goods and services that large contractors acquire from small businesses? Can you think of any that were left out?

Subsector	Title
326	Plastics & Rubber Products Mfg.
331	Primary Metal Mfg.
332	Fabricated Metal Product Mfg.
333	Machinery Mfg.
334	Computer & Electronic Product Mfg.
335	Electrical Equipment, Appliance and Component Mfg.
336	Transportation Equipment Mfg.
421	Wholesale Trade – Durable Goods
422	Wholesale Trade – Nondurable Goods
541	Professional, Scientific, and Technical Services
999	Miscellaneous – Not Elsewhere Listed

Nothing to add. These all seem appropriate.

7. How have opportunities for small subcontractors in the listed industries changed/stayed the same over the past 10-15 years?
Not sure how buying mix has changed. Her perception is that the large primes are still interested in using small businesses as subs, but they are being more efficient about how they find, select, and maintain them.

8. How has the average dollar value level of your subcontracts changed over the past 10-15 years?
The dollar level has grown. Much of the growth is attributable to the changed nature of the relationship between NGS and S6. Where once S6 might ship NGS a box of screws for $150, they now have contracts for a full range of products over a longer term. The relationship is not "one-box-at-a-time" any more.

9. What experiences, if any, has your company had with the small business liaison offices at SAF/SB, AFMC/BC, the product or logistic center small business offices (e.g., ASC/BC), the Air Force Outreach Program office at Brooks AFB, TX, or the Manufacturing Technology Assistance Pilot Program (MTAPP) for small businesses in St. Louis, MO ?
She was not familiar with any of these entities.

10. Thank you for participating in this study.

Thanks again for participating in my research study last month. Since we last talked, I've come across some additional literature on the subject of prime contractors and the relationship with their suppliers.

The literature has sparked a few additional questions that I'd like to ask you, as follows:

1) Are you qualified relative to certain standards such as ISO-9000 or AS-9000? Were they a requirement for doing business with your primary customers?
Yes, we are certified to both ISO and AS-9000. While not an absolute requirement, it was strongly recommended by our primary customer.

2) Does your primary customer have a certified supplier program and is your company a participant? Again, was this a condition of doing continued business with your customer?
Yes, they have a certified supplier program that we participate in, and we understand that our prospects for continued business would be very slim without that participation.

3) Does your primary customer have a supplier council and is your company a member?

If you mean the kind of council that comes together to advise the customer, no, I'm not aware of that. The customer brings suppliers together a few times a year, though, to share vision and to do training in quality concepts. These meetings are symposium style.

4) Has your company participated in continuous improvement or "kaizen" events where someone from your primary customer's supplier development office has come to your facility to help train your company in what might be called "lean manufacturing" concepts?
We do participate in kaizen, continuous improvement, and lean manufacturing concepts.

5) Does your primary customer encourage or require suppliers to "kit" parts for easier use by its assembly line workers?
Yes, we do kit parts as a service.

6) Does your primary customer employ any kind of "target costing" technique during the design of a new system where your company is given a price target for the part it supplies and then asked to tradeoff technical and quality features in order to meet the target?
This has not been experienced with our primary customer.

7) What has your company done to adapt to the trend towards the adoption of these and other "lean manufacturing" concepts?
We have developed a core competence in point-of-use delivery systems - and other supplier-managed inventory programs that provide the customer with tremendous soft-cost savings. We have also made significant investments in educating our staff in "lean" and "six sigma" concepts so we can support our customers in their initiatives.

Your help in answering these additional questions will greatly help me in filling in some gaps in my data. Please feel free to contact me with any questions or concerns that you may have. If you like, just send me an email in response, or if it is easier for you, please let me know when I could call and talk to you over the phone about these questions.

Let me emphasize that, as always, only my thesis advisor and myself will know the true source of my information. You and your company name will be masked from all other readers and described in only the most general terms.

Interview Protocol for **S7**

Interview with: Manager, Sales and Business Development
Company location: Midwest US
In business for: 10 years

Average number of employees: 59
Average annual revenue: $5M
SB size status: Woman Owned SB
Primes/1st tier subs worked with: Boeing, Northrop Grumman, LTV, Howmet at both the prime and 1st tier subcontractor levels
Business category: Manufacturer of complex and precision machined parts

Responses are in **BOLD**

1. What aerospace defense prime contractors has your company worked with during the time that you have been associated with it, and what programs (e.g., F-16, F-22, C-17, JSTARS) have you provided goods and/or services for?

Boeing-StLouis (B-StL) is S7's biggest customer by far, but they have also provided items to Northrop Grumman (NGS), Vought (LTV), and Howmet. The programs supported include the C-17, F-18, T-38, UCAV, Chinook, and F-15.

2. What do you think are the current trends relative to small business participation as subcontractors in major aerospace defense programs?

He sees four major trends.
1) there is more interest by the primes in subs that can do "kitting" and "assembly"; these are two separate initiatives. As an example of "kitting", S7 puts 28 parts into a ship set; they are similar in design but different in size. The parts go 7 per box and there are 4 boxes in a kit. When the prime uses the kit, they send the empty box back and that signals S7 to start another set. It is more involved and places more responsibility than before on the suppliers. Boeing used to perform the job of bringing the parts together that were in the kit.
2) the primes are also more interested in parts that require "monolithic" machining. In lieu of the old way of building up individually cut and shaped parts, monolithic parts are machined out of a single block of aluminum.
3) there has been more conversion to e-commerce methods. There is more information exchange via the net, including such things as 3-D models and purchase orders. Boeing is part of Exostar, a joint venture of Boeing, Lockheed, BAE, Rolls Royce and Raytheon, intended to develop a common standard for information exchanges up and down the supply chain.
4) the use of lean manufacturing concepts to reduce costs; the big manufacturers will help with it; S7 employees have attended Boeing sponsored workshops on the topic.

3. How has your company's business relationship with prime contractors or higher-level subcontractors changed over the years? What aspects have remained the same? What is causing these changes, in your opinion? Why are some aspects unchanged?

His perception is that S7 is more involved in the design stage on key products than they would have been in the past. Recently, Boeing engineers met with S7s machine designers during the process of designing a new monolithically machined

part. This type of relationship is more satisfying, but it can be hard to make happen in the first place.

4. Your company is listed on the SBA's PRONET website as having a primary North American Industry Classification System (NAICS) code of **332710**, which corresponds to "**Machine Shops**". Does this NAICS code accurately describe the categories of skills/abilities/competencies your company providing to the prime contractors or higher-level subcontractors? If not, what codes would provide a more accurate description? Has this changed over time?

Yes, it is accurate but very general. The Manager needs to be able to sell S7 to potential customers based upon its unique capabilities. The broad NAICS categories don't give enough insight into their true strengths. The use of these broad categories can be damaging to the small businesses when the large primes use the codes to identify small suppliers in a database. S7 may get solicited on things that are not their specialty or may be overlooked for subcontract work that they can perform well.

5. At what level in the major defense program are you selling your products/services? (e.g., to the prime contractors, first-tier subcontractors, or lower tier subcontractors)

Usually a first tier sub when dealing with Boeing. Often a second tier sub when dealing with NGS, LTV, or Howmet.

6. A recent analysis of the types of purchases made by a large defense contractor from small business subcontractors/suppliers showed that most of purchases were in the eleven NAIC categories/subsectors listed below. In your perception, is this an accurate listing of the types of goods and services that large contractors acquire from small businesses? Can you think of any that were left out?

Subsector	Title
326	Plastics & Rubber Products Mfg.
331	Primary Metal Mfg.
332	Fabricated Metal Product Mfg.
333	Machinery Mfg.
334	Computer & Electronic Product Mfg.
335	Electrical Equipment, Appliance and Component Mfg.
336	Transportation Equipment Mfg.
421	Wholesale Trade – Durable Goods
422	Wholesale Trade – Nondurable Goods
541	Professional, Scientific, and Technical Services
999	Miscellaneous – Not Elsewhere Listed

The listed categories seem accurate.

7. How have opportunities for small subcontractors in the listed industries changed/stayed the same over the past 10-15 years?

The Manager doesn't really have an impression of the changes going back that far. S7 is only 10 years old. S7 started as a engineering company, but added machine shop capabilities in 1996. When asked about why S7 changed, The Manager explained that the machine shop was always part of the long term plan. The move to eventually add it may have coincided with the machinist strike a B-StL in 1996. The feeling was that if S7 could add this capability, the business was there. As part of their strategic planning process, S7 defined themselves as a "customer served" company. If a customer wants something new, S7 will add the new capability required to satisfy the customer.

8. How has the average dollar value level of your subcontracts changed over the past 10-15 years?

They have seen continual increases; for example, over the last 2 years the dollar value of their average contract has doubled.

9. What experiences, if any, has your company had with the small business liaison offices at SAF/SB, AFMC/BC, the product or logistic center small business offices (e.g., ASC/BC), the Air Force Outreach Program office at Brooks AFB, TX, or the Manufacturing Technology Assistance Pilot Program (MTAPP) for small businesses in St. Louis, MO ?

S7 has only had experiences with MTAPP, and that has only been since the summer of 2001. MTAPP has already helped S7 make contacts at Lockheed. S7 is now poised to get on LM's approved supplier list and expects business to increase as a result. The Manager also explained how MTAPP has shown them the way to check for solicitations issued by OC-ALC at Tinker AFB OK. This could potentially result in direct awards to S7 for Government business. So far, the process has been cumbersome and confusing, with great difficulty in identifying RFP's of interest to S7 and within their capabilities.

10. Thank you for participating in this study.

Thanks again for participating in my research study last month. Since we last talked, I've come across some additional literature on the subject of prime contractors and the relationship with their suppliers. The literature has sparked a few additional questions that I'd like to ask you, as follows:

1)Are you qualified relative to certain standards such as ISO-9000 or AS-9000? Were they a requirement for doing business with your primary customers?

Yes, we are qualified and yes it is a requirement for the majority of the work we do it would be a requirement.

2)Does your primary customer have a certified supplier program and is your company a participant? Again, was this a condition of doing continued business with your customer?

Our primary customer is The Boeing Co., they do have a supplier certification program. They have three levels of certification. Bronze, is the lowest level - the vast majority of suppliers are at this level (My guess would be 80%). Next is Silver, Patriot Machine is certified at silver, far fewer are the number of suppliers that are at this level (My guess would be 19.5%). The highest is Gold I would think only one ½ % of the supplier base is at this level. It just isn't practical!!

3)Does your primary customer have a supplier council and is your company a member?

I'm not aware of a supplier council.

4) Has your company participated in continuous improvement or "kaizen" events where someone from your primary customer's supplier development office has come to your facility to help train your company in what might be called "lean manufacturing" concepts?

We've met a number of times with The Boeing Company's folks. We've done a kaizen event once with them. Kaizen events and other lean mfg. concepts are part of Patriot Machines culture.

5) Does your primary customer encourage or require suppliers to "kit" parts for easier use by its assembly line workers?

Yes, and we do.

6) Does your primary customer employ any kind of "target costing" technique during the design of a new system where your company is given a price target for the part it supplies and then asked to tradeoff technical and quality features in order to meet the target?

No, but this sounds like a good idea.

7) What has your company done to adapt to the trend towards the adoption of these and other "lean manufacturing" concepts?

Upper management at Patriot Machine. Nurtures these concepts and if fact expects ongoing improvement in all areas of engineering and manufacturing.

Your help in answering these additional questions will greatly help me in filling in some gaps in my data. Please feel free to contact me with any questions or concerns that you may have. If you like, just send me an email in response, or if it is easier for you, please let me know when I could call and talk to you over the phone about these questions. Let me emphasize that, as always, only my thesis advisor and myself will know the true source of my information. You and your company name will be masked from all other readers and described in only the most general terms.

Interview Protocol for **S8**

Interview with: CEO
Company location: Midwest US
In business for: 25 years
Average number of employees: 90
Average annual revenue: $13M
SB size status: Native American Owned SB
Primes/1st tier subs worked with: Lockheed Martin, General Electric, Pratt & Whitney at both the prime and 1st tier subcontractor levels
Business category: Manufacturer of complex and precision machined parts, sheet metal fabrication

Responses are in **BOLD**

1. What aerospace defense prime contractors has your company worked with during the time that you have been associated with it, and what programs (e.g., F-16, F-22, C-17, JSTARS) have you provided goods and/or services for?

Researcher noted award plaques in lobby from Lockheed Martin (LM), General Electric (GE), and Pratt & Whitney (P&W)

CEO noted that they designed and built all of the seats for the C-5's, starting in 1984. S8 was AF SB of the year in 1984, the year of their first Govt contract and the year that they entered the 8(a) program. They did work for Gen. Dynamics Ft Worth (now LMTAS) on the F-16. They worked with Rockwell on the B-1B, and built elevators for the KC-10 tankers along with other support equipment. Most of this activity took place in the 1984-1994 timeframe.

2. What do you think are the current trends relative to small business participation as subcontractors in major aerospace defense programs?

From the perspective of S8, they have seen a significant decline in Govt subcontract work since 1994. From 1984-1994, their business base was 80% Govt, 20% Commercial. From 1994-present, it is the reverse (20% Govt, 80% Comm). After graduating from 8(a) in 1994, CEO and his management team have taken the company in a different direction. The top mgrs. put in place a transition plan. Company employment has dropped from 185 to 85, but the commercial marketplace demands that they be more efficient. As far as Govt procurement is concerned, it appears to CEO that "contract bundling" has significantly reduced the opportunities for SB direct awards.

3. How has your company's business relationship with prime contractors or higher-level subcontractors changed over the years? What aspects have remained the same? What is causing these changes, in your opinion? Why are some aspects unchanged?

Although S8 relationship with GE is primarily on commercial contracts, there is still constant pressure on S8 to reduce costs 6%/year. S8 has 3 six-sigma

black belts, which is unusual for a small company. GE conducted the training while S8 paid their salary. Rolls Royce Allison expects cost reductions of 10% a year. If the sub doesn't make the cost cut, the prime gives their business to another supplier. The big primes have started to source their parts worldwide (e.g., GE Lynn now has all of their turbine blades mfg. in China). CEO thinks that doing a lot of Govt work actually encourages inefficiency. Since the Govt would pay O/H and G&A no matter how high they went, it teaches small companies bad cost control habits. As a final point, CEO noted that at one time they were part of a successful mentor/protégé relationship with LM. S8 designed and built the galleys for the C-130H and J models.

4. Your company is listed on the SBA's PRONET website as having a primary NAICS code of 336412, which corresponds to "Aircraft Engine and Engine Parts Manufacturing." PRONET also lists other NAICs codes of 332312 and 333512, which correspond to "Fabricated Structural Metal Mfg." and "Machine Tool (Metal Cutting Types) Mfg.", respectively. Do these NAICS codes accurately describe the categories of skills/abilities/competencies your company providing to the prime contractors or higher-level subcontractors? If not, what codes would provide a more accurate description? Has this changed over time?

The first two codes are accurate. These have been their core businesses from the beginning. CEO was not sure why the 3rd one is listed (333512)

5. At what level in the major defense program are you selling your products/services? (e.g., to the prime contractors, first-tier subcontractors, or lower tier subcontractors)

When S8 did work regularly for LM, GE, P&W, and Northrop, they did it as first tier subcontractors.

6. How have opportunities for small subcontractors changed/stayed the same over the past 10-15 years?

CEO noted that GE and Pratt are now taking over some aspects of engine manufacture that were formerly performed by subcontractors. The big primes are pushing the smaller companies further down into the tiers of subcontractors.

7. How has the average dollar value level of your subcontracts changed over the past 10-15 years?

Govt subcontracts are down significantly since 1994, which coincides with the end of S8 8(a) status. The senior management has taken the company in a new direction (primarily commercial). CEO thinks that the worst thing that he has ever done for S8 was possibly the entry into the 8(a) program. Business was good, but it came in lumps and then was over. When they exited 8(a), they had a lot of catching up to do technically relative to commercial competitors. As noted before, CEO feels that Govt work made S8 inefficient. After the strategic decision, 90% of the existing employees had to leave due to an inability to adapt to the highly competitive commercial culture.

8. What experiences, if any, has your company had with the small business liaison offices at SAF/SB, AFMC/BC, the product or logistic center small business offices (e.g., ASC/BC), the Air Force Outreach Program office at Brooks AFB, TX, or the Manufacturing Technology Assistance Pilot Program (MTAPP) for small businesses in St. Louis, MO ?

Virtually none since the end of 8(a) program in 1994.

9. Thank you for participating in this study.

Thanks again for participating in my research study earlier this month. Since we last talked, I've come across some additional literature on the subject of prime contractors and the relationship with their suppliers. The literature has sparked a few additional questions that I'd like to ask you, as follows:

1) Are you qualified relative to certain standards such as ISO-9000 or AS-9000? Were they a requirement for doing business with your primary customers?

a. Yes
b. Yes

2) Does your primary customer have a certified supplier program and is your company a participant? Again, was this a condition of doing continued business with your customer?
a. Yes and yes.
b. Yes

3) Does your primary customer have a supplier council and is your company a member?
a. No

4) Has your company participated in continuous improvement or "kaizen" events where someone from your primary customer's supplier development office has come to your facility to help train your company in what might be called "lean manufacturing" concepts?
a. Yes

5) Does your primary customer encourage or require suppliers to "kit" parts for easier use by its assembly line workers?
a. Yes

6) Does your primary customer employ any kind of "target costing" technique during the design of a new system where your company is given a price target for the part it supplies and then asked to tradeoff technical and quality features in order to meet the target?
a. Yes

7) What has your company done to adapt to the trend towards the adoption of these and other "lean manufacturing" concepts?
a. We have 3 six-sigma "black belts".

Your help in answering these additional questions will greatly help me in filling in some gaps in my data. Please feel free to contact me with any questions or concerns that you may have. If you like, just send me an email in response, or if it is easier for you, please let me know when I could call you on the telephone.

Interview Protocol for: **L1**

Location: world wide
Employees: over 50,000
2000 Revenue: well over $10B
Interview with: member of Small Business Liaison Office (SBLO) staff

Responses are in BOLD.

1. Does your company participate in the Comprehensive Subcontracting Plan Program? If so, is your company's plan developed on a plant-wide, division-wide, or company-wide basis? **Yes, L1 participates and the plan is company-wide.**

2. What do you think are the current trends relative to small business participation as subcontractors in major aerospace defense programs? **Some of the trends are decreasing opportunities industry wide, with stability at some sites that are in the middle of production runs (e.g., the C-17). Another trend is the desire to unify the supply base, to have common suppliers for both military and commercial programs. This will help keep suppliers at or near optimal capacities, which helps L1 because costs increase when the supplier is not working at capacity. L1 sees a 60%/40% split for their suppliers between Defense/Commercial work. Defense opportunities have declined overall as the DoD procurement budget has declined.**

3. How has your company's business relationship with small business subcontractors changed over the years? What aspects have remained the same? What is causing these changes, in your opinion? Why are some aspects, if any, unchanged? **L1's relationship with small businesses is cyclical. It depends, as noted above, on the opportunities/ programs that are out there. Locally, L1's SB participation is stable, which may be due to the stable nature of the C-17 program.**

4. How have opportunities for small business subcontractors changed over the years? Are they increasing or decreasing? Do they vary by type of small business (e.g., SDB vs. WOSB) or by the nature of the goods/services purchased (e.g., technical services vs. sheet metal fabrication)? **L1 continuously looks for SB opportunities if**

there are problems with another supplier. Bundling and consolidation of requirements reduces opportunities, but may lead to stronger relationships. Efforts to reduce costs are continuous with their SB partners. L1 is attempting to streamline by keeping "in-house" only those activities which it does best and to outsource the rest. This can lead to opportunities for SBs if the outsourced item/service is part of the SBs core competencies and they are price competitive.

5. How has the average dollar value level of the subcontracts your company awards changed over the past 10-15 years? Does it vary by the nature or size of your prime program (e.g., ACAT I vs. ACAT II)? Does it vary by the stage that your prime program is in the acquisition lifecycle (e.g., EMD vs. production)? **Speaking for the C17 program only, they have changed slightly. L1 is using programs like mentor/protégé program to bring suppliers along; SB's that don't keep up to date with capabilities like ISO and 5-axis machining are left behind.**

6. A recent analysis of the types of purchases made by a large defense contractor from small business subcontractors/suppliers showed that most of purchases were in the eleven North American Industry Classification (NAIC) categories/ sub sectors listed below. In your perception, is this an accurate listing of the types of goods and services that large contractors acquire from small businesses? Can you think of any that were left out? **This is a good list. It covers what L1 outsources. She has nothing to add. As noted above, L1 keeps in-house those things that it does well and outsources the rest. L1's strength is in Engineering and Supply Chain Management.**

Sub sector	Title
326	Plastics & Rubber Products Mfg.
331	Primary Metal Mfg.
332	Fabricated Metal Product Mfg.
333	Machinery Mfg.
334	Computer & Electronic Product Mfg.
335	Electrical Equipment, Appliance and Component Mfg.
336	Transportation Equipment Mfg.
421	Wholesale Trade – Durable Goods
422	Wholesale Trade – Nondurable Goods
541	Professional, Scientific, and Technical Services
999	Miscellaneous – Not Elsewhere Listed

7. What experiences, if any, has your company had with the small business liaison offices at SAF/SB, AFMC/BC, the product or logistic center small business offices (e.g., ASC/BC), the Air Force Outreach Program office at Brooks AFB, TX, or the Manufacturing Technology Assistance Pilot Program (MTAPP) for small businesses in St. Louis, MO ? **She has dealt with SAF/SB often when SAF/SB sponsored**

initiatives were brought to L1 for implementation (e.g., WOSB, Native American SB). They have worked with the AFOPO relative to Mentor/Protégé program issues, and attended an MTAPP presentation but with no further involvement

ADDITIONAL COMMENTS:

Questioned what is the Government doing relative to midsize companies.

Relative to earlier requests for SB subcontracting data, feels that data on the first and second tier suppliers to L1 that are LBs have already had to report that data to the Government and thus it should be available from another source.

Suggests that Mr. Miller contact not-for-profit organizations like the Southern California Purchasing Council (of which L1, Ratheon, and TRW are members) for more information regarding trends.

8. Thank you for participating in this study.

Thanks again for participating in my research study last month. Since we last talked, I've come across some additional literature on the subject of prime contractors and the relationship with their suppliers. The literature has sparked a few additional questions that I'd like to ask you, as follows:

1) Does your company require its suppliers to be qualified relative to certain standards such as ISO-9000 or AS-9000?

L1 encourages ISO qualification.

2) Does your company have a certified supplier program? Again, was this a condition of doing continued business with your company or do certified suppliers receive first consideration?

L1 does have a qualified supplier program. L1 will send a team out to review a supplier's operations and make suggestions for improvement. If the improvements are made the supplier will qualify for one of three levels: bronze, silver, or gold, in ascending order. It is L1's goal that all suppliers will be qualified/certified in the future.

3) Does your company have a supplier council?

L1 does have a supplier council. One of it's roles is to identify the most critical suppliers and bring them together at supplier conferences to bring them up to date on changes in the program that they are supplying parts to.

4) Has your company participated in continuous improvement or "kaizen" events where someone from your company's supplier development office goes to a vendor's facility to help train the vendor in what might be called "lean manufacturing" concepts?

L1 is implementing a supplier development plan, where L1's quality and supplier development staff work together to develop and improve a particular supplier.

It is a six-step process that may include "lean" visits depending on the assessed needs of the supplier. The end of the process is a trained supplier.

5) Does your company encourage or require suppliers to "kit" parts for easier use by its assembly line workers?

L1 does use "kitting" with some of its suppliers.

6) Does your company employ any kind of "target costing" technique during the design of a new system where a vendor is given a price target for the part it supplies and then asked to tradeoff technical and quality features in order to meet the target?

L1 has used a "target pricing" technique to reduce costs on some of the major defense programs for which it is the prime contractor. Often that involves using commercial components in lieu of military ones with again the goal to cut costs without a significant degradation in performance, durability, or quality.

Your help in answering these additional questions will greatly help me in filling in some gaps in my data. Please feel free to contact me with any questions or concerns that you may have. If you like, just send me an email in response, or if it is easier for you, please let me know when I could call and talk to you over the phone about these questions. Let me emphasize that, as always, only my thesis advisor and myself will know the true source of my information. You and your company name will be masked from all other readers and described in only the most general terms.

Interview Protocol for: **L2**

Location: world wide
Employees: 126,000
2000 Revenue: $24.9B
Interview with: member of Small Business Liaison Office (SBLO) staff

Responses are in BOLD.

1. Does your company participate in the Comprehensive Subcontracting Plan Program? If so, is your company's plan developed on a plant-wide, division-wide, or company-wide basis? **L2 is an original test plan participant since 1991 initiated with the Air Force. Please note, the Air Force is the only Branch of Services promoting the program at one time with 26 prime contractors. The Army and Navy only signed up two participants each and are highly opposed to the plan. In 1991, the Program X contract was awarded and the $6 billion for the program skewed the percentages for small businesses, although traditionally this site awards $130M to $187M in total Small Business Dollars. The percentage will change based on the total awarded to Large Business. In 1994, we attained 5.2% to SDB firms, in 2001 5% to women owned.**

2. What do you think are the current trends relative to small business participation as subcontractors in major aerospace defense programs? **The entire industry is downsizing their supply base, not only in aerospace but commercially too. The philosophy in the 80`s, more is better, today it`s better, faster, cheaper, and with the Deming methodology adopted by most businesses. Smaller supply chain, negotiate long-term agreements. The small businesses that were fortunate enough to have enough capital and were established aerospace suppliers manufacturers have endured. Those specializing in tooling/machining have been through the quality standards, invested in new equipment, and survived the downturn in the defense business base. The only new programs are the C-17, F-22; Program Y is in development for the Air Force. Most of the successful manufacturers are doing business with more than one prime contractor. Overall, the number of small businesses in aerospace is down. The DOD has many opportunities available for small business firms in modification programs. Areas of decrease have been in indirect services and supplies which was one of the first areas where Corporate Leverage buying nationally has made it almost impossible for small distributors, computer sellers, raw material suppliers, and electronic items to compete against major manufacturers/office supply houses. I call it the Home Depot purchasing philosophy. The government has done the same with bundling requirements, and now procures equipment and parts to obtain better prices on FedBiz Ops.** (SBLO was then asked to expand upon what he meant by Corporate Leverage buying, his response follows) **There has been a consolidation of requirements at the corporate level. For example, LMCO, Boeing, and Raytheon are all part of the trading exchange called "Exostar". The companies are joining together to 'buy in bulk'. Ten years ago most of L2's awards to SDB's were for "indirects", that is, items or services that were part of the overhead or general and administrative costs of running the business. Among the items purchased were computers and other office automation items. Now those items are no longer purchased but instead leased and the leasing is done at a level for the whole corporation. There aren't any SDB's that can handle that level of requirement and be competitive.**

3. How has your company's business relationship with small business subcontractors changed over the years? What aspects have remained the same? What is causing these changes, in your opinion? Why are some aspects, if any, unchanged?

Small businesses are encouraged to participate as subcontractors. From the standpoint of aircraft industry, new opportunities are few as the programs in the late 80`s and early 90`s have matured, and sales of new aircraft has been very slow. Program X EMD development was delayed three times due to budget oversight, and the Government procures Program H and Program C spares. For manufacturers, new ISO requirements for global competition has forced small businesses to invest in software, statistical process control, and now lean manufacturing techniques. Our industry will not accept or do business with a machining firm with less than 5 axis capability, approved quality standards, and previous history. The small

business must deliver 98-100% on schedule. We are also negotiating longer purchase order agreements for manufacturers and non-productive suppliers, whereas in earlier years, a one-year agreement was common. Our office hears from a machine shop at least once a day from across the country, we currently do not have the program requirements to bid all those we do hear from. The Internet has made an impact on the number of marketing calls received and marketing ability of US suppliers.

Additional input from SBLO: **relative to the Program H and Program C, the Govt. procures these items as commercial items or if they are to support an FMS program, the contract from the US Govt. usually has some sort of offset requirement that calls for X% of the subcontract work to be given to companies in the FMS country**.

4. How have opportunities for small business subcontractors changed over the years? Are they increasing or decreasing? Do they vary by type of small business (e.g., SDB vs. WOSB) or by the nature of the goods/services purchased (e.g., technical services vs. sheet metal fabrication)?

The most significant change is the way we purchase and what we purchase. L2 has become an integrator for aircraft, an assembler of aircraft, with major subcontractors providing most of the systems and hardware. There is still some part manufacturing and recently we have begun to outsource more of the following: electronic assembly, machined parts, processing for Program H and Program Z in Location A. L2 focused on identification of small businesses in manufacturing areas and were successful in the mentor protégé program of finding SDB`s which provide Program X parts and Program H assemblies.

A review of the Program X program will reveal the opportunities for small businesses in today's business environment (demval phase, emd phase) for major programs is at the second/third tier levels with major subcontractors. Example. Program X over $500 million was required for major subcontractor investment with rights to these companies for major systems if L2 won. As a result, many small businesses are not engine suppliers, systems, radar, landing gear, and suppliers. However, the program and major subcontractors did procure over $1 billion from small businesses in the EMD program of the Program X. This has been reported to the SPO, however currently DOD was not recognize Program reporting down to the third tier level, which gives a clearer impact on the small businesses actually working on a major weapon systems. The Public Law 5% minimum goal for SDB's was enacted and DOD reporting methods have not changed with the times. Example also, is the recent change in SDB certification. The $750K maximum net worth requirement has prevented many successful small businesses from claiming SDB status, particularly those who have been in aerospace manufacturing for long or in contract labor for an established period of time. Hence, the standard and requirements for what is an SDB have changed, but the Law mandating 5% goals for subcontract awards to SDB's has not changed. So numbers will be down for SDB firms, and we noticed an increase in WOB dollars. Last year $10 Million could

not be counted in the SDB category, because they were not certified by SBA or could not meet new certification requirements.

Additional comments from SBLO**: L2 now outsources most of its sheet metal and machine parts requirements. Very little is made "in-house". Also note that part of organizing a contractor team to compete and win during DEM/VAL includes a promise to keep those same companies involved during the Production phase. There is a substantial investment required on the part of the team members to prepare for the chance to win. This limits what could be available for SBs of all types and many SBs are not willing or able to make that large investment up front. Often, the Govt. award is predicated on the thought that the contractor team from DEM/VAL will be kept intact. The 5% SDB requirement hasn't changed even though the definition of what is an SDB has changed. After the *Adarand Constructors* case, any SB that is minority owned but has a net worth above $750K is no longer an SDB. Also having a negative impact is the rule that an SDB has to be certified by the SBA as an SDB before subcontract awards to one of them can be counted towards meeting SDB goals. The process of certification takes time and costs money that the small business may not be willing to spend, so they are not counted as an SDB when they could be.**

5. How has the average dollar value level of the subcontracts your company awards changed over the past 10-15 years? Does it vary by the nature or size of your prime program (e.g., ACAT I vs. ACAT II)? Does it vary by the stage that your prime program is in the acquisition lifecycle (e.g., EMD vs. production)?

Unfortunately, How DOD reports subcontract awards; the average dollar is influenced when major programs are won. We have to count other large primes as our subcontractors on Program X. The average dollar level of subcontracting for this site is $500-600 million a year. In 1991, $6.9B for Program X total, in FY 2000 $1.2B for Program X PRTV. This year Location A is expecting $11B to Large Business because of Program Y EMD awards.

6. A recent analysis of the types of purchases made by a large defense contractor from small business subcontractors/suppliers showed that most of purchases were in the eleven North American Industry Classification (NAIC) categories/ sub sectors listed below. In your perception, is this an accurate listing of the types of goods and services that large contractors acquire from small businesses? **Can you think of any that were left out? Perhaps contract labor- that is 541. Looks like most of these you captured. There is an aircraft NAICS under 336?**

Sub sector	Title
326	Plastics & Rubber Products Mfg.
331	Primary Metal Mfg.
332	Fabricated Metal Product Mfg.
333	Machinery Mfg.
334	Computer & Electronic Product Mfg.
335	Electrical Equipment, Appliance and Component Mfg.

336	Transportation Equipment Mfg.
421	Wholesale Trade – Durable Goods
422	Wholesale Trade – Nondurable Goods
541	Professional, Scientific, and Technical Services
999	Miscellaneous – Not Elsewhere Listed

7. What experiences, if any, has your company had with the small business liaison offices at SAF/SB, AFMC/BC, the product or logistic center small business offices (e.g., ASC/BC), the Air Force Outreach Program office at Brooks AFB, TX, or the Manufacturing Technology Assistance Pilot Program (MTAPP) for small businesses in St. Louis, MO ?

Outstanding- we have been involved with the Outreach offices and Small Businesses office each year during their planning sessions. We also have a Memorandum of Understanding with the Outreach Center at Brooks AFB, and with the MTAPP program in St. Louis. MTAPP is cross training L2 suppliers.

One final thought: Years ago, supply base information was kept close to the vest by the various large contractors; now they share information more readily about superior suppliers.

8. Thank you for participating in this study.

By chance I do have a few additional questions. Thanks again for participating in my research study last month. Since we last talked, I've come across some additional literature on the subject of prime contractors and the relationship with their suppliers. The literature has sparked a few additional questions that I'd like to ask you, as follows:

1) Does your company require its suppliers to be qualified relative to certain standards such as ISO-9000 or AS-9000? **Yes, L2 has a Super Star Quality program and requires most manufacturing firms to comply with ISO 9000-2000 and Military Standard 9858a. At one time, we required Statistical Process Control for all manufacturing firms. However, we will require our major subcontractors to flow down to sub tier requirements to meet our customer specifications.**

2) Does your company have a certified supplier program? Again, was this a condition of doing continued business with your company or do certified suppliers receive first consideration? **The L2 Location A Super Star Program is a recognition program for approved L2 suppliers who excel in delivery and quality. The Super Star Suppliers are preferred suppliers and are comprised of major subcontractors and small businesses. Being certified prior is not a requirement, however, if a company has received certification from another L2 location, it is recognized, or from other Prime Contractors.**

3) Does your company have a supplier council?
Yes.

4) Has your company participated in continuous improvement or "kaizen" events where someone from your company's supplier development office goes to a vendor's facility to help train the vendor in what might be called "lean manufacturing" concepts?
Yes, the program has been adopted in our manufacturing areas and small business subcontractors also participate in the kaizen or lean programs.

5) Does your company encourage or require suppliers to "kit" parts for easier use by its assembly line workers? **This will be a requirement for the Program X Line and for Program H.**

6) Does your company employ any kind of "target costing" technique during the design of a new system where a vendor is given a price target for the part it supplies and then asked to tradeoff technical and quality features in order to meet the target? **On major subcontracting proposals, we usually perform a cost analysis on any proposal over $500,000. We now employ target goals for pricing and then usually will go back to a supplier for negotiation of a final proposal.**

Your help in answering these additional questions will greatly help me in filling in some gaps in my data. Please feel free to contact me with any questions or concerns that you may have. If you like, just send me an email in response, or if it is easier for you, please let me know when I could call and talk to you over the phone about these questions.

Let me emphasize that, as always, only my thesis advisor and myself will know the true source of my information. You and your company name will be masked from all other readers and described in only the most general terms.

Interview Protocol for: **L3**

Location: world wide
Employees: around 50,000
2000 Revenue: > $10B
Interview with: member of Small Business Liaison Office (SBLO) staff

Responses are in BOLD.

1. Does your company participate in the Comprehensive Subcontracting Plan Program? If so, is your company's plan developed on a plant-wide, division-wide, or company-wide basis? **Yes, since 1997; The 2001 Comprehensive achievements were as follows: 49.6% for SB, 5.1% for SDB, and 6.3% for WOSB. For the year 2002 L3 has been asked to increase Veteran Owned SB (VOSB) to $15M or 3.0%. The goals for the 2002 year are (based on $500M available for subcontracting): SB, 45%($225M); SDB, 5%($25M), WOSB, 5%($25M), HUB Zone, 1%($5M), VOSB, 3%($15M), HBCU/MI, 0.1%($500K). Please note that**

for the Location A alone, for 2001 there were approx. 130,000 Po's placed valued at $1.4B. L3 annually updates their supplier attribute sheets, which takes time and effort to purify the supplier database because the Govt. wants a breakout by NAIC, Congressional district, and other critia etc.

2. What do you think are the current trends relative to small business participation as subcontractors in major aerospace defense programs? **Finding SB sources is getting more difficult because fewer SBs are doing Aerospace work; higher tech capable SBs are hard to find, perhaps because the capital investment is too great for the most modern equipment. Teaming agreements and/or prime/sub agreements that are dictated by the customer (Govt) means that the dollars available for SB subs are declining. For example, the goals for SB were 50% in 1999, 49% in 2000, and 45% in 2001. The trend is coming down, but L3 is still meeting their goals.**

3. How has your company's business relationship with small business subcontractors changed over the years? What aspects have remained the same? What is causing these changes, in your opinion? Why are some aspects, if any, unchanged? **L3 is doing well with some SBs, but sometimes they grow to the point where they become LBs and this takes them out of the small category which makes L3 continue to work hard to find SB'S. An example of this is when L3 spent a lot of effort creating a mentor/protégé relationship that was operating smoothly, but then the SB was bought out by a LB and no longer qualified for the inclusion. The investment of time and funds by L3 was essentially down the drain. L3 has developed a list of preferred suppliers. There are 22 SBs on the list now that L3 is nurturing. L3 has abandoned the "shotgun" approach to finding potential SB suppliers and is continuing to nurture the preferred SB suppliers L3 has identified.**

4. How have opportunities for small business subcontractors changed over the years? Are they increasing or decreasing? Do they vary by type of small business (e.g., SDB vs. WOSB) or by the nature of the goods/services purchased (e.g., technical services vs. sheet metal fabrication)? **See reply to #2 – the bottom line is that opportunities are diminishing. There is a lot of work on L3 part to find the right Small Business Suppliers for the right Aerospace products. There are more WOSB's out there, but it may be the result of game playing. Companies that were not woman owned are changing their corporate structure to become WOSB or NAOSB. The big primes (Boeing, Lockheed) are acting more as program integrators with the Raytheon's, Northrop's, and GD's of the world taking up the first tier. L3 is looking for more high tech companies and companies higher up the food chain of products and there are very few companies at this level.**

5. How has the average dollar value level of the subcontracts your company awards changed over the past 10-15 years? Does it vary by the nature or size of your prime program (e.g., ACAT I vs. ACAT II)? Does it vary by the stage that your prime program is in the acquisition lifecycle (e.g., EMD vs. production)? **Defining subcontracts is difficult, L3 used to count the value of any Purchase Order placed, but awards have changed over the years. The dollar values are smaller for EMD vs. production contracts, primarily due to the larger quantities involved for production contracts. L3 has no large production contracts at the present time; therefore L3 has no large quantity procurements.**

6. A recent analysis of the types of purchases made by a large defense contractor from small business subcontractors/suppliers showed that most of purchases were in the eleven North American Industry Classification (NAIC) categories/ sub sectors listed below. In your perception, is this an accurate listing of the types of goods and services that large contractors acquire from small businesses? Can you think of any that were left out? **Seems accurate. The biggest one for L3 is "421690" – "Other Electronic Parts and Equipment Wholesalers"**

Sub sector	Title
326	Plastics & Rubber Products Mfg.
331	Primary Metal Mfg.
332	Fabricated Metal Product Mfg.
333	Machinery Mfg.
334	Computer & Electronic Product Mfg.
335	Electrical Equipment, Appliance and Component Mfg.
336	Transportation Equipment Mfg.
421	Wholesale Trade – Durable Goods
422	Wholesale Trade – Nondurable Goods
541	Professional, Scientific, and Technical Services
999	Miscellaneous – Not Elsewhere Listed

7. What experiences, if any, has your company had with the small business liaison offices at SAF/SB, AFMC/BC, the product or logistic center small business offices (e.g., ASC/BC), the Air Force Outreach Program office at Brooks AFB, TX, or the Manufacturing Technology Assistance Pilot Program (MTAPP) for small businesses in St. Louis, MO? **L3 has dealt with Tony Deluca's office in the past and have worked also with the AFOPO and MTAPP on supplier development issues.**

8. Thank you for participating in this study.

9. ADDITIONAL COMMENTS: The L3 Location A facility has over 450 programs/platforms. No one individual program makes up over 7% of the total business base. There are over 5,000 contracts being managed by the procurement office. The comprehensive plan allows L3 to consolidate these

requirements and manage them in a less administratively burdensome way verses a large number of individual plans. L3 continues to meet its goals but with great difficulty.

L3 did not respond to repeated requests for additional information similar to those sent to the other case study firms.

Interview Protocol for: **L4**

Location: world wide
Employees: >50,000
2000 Revenue: >$10B
Interview with: member of Small Business Liaison Office (SBLO) staff

Responses are in BOLD.

1. Does your company participate in the Comprehensive Subcontracting Plan Program? If so, is your company's plan developed on a plant-wide, division-wide, or company-wide basis? **Yes, L4 has been participating in the Comp Plan process, but plans to drop out next year. Per SBLO, the Comp Plan process didn't seem to provide any real benefits to L4; they still had to supply the same information at the same level and to the same number of offices as prior to the Comp Plan. L4 will be going to two Master Plan's, one for DoD and one for NASA. Then individual goals for each program will be negotiated with the Govt.**

2. What do you think are the current trends relative to small business participation as subcontractors in major aerospace defense programs? **One major trend is the increased emphasis on the use of electronic communication technology to share information up and down the supply chain. Electronic Data Interchange (EDI) is becoming a requirement for doing business. Quoting SBLO, "If you're not able to do EDI, you're out of the game or will be soon." SBLO believes that SB's may need to form strategic alliances with other SB's or LB's in order to compete for future business. The large primes are expecting their subs to be able to handle more complex and integrated requirements, and perhaps pull together all of the parts for an important subsystem. In the past, the prime pulled all of the parts together, but now the sub does it. This requires SB's that are able to handle a larger piece of the pie. Primes are also looking for longer term relationships with quality SB's that add value to the overall team that L4 is trying to assemble. L4 wants the team together for a while in order to compete more successfully on future programs. As a related trend, L4 is reducing the number of companies in their supply base, but those subs are individually more capable than in the past. L4 is outsourcing more to these subs with expanded capabilities.**

3. How has your company's business relationship with small business subcontractors changed over the years? What aspects have remained the same? What is causing these changes, in your opinion? Why are some aspects, if any, unchanged? **Note part of the answer to #2, above. What has changed is the emphasis on a closer relationship, more like a partnership, if the SB's can provide added value. Another change is the use of "reverse auctioning" techniques by competing requirements among several qualified subs and using auction techniques to get the best price. This is an "out-of-the-box" concept that we'll be seeing more of in the future. What is unchanged is the need for the SB's to be competitive in terms of price, quality, and timely delivery. Another change is that where L4 used to just have their SB suppliers "build-to-print" without any input in how an item was designed, L4 now gets their best suppliers involved early in the design process so that they have input into how what they are going to make is designed and later built. This is a relationship that most of the companies who have evolved into this level find quite satisfying.**

4. How have opportunities for small business subcontractors changed over the years? Are they increasing or decreasing? Do they vary by type of small business (e.g., SDB vs. WOSB) or by the nature of the goods/services purchased (e.g., technical services vs. sheet metal fabrication)? **There are more opportunities in some ways because outsourcing has increased, but the opportunities are more complex. As noted above, the subs are required to bring together an entire subsystem now, not just crank out piece parts. Generally, the type of SB is not a factor in whether there are opportunities or not. The nature of the goods/services being outsourced does affect opportunities. If the need is for something relatively common like IT support or software development, there are a number of SDB sources or other SB sources for that. There are not many sources for some of the complex satellite work that L4 needs help with.**

5. How has the average dollar value level of the subcontracts your company awards changed over the past 10-15 years? Does it vary by the nature or size of your prime program (e.g., ACAT I vs. ACAT II)? Does it vary by the stage that your prime program is in the acquisition lifecycle (e.g., EMD vs. production)? **Award values on average are higher, primarily due to the increased complexity of the requirements and to the trend towards consolidation of requirements (one large buy vs. many small buys). The dollar values during Production tend to be higher than those in EMD due to the increased quantities involved.**

6. A recent analysis of the types of purchases made by a large defense contractor from small business subcontractors/suppliers showed that most of purchases were in the eleven North American Industry Classification (NAIC) categories/ subsectors listed below. In your perception, is this an accurate listing of the types of goods and services that large contractors acquire from small businesses? Can you think of any

that were left out? **One that appears to be missing is the one that correlates to Engineering Services.**

Subsector	Title
326	Plastics & Rubber Products Mfg.
331	Primary Metal Mfg.
332	Fabricated Metal Product Mfg.
333	Machinery Mfg.
334	Computer & Electronic Product Mfg.
335	Electrical Equipment, Appliance and Component Mfg.
336	Transportation Equipment Mfg.
421	Wholesale Trade – Durable Goods
422	Wholesale Trade – Nondurable Goods
541	Professional, Scientific, and Technical Services
999	Miscellaneous – Not Elsewhere Listed

7. What experiences, if any, has your company had with the small business liaison offices at SAF/SB, AFMC/BC, the product or logistic center small business offices (e.g., ASC/BC), the Air Force Outreach Program office at Brooks AFB, TX, or the Manufacturing Technology Assistance Pilot Program (MTAPP) for small businesses in St. Louis, MO? **SBLO has had experiences dealing with practically all of these organizations and the people who staff them. They are knowledgeable and generally doing a pretty good job. SBLO suggests that if the Govt. really wants the primes to increase their level of SB subcontracting, the Govt. needs to put it in the RFP as an evaluation and contract requirement. A contract requirement to brief the SPO or program director monthly on the achievement of SB goals would go a long way towards increasing emphasis on these items by the contractors in general.**

8. Thank you for participating in this study.

Thanks again for participating in my research study last month. Since we last talked, I've come across some additional literature on the subject of prime contractors and the relationship with their suppliers. The literature has sparked a few additional questions that I'd like to ask you, as follows:

1) Does your company require its suppliers to be qualified relative to certain standards such as ISO-9000 or AS-9000?
Yes.

2) Does your company have a certified supplier program? Yes. Again, was this a condition of doing continued business with your company or do certified suppliers receive first consideration?
First consideration.

3) Does your company have a supplier council?
Yes, Southern California Regional Purchasing Council (SCRPC)

4) Has your company participated in continuous improvement or "kaizen" events where someone from your company's supplier development office goes to a vendor's facility to help train the vendor in what might be called "lean manufacturing" concepts?
Yes

5) Does your company encourage or require suppliers to "kit" parts for easier use by its assembly line workers?
Yes

6) Does your company employ any kind of "target costing" technique during the design of a new system where a vendor is given a price target for the part it supplies and then asked to tradeoff technical and quality features in order to meet the target?
Sometimes

Your help in answering these additional questions will greatly help me in filling in some gaps in my data. Please feel free to contact me with any questions or concerns that you may have. If you like, just send me an email in response, or if it is easier for you, please let me know when I could call and talk to you over the phone about these questions.Let me emphasize that, as always, only my thesis advisor and myself will know the true source of my information. You and your company name will be masked from all other readers and described in only the most general terms.

Appendix B: Summary Tables of Trends by Case

Table 14 - S1 Trends for Small Business Subs

Concept	Representative Comment from Interview Transcript (and line number)	Category
Primes as Integrators	"The major primes are more and more integrators of work done by other large primes and medium-to-small sized subs." (64-65)	Out-sourcing
"Lean" concepts important	Lean manufacturing is important to survival. (79-80, 282-284, 308-310)	Lean PSM
Supplier qualification/ certification	Primary customer has certified supplier program with 3 ascending levels. S1 is one of 15 companies at the top level. (260-263)	Lean PSM
Kaizen events at supplier	Primary customer has assisted with training in lean concepts and other continuous improvement techniques. (86-89, 116-117, 279-284, 309)	Lean PSM
Supplier kitting of parts	S1 kits parts for delivery to primary customer's assembly line. (280-282, 289)	Lean PSM
Target costing/pricing	S1 has redesigned subcomponents to include commercial grade parts in lieu of military grade to reduce overall systems costs to meet a target. (87-92, 296-303)	Lean PSM

Table 15 - S2 Trends for Small Business Subs

Concept	Representative Comment from Interview Transcript (and line number)	Category
Requirements Consolidation	Major primes are consolidating their requirements which make it difficult for a small firm to satisfy (29-41)	Lean PSM
Vendor Managed Inventory	The primes are looking for their suppliers to take on more responsibility and cost with things like vendor-managed inventory. (47-52)	Lean PSM
Supplier qualification/ certification	S2 is a certified supplier to Hamilton Sundstrand and S2's President has a seat on the supplier council board. (131-132, 135-141)	Lean PSM
Kaizen events at supplier	Hamilton Sundstrand assisted with *kaizen* event at S2 to improve S2's purchasing function. (147-150)	Lean PSM
Supplier kitting of parts	S2 kits parts for delivery to Raytheon's assembly line. (154-158)	Lean PSM

Table 16 - S3 Trends for Small Business Subs

Concept	Representative Comment from Interview Transcript (and line number)	Category
High Entry Barriers	"For very small shops (<40 employees) the defense subcontractor industry is becoming very complicated to join." (29-30)	Industry Consoli-dation
Supply Base Reductions	"Over the years that S3 has been working with them, NGS has reduced the number of vendors that they deal with…" (41-42)	Industry Consoli-dation
Longer-term relationships	"Lately, the relationship with NGS has become more of a partnership than a simple buyer/seller relationship." (49-50)	Lean PSM
EDI capability for information exchange with prime	"Almost everything is an electronic transaction with the primes now, saving the primes time and paper, but increasing the printing load for subs." (110-112)	Lean PSM
Supplier certification	S3's primary customer does have a certified supplier program. (144)	Lean PSM
Supplier councils	S3's customer does have a supplier council and S3 is a member. (148)	Lean PSM
Kaizen events at supplier	S3's primary customer has held lean improvement seminars for several local suppliers at a central location. (154-156)	Lean PSM

Table 17 - S4 Trends for Small Business Subs

Concept	Representative Comment from Interview Transcript (and line number)	Category
Supplier certification	S4 is a certified supplier with its primary customer. (121)	Lean PSM
Kaizen events at supplier	Primary customer has assisted with training in lean concepts and other continuous improvement techniques. (132)	Lean PSM
Supplier kitting of parts	S4 kits parts for delivery to primary customer's assembly line. (136)	Lean PSM

Table 18 – S5 Trends for Small Business Subs

Concept	Representative Comment from Interview Transcript (and line number)	Category
EDI capability for business-to-business communication	"The ability to use EDI capability and work on the internet has been key to working with the Boeing's and Lockheed's of the world." (222-223)	Lean PSM
Supplier qualification/ certification	S5 is ISO-9002 compliant. S5 is part of their primary customer's certified supplier program. (183, 188)	Lean PSM
Target costing/pricing	S5 is given a target "price" for a component by its primary customer. If S5 can't meet that price the customer will solicit S5 for ideas as to how it might be achieved. (208-210)	Lean PSM

Table 19 - S6 Trends for Small Business Subs

Concept	Representative Comment from Interview Transcript (and line number)	Category
Supplier certification	S6 is plant certified and delivers product directly to the production line at NGES without inspection (50-51)	Lean PSM
Longer-term relationships	S6's current relationship with NGES is more a negotiated one than in the past. The new relationship requires more sophistication on the part of the supplier (45-50)	Lean PSM
EDI capability	S6 made investments in computers and internet access in order to use EDI to communicate with NGES (32-35)	Lean PSM
Vendor managed inventory	S6 manages inventory at the customer's facility. (36-39)	Lean PSM

Table 20 - S7 Trends for Small Business Subs

Concept	Representative Comment from Interview Transcript (and line number)	Category
Supplier kitting	S7 kits parts for ease of assembly by primary customer (Boeing) (26-33)	Lean PSM
Longer-term relationships	S7 relationship with Boeing gets them more involved upfront in the design of key products (50-54)	Lean PSM
EDI and e-commerce	S7 makes extensive use of e-commerce methods for exchange of information with Boeing (37-41)	Lean PSM
Training in "lean" concepts assisted by large prime customer	S7 employees have attended Boeing-sponsored workshops on lean manufacturing methods (36-39)	Lean PSM

Table 21 - S8 Trends for Small Business Subs

Concept	Representative Comment from Interview Transcript (and line number)	Category
Supplier qualification	S8 is a qualified to ISO-9000, MIL-STD-45662A and MIL-Q-9858 (121)	Lean PSM
Kaizen events at supplier	S8 has 3 six-sigma black belts, which is unusual for a small company. GE conducted the training while S8 paid their salary. (46-48)	Lean PSM

Table 22 - L1 Trends for Small Business Subs

Concept	Representative Comment from Interview Transcript (and line number)	Category
Primes as Integrators	L1 outsources all but those activities which are their perceived core competencies (42-45)	Out-sourcing
Common military/ commercial supply base	L1 wants to develop a common supply base for both their military and commercial programs (18-22)	National Industrial Base
Supplier qualification/ certification	L1 has a qualified supplier program with three levels of bronze, silver, and gold (115-119)	Lean PSM
Kaizen events at supplier	Part of the supplier development process at L1 may include lean visits by L1 (130-133)	Lean PSM
Supplier kitting of parts	L1 requires some of its suppliers to kit parts for delivery to L1's assembly line. (137)	Lean PSM
Target costing/pricing	L1 has redesigned items to include commercial grade parts in lieu of military grade to reduce overall systems costs to meet a target. (141-144)	Lean PSM

Table 23 – L2 Trends for Small Business Subs

Concept	Representative Comment from Interview Transcript (and line number)	Category
Primes as Integrators	L2 is acting as more of a program integrator and assembler of aircraft with major subs providing most of the subsystems and hardware. (92-93)	Out-sourcing
Consolidation of requirements across firm	L2 now purchases commodity type items and services such as office supplies and computer leases on a corporate wide basis. (39-57)	Corporate Leverage purchasing
Supplier qualification/ certification	L2 has a Super Star program for identification of certified, quality suppliers (197-201, 205-210)	Lean PSM
Kaizen events at supplier	L2 personnel go out to suppliers to help with continuous improvement (219-210)	Lean PSM
Supplier kitting of parts	L2 will require supplier kitting on two new programs (222-223)	Lean PSM
Longer Term Agreements	L2 is now entering into longer term contracts with key suppliers (74-76)	Lean PSM

Table 24 – L3 Trends for Small Business Subs

Concept	Representative Comment from Interview Transcript (and line number)	Category
Primes as Integrators	The big primes (Boeing, Lockheed) are acting more as program integrators with the Raytheon's, Northrop's, and GD's of the world taking up the first tier. (59-61)	Out-sourcing
Supplier qualification/ certification	L3 has developed a list of preferred suppliers. There are 22 SBs on the list now that L3 is nurturing. L3 has abandoned the "shotgun" approach to finding potential SB suppliers and is continuing to nurture the preferred SB suppliers L3 has identified. (46-49)	Lean PSM Lean PSM

Table 25 – L4 Trends for Small Business Subs

Concept	Representative Comment from Interview Transcript (and line number)	Category
EDI used to communicate with supply chain	One major trend is the increased emphasis on the use of electronic communication technology to share information up and down the supply chain. (22-26)	Lean PSM
Longer-term relationships	Primes are also looking for longer-term relationships with quality SB's that add value to the overall team that L4 is trying to assemble. (33-34)	Lean PSM
Reduction in supply base	As a related trend, L4 is reducing the number of companies in their supply base, but those subs are individually more capable than in the past. (36-38)	Lean PSM

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Vita

Bruce J. Miller is a native of Ashtabula, Ohio who graduated from Harbor Senior High School there in 1979. He earned a Bachelor of Arts degree in Public Administration from Mercyhurst College in Erie, Pennsylvania in May 1983.

He entered civilian service in January 1985 with the Defense Logistics Agency at the former Defense Electronics Supply Center in Kettering, Ohio, where he was a Procurement Agent and Contract Specialist. He transferred to the Air Force at Wright Patterson AFB in May 1988, where he held positions of progressive responsibility as a Contract Negotiator. In March 1994 he received his unlimited Contracting Officer's warrant and added a warrant as a Grants Officer in 1995. In October 2000, he entered the Graduate School of Engineering and Management, Air Force Institute of Technology. Upon graduation, he will be assigned to an acquisition program at the Aeronautical Systems Center, Wright Patterson AFB, Ohio.

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14. ABSTRACT

The United States Government is a major purchaser of goods and services within the nation and overseas. In addition to having the responsibility of acquiring goods and services for the direct benefit of the Government at a price, level of quality, timeliness and other terms and conditions that reflect the best value to the nation, the persons involved in procurement for the Government must also do so in way that reflects certain socio-economic goals set forth by the Congress.

The Small Business Act (15 USC § 637, Public Law 85-536 (1958) established the beginnings of a program to assist domestic small businesses in competing for Federal procurements. The small business act requires that small business concerns be afforded the maximum practicable opportunity to participate in Federal contracts and subcontracts.

This thesis looks the impact of acquisition reform and related developments in the last ten years on the participation of small business subcontractors in the aerospace industry through the window of six major aerospace weapon system programs.

The objectives of this research were to (1) research the buying practices of the defense aerospace industry to determine current trends relating to small business levels of participation by comparing acquisition programs, and (2) compare existing Air Force small business programs, policies, and techniques to developing trends for small business participation and identify strengths and weaknesses.

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