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An Empirical Analysis of the Impacts of Adopting Lean Purchasing and Supplier Management Principles on the Participation of Small Businesses within the Department of Defense Aerospace Industry

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AN EMPIRICAL ANALYSIS OF THE IMPACTS OF ADOPTING LEAN PURCHASING AND SUPPLIER MANAGEMENT PRINCIPLES ON THE PARTICIPATION OF SMALL BUSINESSES WITHIN THE DEPARTMENT OF DEFENSE AEROSPACE INDUSTRY

THESIS

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AFIT/GAQ/ENV/03-04

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Abstract

The Small Business Act requires that small business concerns be afforded the maximum practicable opportunity to participate in Federal contracts and subcontracts. The contract dollars awarded to small businesses by the Air Force have been on the decline for several years and the Air Force is not meeting its small business award goals. This thesis is a follow-on research effort to that conducted by Mr. Bruce Miller (GAQ-02M) who proposed a connection between the Lean Aerospace Initiative's (LAI) Purchasing and Supplier Management (PSM) principles and declining small business participation. The purpose of this research is to determine if the LAI's PSM Principles are acting as entry barriers to small manufacturing/parts supplier businesses attempting to enter the DoD aerospace market. Market entry barriers discourage new entrants into a market, thus providing an advantage to firms already within a market. This advantage or lack of competition can result in higher prices which are paid with taxpayer funds out of dwindling Air Force budgets. If market entry barriers do exist, efforts can be taken to "level the playing field", increase competition, expand the industrial base, and ultimately make more efficient use of dwindling funds. A decision-making exercise was sent out to a sample of small businesses. Regression and repeated measures ANOVA analyses were conducted to identify specific PSM principles that are acting as market entry barriers for small businesses attempting to enter the DoD aerospace market. The results of this study may assist SAF/SB in shaping its training programs and in making intelligent and informed changes to its policy and procedures. These changes may help SAF/SB achieve its goals and more importantly increase the amount of small business participation.

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I. Introduction

Background

The United States Air Force is a major customer in the United States and world economies. In Fiscal Year (FY) 2000, the Air Force directly spent approximately $40.1 billion dollars acquiring goods and services (Dept of AF:III-9). These dollars are spent on items and services ranging from aircraft to grounds maintenance to computer paper. These goods and services are necessary for the Air Force to successfully complete the mission of defending the United States and protecting its interests through aerospace power.

The Air Force's spending of these taxpayer dollars also serves another mission – contributing to congressionally established socio-economic goals. One of these socio-economic goals results from the Small Business Act (Public Law 85-536), which provides small business concerns the maximum practicable opportunity to participate in Federal contracts and subcontracts.

In the 1940s and 50s, a growing concern emerged that small businesses were not receiving a fair proportion of federal contracting dollars. Large businesses, although

relatively small in number as compared to small businesses, were receiving a disproportionate share of the contracts. As a result, the Small Business Act was passed in 1953. The Small Business Act created the Small Business Administration (SBA). The SBA's purpose is to provide financial, technical and managerial assistance to help Americans start, run, and grow their businesses (Learn About:n.pag.).

For federal contracting purposes, a business is classified as either a small or a large business by examining gross revenue or number of employees. Using the North American Industry Classification System (NAICS), the SBA establishes size standards on an industry-by-industry basis. Depending upon the industry, the range set by the SBA in classifying a business as small varies. If gross annual revenue is the determining factor, the limit can be as high as $29 million. If the number of employees is the determining factor, the maximum number of employees can be as high as 1,500 (SBA Small:n.pag.).

There are approximately 25 million small businesses in the United States. These 25 million small businesses account for more than 99.7 percent of all the businesses and two-thirds of all the jobs in the United States (Learn About:n.pag.). According to Mr. Joe Diamond, the director of the Air Force's Office of Small and Disadvantaged Business Utilization (SAF/SB) - the Air Force office responsible for ensuring that small businesses are provided the maximum practicable opportunity to compete - small businesses account for more than 50 percent of the United States' gross national product (Tull, 2002:n.pag.).

Not only are small businesses important to our nation's social, technological, and economic growth, they are also important in terms of increasing or maximizing the United States' dwindling national industrial base and ensuring continued fair and open competition. Small businesses are a critical component in the development and

production of new technologies. Small businesses provide 55 percent of the innovations and account for 38 percent of the jobs in high technology sectors (Learn About:n.pag.).

In an effort to ensure that small businesses are provided the maximum practical opportunity to compete for federal contracts, the SBA sets a certain percentage of total contract award dollars to small businesses as target goals for the Department of Defense (DoD). These small business award goals are then passed down to the component services. The contract dollars awarded to small business by the Air Force have been on the decline for several years and the Air Force is not meeting its small business award goals. From FY 95 through FY 01, the percentage of dollars being awarded to small businesses declined each year. In FY 2001, the Air Force had a goal of awarding 16.2 percent of its contract dollars to small businesses and only achieved 13.8 percent (AFMC/CD Memo, 3 Jul 02).

Why the declining trend in dollars being awarded to small businesses? In his Master's Degree thesis at the Air Force Institute of Technology, Mr. Bruce J. Miller conducted an inductive study with an objective of researching the buying practices of the defense aerospace industry to determine current trends relating to small business levels of participation. Mr. Miller's research identified Lean Purchasing and Supplier Management (Lean PSM) principles as being a common theme in the changing relationship between large business prime contractors and small business subcontractors. Miller (2002:90) suggested that small aerospace manufacturing/parts supplier businesses will have to be ready to employ lean concepts in order to enter or to remain in the aerospace industry.

The Lean Aerospace Initiative, or Lean Aircraft Initiative as it was formerly known, originated in the automobile industry. The Massachusetts Institute of Technology (MIT) conducted a study, the International Motor Vehicle Program (IMVP), to investigate why the Japanese automobile industry was competing so much more successfully than the rest of the automotive industry. The IMVP found that Japanese firms were using lean manufacturing concepts. 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 results of the IMVP culminated in the book *The Machine That Changed the World.*

The Lean Aerospace Initiative (LAI) was a joint effort between the Air Force, industry and MIT to determine whether or not lean principles could be successfully implemented within the defense aerospace industry. Lean Purchasing and Supplier Management (PSM) Principles are subsets of the overall lean manufacturing concept and are the methods by which a company looks outside of its walls to its suppliers so that the entire value chain may become lean as well.

Purpose

The research question to be answered is: Are the Lean Aerospace Initiative's Lean Purchasing and Supplier Management Principles acting as entry barriers to small manufacturing and parts supplier businesses attempting to enter the DoD aerospace market? The research question was studied by testing the following hypotheses:

> Ha1: Electronic data interchange (EDI) is acting as an entry barrier for small businesses attempting to enter the DoD aerospace parts manufacturing/supplier market.

Ha2: Target costing is acting as an entry barrier for small businesses attempting to enter the DoD aerospace parts manufacturing/supplier market.

Ha3: Just-in-time delivery (JIT) is acting as an entry barrier for small businesses attempting to enter the DoD aerospace parts manufacturing/supplier market.

Ha4: The supplier's management of inventory at the customer's facility (SMI) is acting as an entry barrier for small businesses attempting to enter the DoD aerospace parts manufacturing/supplier market.

Ha5: There is a difference in importance among the Lean PSM principles of EDI, target costing, JIT, and the supplier management of inventory at customer's facility for small business parts manufacturing/supplier market entry decisions.

Benefits

This research effort has the potential to be a tremendous source of information for the Air Force Office of Small and Disadvantaged Business Utilization (SAF/SB), small businesses within the DoD aerospace market, the U.S. Air Force and taxpayers.

SAF/SB will directly benefit from this study. As the Air Force's office of primary responsibility for ensuring that small businesses are afforded the maximum practicable opportunity to participate in Federal contracts and subcontracts, SAF/SB, with the results of this study, will be armed with more information and may be able to assist small businesses in obtaining contracts. Based upon the results of this study, SAF/SB may possibly be able to explain, in part, why small business participation and awards are on the decline. This understanding may assist SAF/SB in making intelligent and informed changes to its policy and procedures in order to help achieve its goals and more importantly increase the amount of small business participation. In addition to legislation that promotes small business concerns receiving the maximum practicable opportunity to

participate, SAF/SB may need to initiate actions to help new and emerging small businesses break through market entry barriers.

Small businesses within the aerospace industry may also benefit from this study. If it is found that market entry barriers to the aerospace industry do exist, as mentioned above, SAF/SB may take action to assist small businesses in breaking through the barriers and provide the small businesses the maximum practicable opportunities to compete.

The U.S. Air Force and taxpayers may also benefit from this study. Market entry barriers "discourage" new entrants into a market, thus providing an advantage to firms already within a market. This advantage or lack of competition can result in higher prices which are paid with taxpayer funds out of dwindling Air Force budgets. 15 USC § 631(a) states, "The essence of the American economic system of private enterprise is free competition. Only through full and free competition can free markets, free entry into business, and opportunities for the expression and growth of personal initiative and individual judgment be assured. The preservation and expansion of such competition is basic not only to the economic well-being but to the security of this Nation." If it is found that market entry barriers do exist within the aerospace market, efforts can be taken to "level the playing field", increase competition, expand the industrial base, and ultimately make more efficient use of dwindling funds.

Thesis Structure

The remainder of the thesis is organized as follows: Chapter 2 will provide a review of the literature as related to market barriers to entry, the lean aerospace initiative's purchasing and supplier management principles, and small business. Chapter 3 will focus on the research methodology aspects to be employed in conducting this research effort. Chapter 4 will provide data analysis and results. Chapter 5 will provide conclusions and recommendations for further research.

II. Literature Review

This chapter discusses the literature relevant to this study investigating whether Lean Purchasing and Supplier Management (PSM) Principles act as barriers to entry for small businesses entering the Department of Defense aerospace market. Major issues covered are Miller's (2002) research findings, market barriers to entry, Lean Aerospace Initiative (LAI), and small business.

This chapter first discusses Miller's (2002) findings - the rationale for this follow-on research effort. Market entry barriers are discussed next, to include the different types and how they work. Next, the Lean Aerospace Initiative's PSM principles and how they are related to market entry barriers are discussed. A discussion on small business and its relationship to the LAI Lean PSM principles and market entry barriers follows. Lastly, Miller's findings, market entry barriers, PSM principles and small business issues are brought together in a research question and hypotheses for testing.

The Forerunner Study

Miller's (2002) research resulted from SAF/SB's desire 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" (Miller 2002:87). SAF/SB was concerned that their newly implemented initiatives might not be appropriate for then current market conditions. SAF/SB sponsored Miller's research effort to identify trends in the aerospace market and determine the effectiveness of SAF/SB initiatives. (Miller 2002:87)

Miller's research had two research objectives. The first objective was to determine the trends relating to small business subcontractors within major aerospace defense programs. The second objective was to compare the existing SAF/SB programs, policies, and techniques to the identified trends of small business participation and identify any strengths and weaknesses. (Miller 2002:87)

For the qualitative portion of his research, Miller conducted case studies with twelve different companies in the defense industry. Eight of the companies were small business subcontractors and the other four companies were large prime contractors. Miller identified Lean PSM principles as being a common theme in the changing relationship between large business prime contractors and small business subcontractors. As shown in Table 1, Miller found that implementation of the specific Lean PSM principles varied across the companies involved in his case studies.

Table 1 Matrix of Common Lean PSM Trends by Firm

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

Source (Miller 2002:75)

Miller found that the levels of PSM implementation seemed to vary according to the size of the small business or the businesses' years of experience as a defense subcontractor. He found that the larger small businesses and those that were in the business longer had implemented more of the Lean PSM practices than other small businesses. Small businesses will have to be ready to employ lean concepts in order to enter or to remain in the aerospace industry. Miller suggested that small aerospace manufacturing/parts supplier businesses must be able to participate using Lean PSM techniques or they will not be considered for award of a subcontract. (Miller, 2002:90) Lacking in Lean PSM capabilities may essentially be an entry barrier for these small businesses.

Market Entry Barriers

An entry barrier is basically anything that prevents or hinders a business from being created and entering a particular market. Carlton and Perloff define a barrier to entry as "anything that prevents an entrepreneur from instantaneously creating a new firm in a market" (Carlton and Perloff, 2000:77). *The Economics of Strategy* defines barriers to entry as "those factors that allow incumbent firms to earn positive economic profits, while making it unprofitable for newcomers to enter the industry" (Besanko et al, 1999:397). In order to successfully compete in a market, a newcomer must overcome these barriers.

There are many different market entry barriers. In the 1950s, Bain (1956) initiated a study of barriers to entry. Bain identified economies of scale, product differentiation, and absolute cost advantages as barriers to entry (Bain, 1956:43). In his extensive study, Porter identified six major sources of barriers: cost advantages of incumbents, product differentiation of incumbents, capital requirements, customer switching costs, access to distribution channels, and government policy (Porter, 1980:7). These six identified barriers generally include the most important barriers identified in other literature. Harrigan identified cost advantage of incumbents, capital requirements, advertising, number of competitors, and research and development as being entry barriers (Harrigan, 1981:395). Other entry barriers identified were predatory pricing, business history/reputation or lack thereof, and information costs (Demsetz, 1982:50). Brief definitions of the identified main market entry barriers relevant to this study follow. More detailed definitions and information is provided in Karakaya & Stahl (1989).

Cost Advantages of Incumbents. An incumbent will usually have the advantage over the new entrant of knowing either how to do something or how to do something more efficiently. This knowledge is also known as the "learning curve" effect (Karakaya and Stahl, 1989:81). Economy of scale can be another advantage of an incumbent. An economy of scale occurs with increasing output of a company combined with decreasing unit costs (Karakaya and Stahl, 1989:85).

Product Differentiation of Incumbents. "Established firms have brand identification and customer loyalties stemming from past advertising, customer service, product differences, or simply being first into the market" (Karakaya and Stahl, 1989:85). An incumbent has already spent time and money in establishing its brand-name and reputation. Because an incumbent has already realized and ultimately paid for these costs and a start-up company has not, the incumbent's cost of production is lower. The incumbent can therefore charge a lower cost for its product while still making a profit. A newcomer may have to sell its product at or below cost just to compete.

Capital Requirements. For a particular industry, a new company may require a large amount of financial resources in order to enter and successfully compete (Karakaya and Stahl, 1989:85). As an example and depending on the industry, significant financial resources may be required in order to procure the necessary equipment, land, labor, and raw materials in addition to other resources.

Customer Switching Costs. A customer switching cost is the one-time cost of doing something differently. Karakaya and Stahl define this as "One-time costs to the buyer due to switching from one supplier to another" (Karakaya and Stahl, 1989:85).

Switching from one supplier to another can involve additional training, equipment, and added logistics.

Access to Distribution Channels. Karakaya and Stahl define access to distribution channels as "The extent to which logical distribution channels for a product are already served by the established firms in the market" (Karakaya and Stahl, 1989:85). The pioneers of a particular market may have already established or taken control of the distribution network for their goods. The pioneer may have already realized these distribution channel costs. A newcomer business will need to pay either to access existing distribution channels or to establish new ones. Again, because of these added expenses, it may be difficult for a new business to successfully compete with incumbents or market pioneers.

Karakaya and Stahl found that "market entry barriers are considered to be crucial factors in the market entry decision" (Karakaya and Stahl, 1989:88). It is in the incumbent's best interest to identify the relative importance of these barriers and do what it can to keep the barriers high for new entrants. They found that incumbents tended to be the pioneering firms, or first firms in the market. Pioneering firms tend to face few market entry barriers and enjoy advantages over other potential market entrants such as cost advantages and higher market share. Studies of the industrial and consumer goods industries conducted by Robinson further support the theory that pioneering firms obtain a higher percentage of market shares (Robinson, 1988:87). In an analysis of 82 brands across 24 categories, Urban et al found that later entrants incur "a significant market share penalty" (Urban et al, 1986:655).

The following section discusses the Lean Aerospace Initiative, LAI's PSM Principles, and why the principles could act as market barriers to entry.

Lean Aerospace Initiative

The Lean Aerospace Initiative, or Lean Aircraft Initiative as it was formerly known, originated in the automobile industry. In the late 1980s, American car manufacturers found that they were no longer able to successfully compete with the Japanese automotive companies. The Massachusetts Institute of Technology (MIT), through its International Motor Vehicle Program (IMVP), examined and studied the problems facing the auto industry. MIT published in 1990, the findings of this study of the automotive industry in the book, *The Machine That Changed the World*. MIT found that the Japanese had discovered an entirely different process of production. MIT defined this different production process as being "lean": constantly reducing waste while still being responsive to change (Nightingale, 1998:20).

Following the successful and revealing study of the automotive industry and as a result of declining procurement budgets and increased competition, the Air Force asked if the same concepts, principles and practices of the Japanese automotive industry could be applied to the military aircraft industry. Lieutenant General Thomas R. Ferguson, Jr., Aeronautical Systems Center Commander, asked MIT to explore the possibility of applying these lean principles to America's aerospace sector (Morrocco, 1993:24). MIT, the Air Force, and key defense contractors jointly funded the research of applying lean manufacturing concepts to the U.S. military aircraft industry. The joint research project was called the Lean Aircraft Initiative (Baker, 1998:24).

Besides determining if lean manufacturing principles could be applied to the U.S. military aircraft industry, the LAI sought to reduce the cycle time and cost of future military systems by 50 percent, while improving quality and performance (Baker, 1998:24). The LAI was exploring better, faster, and cheaper ways of fulfilling the Department of Defense's next generation aircraft requirements. LAI's mission statement was "To enable fundamental change within industry and government operations that supports the continuing transformation of the US aerospace enterprise towards providing aerospace systems offering best life-cycle value" (*Proposal*, 1999:3). In 1997, because lean manufacturing principles were found to be applicable not only to the aircraft industry, but also to the space industry, the Lean Aircraft Initiative's name was changed to the Lean Aerospace Initiative.

In order for a company to truly become "lean", lean principles must be applied to the entire supply or value chain (Cook and Graser, 2001:88). It is estimated that purchased materials and parts make up between 50 to 70 percent of the cost of a typical military aircraft (Cook and Graser, 2001:87). Lean Purchasing and Supplier Management (PSM) is the method by which a company looks outside of its walls to its suppliers so that the entire value chain may become lean as well. The nine specific Lean PSM practices are: 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 (Cook and Graser, 2001:92-99). Brief summaries of the Lean PSM principles and a discussion as to why implementing the principles could act as market entry barriers follow. More detailed

definitions and discussion on Lean PSM principles can be found in Cook and Graser (2001).

Supplier Qualification and Certification. In an effort to procure only the best quality parts and materials, a prime contractor or customer company pre-qualifies eligible suppliers as acceptable bidders. Pre-qualification may include an examination of the supplier's internal processes, quality control standards, management, and financial condition. After pre-qualification, supplier certification is the next step. In the certification process, a supplier earns ratings based upon their performance, quality, and delivery record over time. (Cook and Graser, 2001:92; Vonderembse and Tracey, 1999:33)

A supplier selection criterion is one means of optimizing a firm's supplier base and is widespread within the parts manufacturing industry (Vonderembse and Tracey, 1999:36). Specific supplier selection criteria can be barriers for a firm wishing to enter a market, but ones that can be "hurdled". A firm not "making the grade" or not scoring well against the established supplier selection criteria will likely not get any business. It is critical, therefore, for a prospective supplier to understand completely the criteria against it will be judged or graded. When a prospective supplier clearly understands the selection criteria, its level of effort and performance are likely to increase significantly (Vonderembse and Tracey, 1999:38). Firms that do not "make the grade" under supplier qualification and certification requirements may view this principle as a market entry barrier. Implementing an adequate internal quality control program may require a significant amount of both financial and highly-skilled human resources. This is an example of the previously identified capital requirements market entry barrier.

Long-Term Relationships. Once a good supplier is identified and proven, a company uses good business sense to repeatedly use the good supplier over time. Promises of continued business for a certain period of time are the reward a supplier gets for proven exceptional performance (Cook and Graser, 2001:93). Clearly and carefully established supplier selection criterion is a key component or prerequisite for implementing long-term supplier relationships. Long-term relationships are win-win situations. The supplier can plan for a known demand over time and possibly offer volume price discounts as consideration (Monczka et al, 2002:494). The customer is able to reduce its procurement costs and achieve quantity discounts while being assured of its required level of quality. Long-term relationships help in reducing costs, eliminating waste, and focusing on quality -- integral parts of a lean manufacturing system.

Although long-term supplier relationships apply to a supplier that is already in a particular market, the relationships may be viewed as market entry barriers for new firms. Not only do long-term relationships contribute to both the cost advantage and product differentiation of the incumbent suppliers, but customer switching costs can also be an issue. Long-term supplier relationships are usually contractual agreements. Once these contractual arrangements are executed and in place, it is difficult and can be costly to switch suppliers. (Monczka et al, 2002:497)

Communications with Suppliers. Cook and Graser suggest that regular, formal communication programs like newsletters and supplier councils are keys to exchanging information like industry best practices and to giving and receiving feedback (Cook and Graser, 2001:93). Communications with suppliers may be the easiest of the Lean PSM principles for a supplier to implement. This principle would be more difficult for a

company to maintain a competitive advantage in because this principle could be easily and relatively cheaply implemented.

Electronic Data Interchange (EDI) with Suppliers. "EDI is a communications standard that supports the interorganization electronic exchange of common business documents and information between buyers and sellers" (Monczka et al, 2002:710). "EDI is the computer-to-computer exchange of standard business documentation in machine-processable form" (Marcussen, 1996:20). What was once a timely and inefficient physical flow of paperwork between a buyer and seller is now electronic via data links or the Internet (Cook and Graser, 2001:94). EDI has significantly increased the speed of transactions and communications while reducing the amount of paperwork flowing between a buyer and a seller. EDI is a key component in keeping all parties aware of the latest information.

To be completely effective, the benefits of EDI should be shared throughout the supply chain. Marcussen found that many suppliers have implemented EDI in order to keep their customers although they have realized little to no financial benefits from using EDI (Marcussen, 1996:20). Marcussen suggests that unless buying organizations see to it that a fair share of the financial benefits is passed on to the suppliers; the suppliers may lose their enthusiasm and positive attitude towards EDI (Marcussen, 1996:25). A supply chain is essentially a partnership. If the partners aren't sharing in the benefits, the partnership will eventually fall apart.

Customer EDI requirements could possibly be viewed as a market entry barrier for a supplier. Implementing an EDI system may require additional capital outlays or investments in a computer network, hardware, software, technical expertise and training.

If a prime contractor (customer) has implemented an EDI system, in order to get business, its existing and prospective suppliers will need to have EDI on their end as well. Otherwise, the customer will take its requirement(s) to a supplier that does have the EDI capability. These are examples of capital requirements and cost advantages of incumbents market entry barriers.

Continuous Improvement (Kaizen) Events at Suppliers. The *kaizen* philosophy is to continually strive for the elimination of waste -- reducing costs while increasing quality (Cook and Graser, 2001:94). In order for the benefits and efficiencies of continuous improvement to be fully achieved, the *kaizen* mindset needs to be embraced throughout the entire value chain.

Although continuous improvement is a fundamental principle in lean manufacturing, the act of continuous improvement may or may not be viewed as a market barrier to entry. The theory is *kaizen* occurs over time by suppliers that are already in the market; thus by already being in the market, it can be argued that the suppliers have already hurdled or circumvented market entry barriers. However, if these suppliers are already in the market and have not yet implemented a continuous improvement philosophy desired by their customer, the suppliers will have to comply or their customers will go to elsewhere for their business. If a company is either a new business or is already in the market, implementing a continuous improvement philosophy may require capital outlays, training, and skilled personnel.

Target Costing. The principle of target costing is a potential source of competitive advantage for the supply chain. The traditional means of a supplier and a company doing business was that a supplier would add up the cost of resource inputs and then add a

profit. In an effort to keep its overall costs down, the company would then usually select the lowest quote even if the product's quality was not the best. Target costing is a radical departure from this process. Target costing is market driven. Market analysis reveals the market price for a particular product. A business then works backward from the overall price of a product and determines what the individual component or material costs need to be to be competitive. (Cook and Graser, 2001:95; Ellram, 2000:95; Newman and McKeller, 1995:443) A customer requires product X from its existing or potential supplier(s) at or below the target cost. If the supplier can not accept or meet the target cost, the customer will go to another supplier that can.

"Target costing requires a high degree of trust, information sharing, and joint problem solving" (Monczka et al, 2002:445). Requirements for implementing target costing capabilities may include an adequate accounting system and skilled personnel. Because of this, target costing is closely related to other PSM principles of long-term relationships, communication, and EDI. Capital requirements and cost advantages of incumbents may make implementing target costing and having the ability to meet a particular target cost act as market barriers to entry for new entrants.

Just-In-Time Delivery (JIT). JIT is simply having the right product at the right place at the right time; the supplier delivers parts to customers when the parts need to be used in production (Cook and Graser, 2001:96; Karlsson and Ahlstrom, 1996:29). JIT contributes to the lean process by reducing inventory and its associated costs, improving quality, and shortening lead times (Cook and Graser, 2001: 96). Indirect benefits of JIT include increasing cash flows and competitiveness in the market (Brown and Inman,

1993:64). Continuous two-way communication and an EDI system are critical to JIT working successfully.

JIT is another fundamental principal for a "lean" organization's supply chain. If a customer, such as a prime contractor, has implemented JIT, it is imperative for its suppliers to play by JIT rules. As with EDI, implementing JIT may require additional capital outlays for communication/computer equipment, skilled personnel, and training, to name a few. Besides any capital requirements, access to distribution channels may be another example of a market entry barrier possibly involved in implementing JIT. Incumbents may have already setup their distribution channels and realized these costs - adding to their cost advantage (of incumbents) over new entrants. Newcomers will need to pay either to access existing distribution channels or to establish new ones; further adding to the cost advantage of incumbents.

Supplier Management of Inventory at Customer. Supplier management of inventory at the customer's facility is another effort to reduce inventory costs. Instead of the customer taking responsibility for products and materials upon delivery, the supplier owns and manages the inventory at the customer's facility. The products and materials become the customer's when they are actually needed in production. (Cook and Graser, 2001:98) Cook and Graser's research concluded that concept applied only to suppliers of such commodities as fasteners and such equipment wear parts as drill bits (Cook and Graser, 2001:98). Because the supplier manages its customer's inventory at the customer's facility, it can more closely monitor the supply and reorder as needed.

Managing a customer's inventory at their facility may require additional personnel resources, training, and communication systems. Thus being able to implement this

principle may involve capital and incumbent's cost advantage market barrier to entry characteristics and situations.

Supplier Kitting. Instead of suppliers providing individual components that a customer then assembles, supplier kitting is the process where suppliers assemble the components and provide the subassemblies to the customer (Cook and Graser, 2001:99). An efficient and lean business does what it is good at and outsources the rest (Monczka et al, 2002:204). It is possible that a supplier can provide subassemblies or kits cheaper than a customer can buy and assemble the parts. Supplier kitting is closely related to JIT in that it is another effort to reduce inventory associated costs.

Kitting requirements can affect suppliers and may possibly act as a market entry barrier. Instead of producing and delivering a particular component to a customer for final assembly, a supplier may have to produce or outsource for several required components and assemble them. Capital outlays for equipment, personnel and training may be necessary to meet the kitting requirement.

Are the Lean Aircraft Initiative and its above-mentioned Lean PSM principles a good fit for small businesses? Through the use of a clinical field study, Karlsson and Par found that the lean enterprise concept, operating in a global network of leading technological competences, is applicable to small and medium-sized firms. The rapidly developing global market is providing tremendous opportunities for small businesses. (Karlsson and Ahlstrom, 1997:949)

Small Business

A small manufacturing firm may want to implement the JIT principle to achieve the benefits of smaller inventories, improved quality, and shortened lead times. Indirect benefits of JIT include increasing cash flows and competitiveness in the market. (Brown and Inman, 1993:64) Small businesses may enjoy advantages over large business JIT suppliers such as: having lower overhead costs; having increased flexibility; and being able to locate more closely to its customers (St. John and Heriot, 1993:15). Larger businesses traditionally tend to have more overhead and less flexibility. Cumbersome, large businesses find it more difficult to change their product mix rapidly than do lean and flexible small businesses. There are potential disadvantages for a small supplier implementing JIT. St. John and Heriot point out a small business JIT supplier can become a "virtual captive" of its customer. While the small business may enjoy a certain level of predictable or known future business, it could be susceptible to the customer's growth and negotiating position (St. John and Heriot, 1993:13). A small business may not have the financial capital to hold inventories or allocate all of their capacity to one customer (St. John and Heriot, 1993: 15). In addition, a small business may not want to rely solely on one customer as its source of demand.

A small business may not have either the monies to finance Lean PSM principles or the human capital necessary for implementation, training, and operations. Depending on the particular industry, small businesses are defined based upon either yearly gross revenues or the number of employees. The gross annual revenue limit can be as high as $29 million and the maximum number of employees can be as high as 1,500. However, the most common numbers across all industries are a gross revenue limit of $6 million or

having 500 or fewer employees. (SBA Small, 2002:n. pag.) These are human and financial limitations large businesses are not encumbered with. P*urchasing* magazine published a 4-part article relating to minority supplier development. The authors found lack of access to capital; lack of credibility in the marketplace; lack of business experience; supplier-base downsizing; strategic alliances and a lack of talent to be reasons for why minority supplier firms weren't more successful. (Why Aren't, 1995:97-100; Krause et al, 1999:34) These are some of the same problems that small businesses within a "lean" supply chain like the DoD aerospace industry could encounter.

Miller (2002) suggested that small aerospace manufacturing/parts supplier businesses must be able to participate using Lean PSM techniques or they will not be considered for award of a subcontract. Are Lean PSM principles entry barriers?

Hypotheses

The research question of this study is: Are Lean Purchasing and Supplier Management Principles acting as entry barriers to small manufacturing and parts supplier businesses attempting to enter the Department of Defense aerospace market?

All nine of the Lean PSM principles identified by Cook and Graser were not included in the hypotheses tests to answer the research question. The Lean PSM principles of supplier qualification and certification, continuous improvement, and communications with suppliers were removed from the study. The reasoning behind the exclusion of each of these principles is explained below.

The Lean PSM supplier qualification and certification principle was removed from the study. A supplier qualification and certification program is clearly an attempt by a

firm to optimize its supplier base and maintain relationships with only its best and proven suppliers. In optimizing its supplier base, a firm is "shrinking" the pool from which it will choose to do business with. It can be argued that this is obviously a market entry barrier for firms wishing to enter a market. As further support for removing this principle from the study, all four of the large firms and all eight of the small firms Miller studied, implemented qualification and certification techniques (Miller, 2002:75).

The Lean PSM principle of continuous improvement (*kaizen)* events at suppliers was also removed from the study. In Miller's (2002) research, he found that three of the four large firms studied required continuous improvement events at their suppliers and seven of the eight small firms had implemented continuous improvement techniques. Seven of the eight small firms studied may have implemented continuous improvement techniques as a necessary cost of doing business or perhaps because its implementation was not overly difficult. As further support for removing continuous improvement events from this study, the researcher took the position that continuous improvement occurs over time by suppliers that are already in the market. Already being in the market means that any entry barriers have been successfully hurdled or circumvented.

Lastly, the Lean PSM principle communications with suppliers was removed from the study. As Cook and Graser suggested, communications with suppliers can be as simple as regular, formal communication programs like newsletters and supplier councils. Communications with suppliers is a means of and key to exchanging information like industry best practices and to giving and receiving feedback. (Cook and Graser, 2001:93) These communications probably do not require significant capital outlays. Furthermore, communications with suppliers, as defined, infers communications between a buyer and a

seller that are already in the market. This means that any market-entry barriers have been successfully hurdled or circumvented.

At this point in the research and prior to pilot testing, the Lean PSM principles included in this study are: long-term relationships, EDI, target costing, JIT, supplier management of inventory at customer, and supplier kitting. Implementing any of these principles may require additional financial or human capital, access to distribution channels, and/or involve cost advantages for the incumbents. Not only may financial capital be required to procure and implement systems for these principles, but human capital in high-skilled labor and management may be required.

The research question was studied by testing the following hypotheses:

Ha1: Long-term relationships are acting as an entry barrier for small businesses attempting to enter the DoD aerospace parts manufacturing/supplier market.

Ha2: EDI is acting as an entry barrier for small businesses attempting to enter the DoD aerospace parts manufacturing/supplier market.

Ha3: Target costing is acting as an entry barrier for small businesses attempting to enter the DoD aerospace parts manufacturing/supplier market.

Ha4: JIT is acting as an entry barrier for small businesses attempting to enter the DoD aerospace parts manufacturing/supplier market.

Ha5: The supplier's management of inventory at the customer's facility is acting as an entry barrier for small businesses attempting to enter the DoD aerospace parts manufacturing/supplier market.

Ha6: Supplier kitting is acting as an entry barrier for small businesses attempting to enter the DoD aerospace parts manufacturing/supplier market.

Ha7: There is a difference in importance among the Lean PSM principles of LT relationships, EDI, target costing, JIT, supplier management of inventory at customer's facility, and supplier kitting for small business parts manufacturing/supplier market entry decisions.

Conclusion

This chapter provided a review of the literature as related to Miller's (2002) research, market entry barriers, Lean Aerospace Initiative's PSM principles, and small business. These areas were brought together into a research question and hypotheses for testing. Chapter 3 discusses the methodology used in testing the research question hypotheses.

III. Methodology

This chapter discusses the methodology used to test the research question hypotheses. Major issues addressed in this chapter include rationale for using a survey, survey development, the survey-sampling frame, and the processes for testing the hypotheses. This methodology is based on the work of Stahl and Zimmerer (1984), Karakaya and Stahl (1989) and Karakaya (1987).

Survey

A survey methodology was used in favor of other methods. One reason for using a survey exists when a researcher wants to understand or predict human behavior or conditions. (Alreck and Settle, 1995:3) In this case, the desire is to understand a portion of a firm's logic for either entering or not entering the DoD aerospace parts supplier or parts manufacturing market.

"Social science has come to depend on sample surveys because the alternatives to them are either a census – survey of everyone in the population - or no information at all" (Dooley, 2001:119). Except for the Federal Government, conducting a census is usually impractical and infeasible.

Yin (1994) states that the most important factor to consider in selecting a research strategy is to identify the type of research question being asked. The research question for this effort is in the form of a "what" question – "what are the effects of Lean PSM principles upon small business parts manufacturing/supplier market entry decisions?" Yin suggests archival analysis and survey strategies are best methodologies for handling

"what" research questions. (Yin, 1994:6) Because archival data was not available for this effort, a survey methodology was used.

A cross-sectional mail survey design was developed. The data was collected at one point of time; therefore, the findings can only be generalized to the sampling frame at the time of the survey. (Dooley, 2001:119). A mail survey design was chosen because it was infeasible to physically contact and interview each member of the sample within a reasonable amount of time.

After reviewing the literature, a decision-making exercise was chosen as the sampling instrument for several reasons. First, the ideal situation for finding out what circumstances affect an executives' decision to either enter or not enter the aerospace market would be to be present during the actual decision-making process. This was not possible. Second, it was also not a good idea to simply ask the decision makers to relate their decision making process. Slovic and Lichtenstein (1971:660) found that most decision makers have rather poor insight into their own multiple criteria decision processes. Third, though respondents being asked to make market entry decisions based upon hypothetical situations instead of making actual market entry decisions based upon actual data and conditions may seem to be a significant limitation, Brown (1972:210) found that policy models for individuals' decisions derived under natural and experimental conditions did not differ significantly. Therefore a decision-making exercise was created to simulate the market entry decision process.

There are advantages to using a decision-making exercise. Stahl and Zimmerer wrote, "An advantage of such a methodological approach is that the researchers can incorporate a planned experimental design into the exercise and substantially control the

information the participants incorporate into the decisions" (Stahl and Zimmerer, 1984:372).

Survey Development

Modeled after Stahl and Zimmerer (1984) and Karakaya and Stahl (1989), the decision making exercise was created around a one-half replicate of a full factorial design with six independent variables, each of which had two treatment levels as shown in Figure 1. Reasons for choosing a fractional factorial design included: the resources required to conduct a full factorial design exceeds the available resources, information is required only on main effects and low-order interaction, and an assumption that only a few effects are important (Kuehl, 1994:390). The two levels at each of the six criteria were either "High" or "Low" and represented the level of implementation by incumbent subcontractors. The level of PSM factor implementation by the incumbent companies a market entrant is competing against creates the market entry barriers. Besanko et al (1999:397) define barriers to entry as "those factors that allow incumbent firms to earn positive economic profits, while making it unprofitable for newcomers to enter the industry." This ½ X 2 X 2 X 2 X 2 X 2 X 2 fractional factorial, repeated measure design resulted in 32 combinations of the possible 64 treatment levels on the independent variables. To control for any order effect in the survey results, the order of the 32 market entry opportunities and the treatment on the independent variables were randomized. Also, because a repeated measures design was used, the respondents may become over-sensitized to the variables under study and may be able to infer the research hypotheses. Knapp (1985:209) identified that using a repeated measures design may yield results

influenced by experimental demand – that is, subjects attempting to respond cooperatively with the researchers' hypotheses. In this study, the wording of the survey instructions, definitions, and scenarios were worded in as neutral a manner as possible to reduce the probability of any experimental demand. Figure 2 is an example of the decision making exercise modeled after that of Stahl and Zimmerer (1984) and Karakaya and Stahl (1989). The finalized survey instrument is included at Appendix A.

	Treatment Level	
	1	2
Long-term Relationships	High	Low
Electronic Data Interchange	High	Low
Target Costing	High	Low
Just-In-Time Delivery	High	Low
Supplier Management of Inventory at Customer's Facility	High	Low
Supplier Kitting	High	Low

Figure 1 Treatment Levels of Independent Variables

During the exercise, please assume you are making the decision to enter or not enter the market as a subcontractor to a large aerospace firm. Each market condition specifies attributes the prime contractor is requiring in making its subcontract award decision. In each condition and decision, consider your company's current capabilities, financial strength, and any costs necessary for you to implement the required attributes. With the level of the incumbent subcontractors' implementation for these 6 attributes in mind, please indicate the chance you would decide to enter the market.

MARKET CONDITION #1

Attribute Required by Prime Contractor	Incumbents' Level of Implementation
Long-term Relationships	HIGH
Electronic Data Interchange	HIGH
Target Costing	LOW
Just-In-Time Delivery	LOW
Supplier Management of Inventory at Customer's Facility	LOW
Supplier Kitting	LOW

Example Decision: Please circle your probability of entering the example market condition.

(No Chance) 0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 100% (Definite)

NOTE: The actual survey instrument contained explicit definitions of the PSM principles and the differences between the incumbents' level of implementation. This was necessary to avoid confusion and increase reliability

Figure 2 DoD Aerospace Manufacturing and Parts Supplier Market Entry Decision Making Exercise Example

The survey instrument was pilot tested at the 2002 Manufacturing Technical Assistance Pilot Program (MTAPP) conference in Las Vegas, Nevada. MTAPP is an Air Force Small Business Office program initiative to help small manufacturing firms across the United States (Air Force, 2003:n. pag.). The purpose of the pilot test was to test the survey, identify discrepancies and improvements, and gather initial data for testing and comparison purposes.

The pilot survey recipients were under a one-hour time constraint to complete the survey and subsequently took about an average of 35 minutes to complete the survey. After checking the linear regression assumptions, the group regression results were used to identify the significant PSM principles. The pilot data analysis results are found at Table 2.

Table 2 Pilot Test PSM Factor Analysis

Factor	Standardized Beta Coefficients	P-Values
LT*	-0.21996	**<.0001**
EDI*	-0.05532	**0.0401**
TC*	0.114614	**<.0001**
JIT	0.004897	0.8557
SMI*	0.164923	**<.0001**
KIT	0.03799	0.1586
R^2	0.093687	
*Significant p<=.05		

The explained variation, R^2, at .093687 is quite low. However, this can be explained by the fact that the respondents' decisions are made based upon different conditions. The survey asked the respondent's to answer their probability of entering each market condition based upon their company's existing capabilities and financial condition. It is unlikely that the businesses in the pilot sample had similar capabilities and financial conditions; therefore, the explained variation is relatively low. (Karakaya, 1989:54)

Standardized beta coefficients were computed to allow comparison of the beta coefficients. A positive significant factor would indicate that a high level of implementation by the incumbent subcontractors of the particular PSM factor was

encouraging a decision maker to enter the market condition. A negative significant factor would indicate that a high level of implementation by the incumbent subcontractors of the particular PSM factor was causing the decision maker's probability of entering to decrease and therefore acting as a barrier to entry. The Lean PSM principles of long-term relationships and electronic data interchange had significant negative standardized beta coefficients at $\alpha = .05$ and were therefore acting as market entry deterrents in the sample. The PSM factors of target costing and supplier's management of inventory at the customer's facility had significant positive standardized beta coefficients at $\alpha = .05$ and were therefore encouraging the respondents to enter the market. Just-in-time delivery and supplier kitting were not found to be significant predictors among the pilot sample.

Feedback on the pilot survey instrument from the 48 survey recipients was generally positive and constructive. Recipients did mention that the survey length was too long. Some recipients also mentioned that the survey definitions and instructions needed to be more clearly defined. The recipient feedback combined with the pilot data analysis resulted in revisions to the actual survey and hypotheses.

Shortening the length of the survey required either using a smaller fractional factorial design or the removal of independent variable(s). A concern of using a fractional factorial design is that only a fraction of the possible question combinations are actually asked and that higher-order interactions are difficult to test and identify. Therefore in order to shorten the survey to a more manageable length, the number of independent variables – Lean PSM principles – was reduced and the survey instrument was converted from a fractional to a full factorial (2 X 2 X 2 X 2) design. Based upon an analysis of the

pilot test data and Miller's (2002) findings, the PSM principles of long-term relationships and supplier kitting were removed from the study.

By its very definition, long-term relationships are barriers to entry for new firms attempting to enter a market. A long-term relationship is a promise or agreement for continued business as long as performance meets or exceeds expectations. Basically, a customer or prime contractor has optimized its supplier base and executed contractual agreements with its preferred suppliers. Once these contractual arrangements are executed and in place, it is difficult to switch suppliers (Monczka et al, 2002:497). Evidence from the pilot study further supports the reasoning that long-term relationships by their definition are barriers to entry for new firms. In the pilot study (reference Table 2), long-term relationships were found to be acting as a market entry barrier.

Supplier kitting, the process where suppliers assemble components and provide subassemblies to the customer rather than the individual components (Cook and Graser, 2001:99), was removed because evidence from the pilot study showed support for it being the least important PSM principle and insignificant among the pilot sample. As further rationale for removing supplier kitting from the study, Miller (2002) found that supplier kitting was being implemented by all but one of the eight small firms interviewed (reference Table 1). Because supplier kitting was being implemented by nearly all of the small firms Miller (2002) interviewed and because of the results of the pilot study, it was removed.

Electronic data interchange, target costing, supplier management of inventory at the customer's facility, and just-in-time delivery were included in the final survey. Electronic data interchange was found to be acting as a market entry barrier for the pilot

test sample. Target costing and supplier management of inventory at the customer's facility were not acting as market entry barriers for the pilot test sample, but were instead significant factors that encouraged decision makers to enter a market. It was logical to include electronic data interchange, target costing, and supplier management of inventory at the customer's facility in the actual survey instrument to see if the evidence holds true in a different sampling frame and to see if the results would be consistent with Miller's (2002) findings. Just-in-time delivery was not found to encourage market entry or to be a market entry barrier among the overall pilot sample. Just-in-time delivery was included in the study because Miller (2002) found that this principle was implemented by five of the eight small firms he interviewed (reference Table 1) and because of the fact that the pilot sample may have been biased. It is important to note that the pilot was conducted with a sample of small businesses that were a part of the manufacturing technical assistance pilot program (MTAPP). MTAPP is an Air Force Small Business Office program initiative to help small manufacturing firms. Had the pilot sample received some training or other assistance with these principles? Just-in-time delivery was included to see how a more representative sample would respond.

The research question to be answered is unchanged: Are Lean Purchasing and Supplier Management Principles acting as entry barriers to small manufacturing and parts supplier businesses attempting to enter the Department of Defense aerospace market? The research question was studied by testing the following revised hypotheses:

Ha1: EDI is acting as an entry barrier for small businesses attempting to enter the DoD aerospace parts manufacturing/supplier market.

Ha2: Target costing is acting as an entry barrier for small businesses attempting to enter the DoD aerospace parts manufacturing/supplier market.

Ha3: JIT is acting as an entry barrier for small businesses attempting to enter the DoD aerospace parts manufacturing/supplier market.

Ha4: The supplier's management of inventory at the customer's facility is acting as an entry barrier for small businesses attempting to enter the DoD aerospace parts manufacturing/supplier market.

Ha5: There is a difference in importance among the Lean PSM principles of EDI, target costing, JIT, and the supplier management of inventory at customer's facility for small business parts manufacturing/supplier market entry decisions.

A web-based survey was chosen over a traditional mail survey. "Web-based surveys are conducted to determine the characteristics, behaviors, opinions, and knowledge of a particular population" (How Do, 2002:n. pag.). A web-based survey is relatively inexpensive, produces fast results, and the data can be easily collected in a format readable by statistical software. One possible form of sample bias was avoided by requiring those firms listed in the sampling frame database to have an e-mail address and web access – the sample would not be biased by excluding any firms that do not have e-mail or web access. The web survey was created using *Macromedia Dreamweaver MX*®.

The survey was too long to include as an attachment to an e-mail. In an effort to improve the response rate, the survey was distributed with an invitation e-mail and link to the web survey. In order to keep the survey anonymous, an individual message was sent to each respondent. The e-mail messages described the purpose of the research and contained contact information. (How Do, 2002:n. pag.)

In an effort to gain attention, lend credibility to, and motivate the respondents, the welcome screen of the webpage contained a letter signed by Mr. Joe Diamond, the director of the Air Force's Office of Small and Disadvantaged Business Utilization

(SAF/SB) and sponsor of this research effort. Mr. Diamond's letter gave SAF/SB support for the research project and encouraged the respondent's participation. (Dillman et al, 1999:7) A copy of this letter is attached at Appendix B.

The web survey was designed with the decision-making exercise questions first followed by the demographic questions. "Survey design research demonstrates that respondents will be more likely to complete long surveys and answer honestly if they can begin by answering the core material rather than being distracted by questions that are not pertinent to the reason the survey is being conducted" (Survey Design, 2002:n.pag.).

To make survey completion easier for the respondent, several actions were taken. To reduce the amount of "scrolling" up and down a webpage, each screen contained only one market entry question. Each page contained a link back to the instructions and definitions that would then open in a separate browser. Additionally, each page included a status bar showing the respondent's percentage of completion of the survey. (Dillman et al, 1999:8-12)

The web survey was pretested with 11 graduate acquisition management students and four academic professors. Including academic professors in pretesting and approving the survey increased the content validity of the survey instrument. Relying on the expertise of the thesis committee members and academic professors in order to test content validity can have some limitations. This methodology relies upon the judge's subjective judgment. It has been shown that this approach may be too subjective and imprecise for many scientific purposes (Dooley, 2001: 90). Additionally, according to Dooley, "Items with content validity tend to be obvious in their intent, and items that give away tests may lead to incorrect measurement" (Dooley, 2001: 90). To help control for this possible

limitation, the survey instrument contained explicit and objective scenarios, definitions of the PSM principles, and the differences between the incumbents' level of implementation Comments from the web survey pretest resulted in positive comments and minor recommendations for improvement. The instrument was then slightly modified and approved for release.

Sample

The population for this study was all American small businesses that are currently in or considering entering the DoD aerospace manufacturing and parts supplier market. Because it would be nearly impossible to compile a comprehensive listing of this population, the Small Business Administration's Pro-Net Database was used as a sampling frame.

"Pro-*Net* is an Internet-based database of information on more than 195,000 small, disadvantaged, and women-owned businesses. It is free to federal and state government agencies as well as prime and other contractors seeking small business contractors, subcontractors and/or partnership opportunities. Pro-*Net* is open to all small firms seeking federal, state and private contracts" (What is, 2002:n. pag.). Businesses listed on the Pro-*Net* system can be searched by Standard Industry Codes (SIC), North American Industry Classification System (NAICS), key words, location, quality certifications, business type, ownership race and gender, EDI capability, and other fields as well.

Using the SBA Pro-Net database as the only sampling frame source may have led to some sample bias. This sampling frame may be inherently biased by its nature. Small businesses desiring to conduct business with the Government register in Pro-Net. This

sampling frame may not be a representative sample because those businesses that have previously chosen not to do business with the Government, for whatever reason, may not be listed in the Pro-Net database and included in the sampling frame. Results of a study taken from a sampling frame can only be generalized to that sampling frame and can therefore limit external validity (Dooley, 2001:127). It would have been ideal to include the Thomas Register and Dun & Bradstreet databases in the sampling frame. These databases were subsequently not used due to significant financial and limited time resource requirements to do so.

From the Pro-Net sampling frame, a database of small businesses was compiled using searches containing the keywords "aerospace" and "aircraft" within manufacturing and research and development business types. Some businesses were redundant and multiple listings were removed from the sampling database. In an effort to control for possible sample bias, a question was included in survey instrument that asked if the company was involved in the DoD aerospace manufacturing and parts supplier market. If the company responded that they weren't involved in the DoD aerospace manufacturing and parts supplier market, their survey was not used. As a further means to control for sample bias, questions were included asking if the survey respondent was in fact the individual responsible for making market entry decisions for the company. Because the survey instrument was an aerospace parts manufacturing/supplier market decision-making exercise, if the respondent was not involved in the aerospace parts manufacturing/supplier market or was not the decision maker, their survey was not used.

The Pro-Net keyword search yielded 653 companies. Instead of taking a random sample from the Pro-Net sampling frame of 653 companies, all 653 companies were

included in the sample. The amount of resources required to include all 653 companies or to compile a randomized sample are nearly the identical. Sending the survey to 653 recipients is more likely to result in a larger number of responses or achieved sample size.

Electronic mail notifications containing a link to the survey web page were sent out to all sample recipients. The notification contained language to inform and motivate recipients to respond. A follow-up electronic mail notification was sent out two weeks after the initial notification.

Of the 653 E-mail notifications, 62 were returned as non-deliverable. 591 companies actually received the E-mail notifications. 171 responses were received and resulted in a 28.93 percent response rate. 60 survey responses were found to be unusable because they were either incomplete or because the company's decision maker did not complete the survey. 111 usable surveys were collected and represent a usable response rate of 18.78 percent. As mentioned above, numerous efforts were taken to improve the response rate as much as possible in order to reduce the likelihood of nonresponse bias. A low response rate can result in a case where some people are over-represented and others underrepresented in the sample received, thus creating biased results (Alreck and Settle, 1995: 35). Biased results are not an accurate representation of the sampling frame.

Hypotheses Testing Process

The regression analysis hypotheses testing process was modeled after Stahl and Zimmerer (1984) and Karakaya and Stahl (1989). The repeated measures analysis of variance (ANOVA) testing process was modeled after Keppel and Zedeck (1989) and

Knapp (1985). All statistical calculations were compiled using JMP® Version 4.0.4 and Microsoft Excel® 2002.

Hypotheses 1 Through 4

Hypotheses 1 through 4 were first tested by computing and analyzing regression results. First, each respondent's decisions were regressed after the independent variable treatments were coded as +1 (High) or -1 (Low) to preserve the orthogonality (Stahl and Zimmerer, 1984:373). Response styles reflecting the tendencies to be agreeable, disagreeable or to select the extreme answer options may have occurred in this study (Dooley, 2001: 88). Using the R^2 (explained variability) as a measure of internal consistency and reliability helped address response style bias and identify any "pencil-whipped" responses. Any individual with an R^2 below 0.085 ($\alpha = .05$) was excluded from the data analysis. (Karakaya and Stahl, 1989:84) The R^2 cut-off was determined based upon the distribution of the F statistic. R-square is a function of F-critical (at $\alpha = .05$), the number of independent variables (k), and the sample size (n). A more detailed discussion of this calculation is found at Appendix C. R-square was used rather than R-square adjusted because the number of data points (1632) was significantly more than the number of beta coefficients in the model (McClave et al, 2001:556).

Second, individual and group regressions were then conducted on the revised sample. In order to use linear regression, assumptions must be made about the general form of the random error component. McClave et al states, "The random error component assumptions are that the random error has a normal probability distribution with a mean equal to zero and variance equal to σ^2. Further, we assume that the random errors

associated with any pair of y values are probabilistically independent" (McClave et al, 2001:542). McClave et al further states, "When we apply regression analysis to a set of data, we never know for certain whether these assumptions are satisfied. It is unlikely that these assumptions are ever satisfied exactly in a practical application of regression analysis. Fortunately, experience has shown that least squares regression analysis produces reliable statistical tests, confidence intervals, and prediction intervals as long as the departures from the assumptions are not too great" (McClave et al, 2001:634). JMP® Version 4.0.4 was used to calculate, plot, and conduct the residual analysis to check these assumptions.

Third, the statistical significance of the interactions terms was examined. A model consisting of the four main effects and the six possible two-way interactions was analyzed at the individual and group level. The two-way and higher interactions were analyzed to determine if their inclusion in the study was warranted. Using an alpha of .05, if there was not a significant percentage of significant second order and higher interactions, the analysis will center upon only the first order interactions. If the second order and higher interactions were insignificant, the individual and group regressions were conducted again using only the first order interactions. The number of significant effects for each independent variable consistent with the hypotheses was reported as well as the number of times the significant effects were inconsistent with the hypotheses.

Fourth, the group regression results were used to identify the sample's significant PSM principles. Standardized beta coefficients were computed to allow comparison of the beta coefficients. Negative standardized beta coefficients represent factors that decrease the probability of a decision maker deciding to enter the given market condition.

Significant ($\alpha = .05$) negative standardized beta coefficients were identified as market barriers to entry. Positive standardized beta coefficients represent factors that increase the probability of a decision maker deciding to enter the given market condition. Significant ($\alpha = .05$) positive standardized beta coefficients were identified as conditions that actually encouraged the sample to enter the market.

The results of the regression analysis were then checked by analyzing the repeated measures individual subjects' ANOVA models. The difference between the regression and repeated measures ANOVA lies in the fact that repeated measures ANOVA designs use the mean square associated with the specific treatment-subject interaction as the F-ratio denominator (Knapp, 1985:206). "Under most circumstances, the error terms used to evaluate the significance of treatment effects in within-subjects designs are considerably smaller than those used in corresponding between-subjects designs. With smaller error terms, more treatment effects will be significant, and so the power will be increased" (Keppel and Zedeck, 1989:263).

The first step in conducting the repeated measures ANOVA analysis was to compute the overall ANOVA tables found at Table 3 for each of the four independent variables (Lean PSM factors). The procedure followed and computational formulas for the overall analysis of variance used were taken from Keppel and Zedeck (1989:270). In this method, each main effect is tested while holding the other effects constant.

Table 3 Overall ANOVA Computational Table

Source	Basic Ratio	df	Sum of Squares	MS	F
A	$[A] = (\sum A^2) / s$	a - 1	[A] – [T]	SS_A / df_A	$MS_A / MS_{A \times S}$
S	$[S] = (\sum S^2) / a$	s - 1	[S] – [T]	SS_S / df_S	
A X S	$[Y] = \sum Y^2$	(a-1)(s-1)	[Y] – [A] – [S] + [T]	$SS_{A \times S} / df_{A \times S}$	
Total (T)	$[T] = T^2 / (a)(s)$	(a)(s) - 1	[Y] – [T]		

F statistic values greater than F critical at $\alpha = .025$ represent significant differences in the marginal means of the independent variable's treatment effects. Using an alpha of .025 is a relatively simple and conservative measure to address a within-subjects design assumption violation that the correlations between all possible pairs of treatments are equal. (Keppel and Zedeck, 1989:266)

The last step was to calculate the marginal means for the treatment levels of each independent variable. From the marginal means, the direction (relationship) of each independent variable's impact on the dependent variable (probability of entering the market) can be inferred and compared to the hypothesized direction.

Hypotheses 5

In order to do an analysis of the relative importance of the PSM principles identified as being market entry barriers in making a market entry decision, relative weights were computed. The relative weights were computed from the individual regression results by squaring the standardized beta coefficients and then dividing them by the R-square as follows:

$RW_i = B_i^2 / R^2$, i = 1, 2,……, n

Where: RWi = relative weight for factor i,

Bi = standardized beta coefficient for factor i,

R2 = square of the multiple correlation coefficient.

Source: Hoffman (1960); Stahl and Zimmerer (1984)

Ward (1962) demonstrated that this procedure is meaningful only in the case of an orthogonal design. This procedure produces results in relative weights that sum to 1.0. Multiplying each of the relative weights by 100 makes them sum to 100. Doing so allows researchers to compare the relative importance of the decision cues used in decision making exercises. (Stahl and Zimmerer, 1984:371)

An Analysis of Variance (ANOVA) was conducted on the relative weights to see if there was a significant difference among the included PSM principle variances. If the ANOVA F-test was significant ($\alpha = .05$), a Duncan's Multiple Range Test was conducted to determine the significance among the PSM factors.

Conclusion

This chapter provided the methodology used to test the research question hypotheses. The next chapter provides the data analysis portion and research question hypotheses test results.

IV. Results and Analysis

This chapter contains the results and analysis of the hypotheses tests. Discussion begins with the sample demographic information and continues with the specific hypotheses test results and analysis. The conclusion section contains a summary of the hypotheses test results and compares them to Miller's (2002) findings.

Sample Demographics

Of the 653 E-mail notifications, 62 were returned as non-deliverable. 591 companies actually received the E-mail notifications. 171 survey responses were received and this resulted in a 28.93 percent response rate. 60 survey responses were deemed unusable because they were either incomplete or because the company's decision maker did not complete the survey. 111 usable surveys were collected and represent a usable response rate of 18.78 percent. In analyzing the data, nine additional responses were discarded due to lack of internal consistency and reliability.

The effective sample size was 102. The demographical information from the effective sample follows. All 102 of the respondents were small businesses. The average number of employees for these businesses was about 44. The type and number of small businesses represented are identified in Table 4. Of the 102 small businesses, 37 were woman-owned, 29 were small disadvantaged businesses, 16 were veteran-owned, seven were located in historically underutilized zones (HUBZone) and five were qualified small disadvantaged businesses under section 8(a) of the Small Business Act.

Table 4 Type of Small Business Representation

Type of Small Business	Number	Percentage of Sample
Woman-Owned Business	37	36%
Small Disadvantaged Business	29	28%
Veteran-Owned Business	16	16%
HUBZone	7	7%
SBA Section 8(a)	5	5%

The companies were in business for a varied number of years. The average time was 19 years with a standard deviation of 14.15 years. Table 5 shows the industries the respondents were involved in. Most of the companies (77) were involved in both the commercial and DoD aerospace industries; for these 77 companies, the average proportion was 55 percent devoted to the commercial industry and 45 percent to the DoD aerospace industry. Nine companies dealt specifically with the commercial aerospace industry and 16 companies dealt specifically with the DoD aerospace industry.

Table 5 Industry Representation

Industry	Number	Percentage of Sample
Commercial	9	9%
Department of Defense	16	16%
Both	77	75%

Most of the companies (69) were already in either the DoD or commercial aerospace market. 11 of the companies have been trying for an average of 3.43 years to enter the commercial market and the other 22 companies have been trying for an average of 3.68 years to enter the DoD aerospace market. The decision makers' job titles varied and are

shown in Table 6. The decision makers consisted of 31 presidents, 22 vice presidents, 15 managers, and 11 chief executive officers. The other 23 decision makers were various managerial positions within their company.

Table 6 Decision Makers' Job Titles

Decision Maker Job Title	Number	Percentage of Sample
President	31	30%
Vice President	22	22%
Manager	15	15%
Chief Executive Officer	11	11%
Various Managerial Positions	23	23%
	102	

The average amount of experience that each of the decision makers had in their current position was 14.74 years with a standard deviation of 9.5 years.

Hypotheses 1 through 4

Regression Analysis

The first step in analyzing the data was calculating the individual respondent's R^2 or the explained variability. The descriptive statistics of R^2 for the 111 returned surveys are presented in Table 7. R-square was used as a measure of internal consistency and reliability. Any individual with an R^2 below 0.085 (alpha = .05) was excluded from the analysis. Nine surveys were subsequently removed from the analysis. The descriptive statistics of the R^2 for the 102 usable surveys are presented in Table 8.

Table 7 Summarized Data for the Original Individual Regression Models

R^2				
Mean	Standard Deviation	Minimum Value	Maximum Value	
0.8010505	0.258089274	0.000000	1.000000	n=111

Table 8 Revised Summarized Data for the Individual Regression Models

After Removing Decision Makers w/ $R^2 < .085$ (Removed 9 Decision Makers)				
R^2				
Mean	Standard Deviation	Minimum Value	Maximum Value	
0.830625	0.101591304	0.440000	1.000000	n=102

Considering the number of factors that the respondents had to consider in making their market entry decisions, the R^2 values are quite high. The high R^2 means that a large percentage of the variability in the analysis is explained and that the decision makers were quite consistent in making their decisions.

The statistical significance of the interactions terms was then examined. A model consisting of the four main effects and the six possible two-way interactions was analyzed at the individual and group level. The two-way and higher interactions were analyzed to determine if their inclusion in the study was warranted. Using an alpha of .05, of the 612 possible (102 respondents X 6 two-way interactions) two-way interactions, 37 (approximately 6 percent) were found to be significant at the individual level. Using an alpha of .01, five of the two-way interactions, or .81 percent, were

significant. At the group regression level, none of the second order or higher interactions were significant at either the .05 or .01 alpha levels. Karakaya and Stahl (1989) had approximately 3 percent of their two-way interaction terms being significant ($\alpha = .05$) at the individual level and subsequently focused the rest of their analysis on only the main effects. Because of these low percentages, the remainder of this analysis centered upon only the main effects.

The linear regression assumptions were checked using residual analysis. "Because the assumptions all concern the random error component, the first step is to estimate the random error. Since the actual random error associated with a particular value of y is the difference between the actual y value and its unknown mean, we estimate the error by the difference between the actual y value and the estimated mean. This estimated error is called the regression residual, or simply the residual" (McClave et al, 2001:634).

The assumption that the mean of the probability distribution of the error is zero was and always will be satisfied when performing residual analysis by its very definition. "The mean of the residuals is equal to zero. This property follows from the fact that the sum of the differences between the observed y values and their least squares predicted y values is equal to zero" (McClave et al, 2001:635).

Using an orthogonally designed survey satisfied the assumption that the random errors are independent by its definition. An orthogonal design means that the predictors are independent or that the independent variables convey no information about the other. (Kuehl, 1994:73) This assumption was further confirmed by computing the variance inflation factor (VIF) of each independent variable. Each independent variable's (Lean PSM factor's) VIF was checked via JMP® to ensure the lack of multicollinearity. Each

independent variable had a VIF value of 1.0, meaning that there was no multicollinearity – the predictors are independent.

Computing and displaying a normal quantile plot of the residuals checked the random error normal probability distribution assumption. The normal quantile plot of the residuals is found at Figure 3. The distribution is not a classic normal distribution; however, it is fairly close. This assumption is further met by invoking the Central Limit Theorem. The Central Limit Theorem states that when n is sufficiently large, the sampling distribution will be approximately normal. (McClave et al, 2001:272) "The larger the sample size, the better will be the normal approximation to the sampling distribution" (McClave et al, 2001:272). "For most sample populations, sample sizes of n>= 25 will suffice for the normal approximation to be reasonable" (McClave et al, 2001: 273). This research effort had a sample size of 102 with 1632 observations.

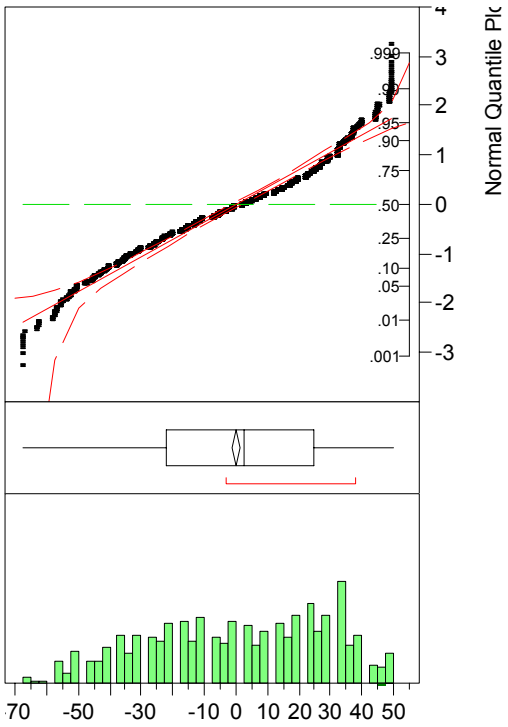

Figure 3 Residual Normal Quantile Plot

The last assumption that the random error has a constant variance was checked via JMP® by conducting and analyzing a residual by row plot. The residual by row plot is found at Figure 4. The variances are equal. There are an equal number of residuals above and below the mean of zero.

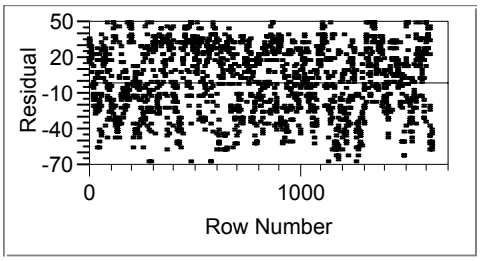

Figure 4 Residual by Row Plot

After checking the linear regression assumptions, the group regression results were used to identify the significant PSM principles. The group regression results are presented in Table 9. The explained variation, R^2, at .048597 is quite low. However, as Karakaya (1987:54) identified when his explained variation values ranged from .03 to .10, this can be explained by the fact that the respondents' decisions are made based upon different conditions. The survey asked the respondent's to answer their probability of entering each market condition based upon their company's existing capabilities and financial condition. It is unlikely that the businesses in the sample had similar capabilities and financial conditions; therefore, the explained variation is relatively low.

Table 9 Group Regression Results of PSM Factors

Factor	Standardized Beta Coefficients	P-Values
EDI	0.002734	0.91
TC*	-0.07551	**0.0018**
JIT	-0.01199	0.6201
SMI*	-0.20675	**<.0001**
R^2	0.048597	
*Significant p<=.05		

Standardized beta coefficients were computed to allow comparison of the beta coefficients. A positive significant factor would indicate that a high level of implementation by the incumbent subcontractors of the particular PSM factor was encouraging a decision maker to enter the market condition. A negative significant factor would indicate that a high level of implementation by the incumbent subcontractors of the particular PSM factor was causing the decision makers' probability of entering to

decrease and therefore acting as a barrier to entry. The Lean PSM principles of target costing and supplier management of inventory at customer's facility had significant negative standardized beta coefficients at $\alpha = .05$ and were therefore acting as market entry deterrents in the sample. The PSM factors of just-in-time and electronic data interchange were not found to be significant predictors among the sample.

Table 10 shows the number of significant effects for each independent variable consistent with the hypotheses and the number of significant effects that were inconsistent with the hypotheses at the individual level.

Table 10 Frequency of Significant Effects Consistent and Inconsistent with Research Hypotheses

Effect	Significant* Effects Consistent with Hypotheses	Significant* Effects Inconsistent with Hypotheses	Total
EDI	26	24	50
TC	**29**	11	40
JIT	19	14	33
SMI	**46**	7	53

*p<=.05

The subjects' judgments relating to TC and SMI were significantly influenced in the hypothesized direction. Out of the 102 subjects in which 40 had TC as a significant factor, 29 (72.5 percent) subjects viewed a high level of TC implementation by incumbent subcontractors as being a market barrier to entry. A high level of TC implementation by the incumbents had a significant negative effect on the decision

makers' probability of entering the market. Out of the 102 subjects in which 53 had SMI as a significant factor, an overwhelming 46 (86.8 percent) viewed a high level of SMI implementation by incumbent subcontractors as being a market barrier to entry. A high level of SMI implementation by the incumbents had a significant negative effect on the decision makers' probability of entering the market.

The subjects' judgments relating to EDI and JIT were not significantly influenced in either the hypothesized or other direction. Of the 102 subjects, 50 viewed the level of EDI implementation by the incumbent subcontractors as being a significant factor. However, 26 (52 percent) viewed a high level of EDI implementation as having a negative effect on the decision makers' probability of entering the market and 24 (48 percent) viewed a high level of EDI implementation by the incumbents as having a positive effect on their probability of entering the market. It appears that the sample is split into two groups – those that have EDI capabilities and those that do not. Of the 102 subjects, 33 viewed the level of JIT implementation by the incumbent subcontractors as being a significant factor. Of these 33, 19 (57.58 percent) viewed a high level of JIT implementation by the incumbent subcontractors as having a negative effect on the decision makers' probability of entering the market and 14 (42.42 percent) viewed a high level of JIT implementation by the incumbent subcontractors as having a positive effect on their probability of entering the market. Again, the sample appears to be somewhat split between those that have JIT capabilities and those that do not.

An analysis of the demographic data was conducted to try to identify any differences between those groups showing EDI and JIT being significantly positive factors and those being significantly negative factors. The demographic areas checked for correlation to

these significant factors included: industry company involved in, length of time company has been in business, respondent job titles, and length of time the companies were trying to enter the market. The analysis did not reveal any identifiable correlation. Ideally, the demographic information collected should have included more detailed questions such as any training the respondent company may have already received. It may be that some respondents had received training in the EDI and JIT areas, while others may not have received training.

Repeated Measures ANOVA

Repeated measures analysis of variance for the combined sample was computed. The individual ANOVA tables for each PSM factor are shown in Tables 11 through 14. A summary of the main effect ANOVA is shown in Table 15. The marginal means for the treatment levels of each independent variable are shown in Table 16. For each independent variable, the directional impact on the dependent measure was as hypothesized – the Lean PSM factors are acting as entry barriers for market entrants. Thus, an independent variable with a HIGH level of implementation by incumbent subcontractors results in a lower probability of entering the market than do LOW levels of implementation.

Table 11 EDI ANOVA Computational Table

Source	Basic Ratio	df	Sum of Squares	MS	F
A	45,073,083.33	1	82.84	82.84	0.00761
S	50,406,250.00	101	5,333,249.51	52,804.45	
A X S	51,506,300.00	101	1,099,967.16	10,890.76	
Total (T)	45,073,000.49	203	6,433,299.51		

P-Value = .931 (α = .025)

Table 12 Target Costing ANOVA Computational Table

Source	Basic Ratio	df	Sum of Squares	MS	F
A	45,136,177.45	1	63,176.96	63,176.96	6.46968
S	50,406,250.00	101	5,333,249.51	52,804.45	
A X S	51,455,700.00	101	986,273.04	9,765.08	
Total (T)	45073000.49	203	6,382,699.51		

P-Value = .012 (α = .025)

Table 13 JIT ANOVA Computational Table

Source	Basic Ratio	df	Sum of Squares	MS	F
A	45,074,593.14	1	1,592.65	1,592.65	0.24050
S	50,406,250.00	101	5,333,249.51	52,804.45	
A X S	51,076,700.00	101	668,857.35	6,622.35	
Total (T)		203	6,003,699.51		

P-Value = .625 (α = .025)

Table 14 SMI ANOVA Computational Table

Source	Basic Ratio	df	Sum of Squares	MS	F
A	45,546,671.57	1	473,671.08	473,671.08	40.44094
S	50,406,250.00	101	5,333,249.51	52,804.45	
A X S	52,062,900.00	101	1,182,978.92	11,712.66	
Total (T)			6,989,899.51		

P-Value = <.0001 (α = .025)

Table 15 Analysis of Variance for Main Effects

Effect	F	P-Value (α = .025)
EDI	0.00761	.931
TC*	**6.46968**	**.012**
JIT	0.2405	.625
SMI*	**40.44094**	**<.0001**

Table 16 Marginal Means for Treatment Levels of Independent Variables

	Treatment Level	
	1	2
	HIGH	LOW
EDI	59.06	59.13
TC*	**56.55**	**60.96**
JIT	58.4	59.11
SMI*	**52.73**	**64.78**

The analysis of variance for the main effects shows that the Lean PSM principles of target costing and supplier management of inventory at customer's facility have a significant difference between their treatment level marginal means. Target costing and supplier management of inventory at the customer's facility have F-statistic values of 6.46968 and 40.44094. Both of these F-statistic values are larger than the F-critical value of 5.2. The F-critical value was found using an alpha of .025. Using an alpha of .025 is a relatively simple and conservative measure to address any within-subjects design assumption that the correlations between all possible pairs of treatments are equal. (Keppel and Zedeck, 1989:266) The marginal means amounts for TC and SMI are consistent with the hypothesized direction meaning that high levels of implementation of TC and SMI by incumbent subcontractors are acting as significant entry barriers at the overall level. The Lean PSM principles of electronic data interchange and just-in-time delivery do not have significant differences in their marginal mean levels and are therefore not acting as entry barriers.

Regression Compared to Repeated Measure ANOVA Results

The results between the regression and repeated measures analysis of variance are consistent. Both identified a high level of TC and SMI implementation by the incumbent subcontractors as having a significant negative effect on the probability a decision maker would enter the market.

Hypotheses 1 Through 4 Test Results

Ha1: EDI is acting as an entry barrier for small businesses attempting to enter the DoD aerospace parts manufacturing/supplier market.

NOT SUPPORTED. In using the regression and repeated measures analysis of variance, there is insufficient evidence to support the hypothesis that electronic data interchange is acting as a market entry barrier. Implementing an EDI system may require additional capital outlays or investments in a computer network, hardware, software, technical expertise and training. As mentioned above, in this sample it appears that there are basically two groups of subjects – those that have EDI capabilities and those that do not. The significance of these two groups are basically negating each other, causing overall insignificance.

Ha2: Target costing is acting as an entry barrier for small businesses attempting to enter the DoD aerospace parts manufacturing/supplier market.

SUPPORTED. In using the regression and repeated measures analysis of variance, there is sufficient evidence to support the hypothesis that target costing is acting as a market entry barrier. It makes sense to suggest that a high level of target costing implementation by incumbent subcontractors is acting as a market entry barrier. Because

target costing requires a high degree of trust, information sharing, and joint problem solving (Monczka et al, 2002:445), incumbents may have a significant advantage in that they have these working relationships already established. Switching from an incumbent to a new entrant may involve customer-switching costs. As further barriers, capital requirements may be needed to implement target costing accounting systems and skilled personnel. All of these issues create cost advantages for the incumbents.

Ha3: JIT is acting as an entry barrier for small businesses attempting to enter the DoD aerospace parts manufacturing/supplier market.

NOT SUPPORTED. In using the regression and repeated measures analysis of variance, there is insufficient evidence to support the hypothesis that just-in-time delivery is acting as a market entry barrier. Implementing JIT may require additional capital outlays or investments in communication/computer equipment, skilled personnel, and training, as well as access to distribution channels. As mentioned above, in this sample it appears that there are basically two groups of subjects – those that have JIT capabilities and those that do not. The significance of these two groups are basically negating each other, causing overall insignificance.

Ha4: The supplier's management of inventory at the customer's facility is acting as an entry barrier for small businesses attempting to enter the DoD aerospace parts manufacturing/supplier market.

SUPPORTED. In using the regression and repeated measures analysis of variance, there is sufficient evidence to support the hypothesis that the supplier's management of inventory at the customer's facility is acting as a market entry barrier. It makes sense that managing a customer's inventory at their facility is acting as a market entry barrier. Managing a customer's inventory at their facility may involve requiring additional

personnel resources, training, and communications systems to name a few. Incumbents may have a significant advantage in that they have these resources available and have already established working relationships with their customers. Thus being able to implement this principle may subject a new entrant to capital, customer switching costs, and incumbent cost advantage market barriers to entry.

Hypotheses 5

In order to do an analysis of the relative importance of the identified PSM principles in making a market entry decision, relative weights were computed. Again, the relative weights were computed from the individual regression results by squaring the standardized beta coefficients and then dividing them by the R^2 as follows:

$RW_i = B_i^2 / R^2$, i = 1, 2,……, n

Where: RWi = relative weight for factor i,

Bi = standardized beta coefficient for factor i,

R2 = square of the multiple correlation coefficient.

This procedure produces results in relative weights that sum to 1.0. Multiplying each of the relative weights by 100 makes them sum to 100. Doing so allows researchers to compare the relative importance of the decision cues used in decision-making exercises. (Stahl and Zimmerer, 1984:) The PSM factors' identified as being entry barriers relative weights are listed in Table 17.

Table 17 PSM Entry Barrier Relative Weights

Average Individual Relative Weights	
PSM Principle	Relative Weight
SMI	57.004
TC	42.996
	100

An Analysis of Variance (ANOVA) was conducted on the relative weights to see if there was a significant difference between TC and SMI's relative weight variances. The ANOVA's F-test yielded a P-value of <.0067 and suggests that there is a significant difference between TC and SMI's relative weight variances.

Because TC and SMI were the only PSM factors identified as being market entry barriers, there was no need to conduct the Duncan's Multiple Range Test. The ANOVA F-test already provided evidence showing that there is a significant difference between TC and SMI's relative weight variances. Although redundant, Duncan's Multiple Range Test was conducted and it verified that there is a significant difference between TC and SMI's relative weights.

> Ha5: There is a difference in importance among the Lean PSM principles of electronic data interchange, target costing, just-in-time delivery, and supplier's management of inventory at the customer's facility for small business parts manufacturing/supplier market entry decisions.

SUPPORTED. There is evidence to support the hypothesis that there is a difference in importance among the two Lean PSM principles identified as being market entry barriers for small business parts manufacturing market entry decisions. The supplier management of inventory at customer's facility relative weight is significantly different than the relative weight of target costing. Table 17 shows the two PSM principles in their

relative weight order of importance. Computing the relative weights allows a comparison of the relative importance of the decision cues used in decision-making exercises. (Stahl and Zimmerer, 1984:371) In this sample, the respondents considered the supplier management of inventory at the customer's facility to be the most important factor in making their market entry decision.

Conclusion

This chapter provided the results and analysis of the hypotheses tests. A summary of the hypotheses test results is found at Table 18. The results of this study appear to be consistent with Miller's (2002) findings. Table 19 is an excerpt taken from Miller's (2002) research found at Table 1.

Table 18 Summary of Hypotheses Test Results

Hypothesis	Test Result
Ha1: EDI	Not Supported
Ha2: TC	**Supported**
Ha3: JIT	Not Supported
Ha4: SMI	**Supported**
Ha5: Difference	**Supported**

Table 19 Miller (2002) Research Table Excerpt

Trend	Company											
	S1	S2	S3	S4	S5	S6	S7	S8	L1	L2	L3	L4
EDI with Suppliers	√		√		√	√	√			√		√
Target Costing	√				√			√	√	√		
Just-in-Time Delivery	√	√	√			√	√			√		√
Supplier Managed Inventory		√				√						

Among the eight small firms that Miller (2002) interviewed, EDI and JIT were the most common Lean PSM principles and had been implemented by five firms. Target costing and supplier-managed inventory were the least common principles and had been implemented by three and two small firms respectively. The occurrences of these Lean PSM principles in Miller's (2002) findings appear to correlate to the results of this study. Target costing and supplier managed inventory were the principles implemented the least in Miller's (2002) study and were found to be market entry barriers in this study. EDI and JIT implementation in Miller's (2002) study were the most commonly implemented principles and were not found to be acting as market entry barriers in this study.

The next chapter provides the conclusions and recommendations for further research.

V. Conclusions and Recommendations

This thesis is a follow-on research effort to that conducted by Mr. Bruce Miller (GAQ-02M) who proposed a connection between the Lean Aerospace Initiative's Purchasing and Supplier Management principles and declining small business participation. Miller (2002) suggested that small aerospace manufacturing/parts supplier businesses will have to be ready to employ lean concepts in order to enter or to remain in the aerospace industry.

The purpose of this research is to determine if the Lean Aerospace Initiative's Purchasing and Supplier Management Principles are acting as entry barriers to small manufacturing and parts supplier businesses attempting to enter the Department of Defense aerospace market. Market entry barriers discourage new entrants into a market, thus providing an advantage to firms already within a market. This advantage or lack of competition can result in higher prices that are paid with taxpayer funds out of dwindling Air Force budgets. If market entry barriers do exist within the aerospace market, efforts can be taken to "level the playing field", increase competition, expand the industrial base, and ultimately make more efficient use of dwindling funds.

A decision making exercise was sent out to a sample of small businesses from the SBA's Pro-Net sampling frame. Both regression and repeated measures analysis of variances were conducted to identify specific PSM principles that are acting as market entry barriers for small businesses attempting to enter the DoD aerospace market.

This chapter addresses this research effort's conclusions, benefits, limitations, and suggestions for future research.

Conclusions

Table 20 provides a summary of the hypotheses test results. A brief discussion of each hypothesis and test result follows.

Table 20 Summary of Hypotheses Test Results

Hypothesis	Test Result
Ha1:	Not Supported
Ha2:	**Supported**
Ha3:	Not Supported
Ha4:	**Supported**
Ha5:	**Supported**

Ha1: EDI is acting as an entry barrier for small businesses attempting to enter the DoD aerospace parts manufacturing/supplier market.

NOT SUPPORTED. In using the regression and repeated measures analysis of variance, there is insufficient evidence to support the hypothesis that electronic data interchange is acting as a market entry barrier.

Ha2: Target costing is acting as an entry barrier for small businesses attempting to enter the DoD aerospace parts manufacturing/supplier market.

SUPPORTED. In using the regression and repeated measures analysis of variance, there is sufficient evidence to support the hypothesis that target costing is acting as a market entry barrier. A high level of target costing implementation by incumbent subcontractors appears to act as a market entry barrier. Because target costing requires a high degree of trust, information sharing, and joint problem solving (Monczka et al, 2002:445), incumbents may have a significant advantage in that they have these working relationships already established. Switching from an incumbent to a new entrant may

involve customer-switching costs. As further barriers, capital requirements may be needed to implement target costing accounting systems and skilled personnel. All of these issues create cost advantages for the incumbents.

> Ha3: JIT is acting as an entry barrier for small businesses attempting to enter the DoD aerospace parts manufacturing/supplier market.

NOT SUPPORTED. In using the regression and repeated measures analysis of variance, there is insufficient evidence to support the hypothesis that just-in-time delivery is acting as a market entry barrier.

> Ha4: The supplier's management of inventory at the customer's facility is acting as an entry barrier for small businesses attempting to enter the DoD aerospace parts manufacturing/supplier market.

SUPPORTED. In using the regression and repeated measures analysis of variance, there is sufficient evidence to support the hypothesis that the supplier's management of inventory at the customer's facility is acting as a market entry barrier. Managing a customer's inventory at their facility may involve requiring additional personnel resources, training, and communications systems to name a few. Incumbents may have a significant advantage in that they have these resources available and have already established working relationships with their customers. Thus being able to implement this principle may subject a new entrant to capital, customer switching costs, and incumbent cost advantage market barriers to entry.

> Ha5: There is a difference in importance among the Lean PSM principles of EDI, target costing, JIT, and supplier's management of inventory at the customer's facility for small business parts manufacturing market entry decisions.

SUPPORTED. There is evidence to support the hypothesis that there is a difference in importance between the two Lean PSM principles identified as being market entry

barriers for small business parts manufacturing market entry decisions. The supplier management of inventory at customer's facility relative weight is significantly different than the relative weight of target costing. In this sample, the respondents considered the supplier management of inventory at the customer's facility to be the most important factor in making their market entry decision.

Benefits and Contributions of Research

This research effort resulted in evidence to support the hypotheses that target costing and supplier management of inventory at the customer's facility are acting as entry barriers for small businesses attempting to enter the DoD aerospace parts supplier/manufacturing market. These findings will be a tremendous source of information for the Air Force Office of Small and Disadvantaged Business Utilization (SAF/SB), small businesses within the Department of Defense aerospace market, the U.S. Air Force and taxpayers.

SAF/SB will directly benefit from this study. As the Air Force's office of primary responsibility for ensuring that small businesses are afforded the maximum practicable opportunity to participate in Federal contracts and subcontracts, SAF/SB, with the results of this study, will be armed with more information and may be able to assist small businesses in obtaining contracts. Based upon the results of this study, SAF/SB has information that may partially explain why small business participation and awards are on the decline. This understanding may assist SAF/SB in making intelligent and informed changes to its policy and procedures in order to help achieve its goals and more importantly increase the amount of small business participation.

Small businesses within the aerospace industry will benefit from this study. Because specific market entry barriers to the aerospace industry have been identified, as mentioned above, SAF/SB may take action to provide training and to assist small businesses in breaking through the barriers and provide the small businesses the maximum practicable opportunities to compete.

The U.S. Air Force and taxpayers may also benefit from this study. Market entry barriers "discourage" new entrants into a market, thus providing an advantage to firms already within a market. This advantage or lack of competition can result in higher prices which are paid with taxpayer funds out of dwindling Air Force budgets. 15 USC § 631(a) states, "The essence of the American economic system of private enterprise is free competition. Only through full and free competition can free markets, free entry into business, and opportunities for the expression and growth of personal initiative and individual judgment be assured. The preservation and expansion of such competition is basic not only to the economic well-being but to the security of this Nation." The identification of specific market entry barriers within the aerospace market, can lead to efforts to "level the playing field", increase competition, expand the industrial base, and ultimately make more efficient use of dwindling funds.

Limitations

The main limitation of this study deals with sample bias. The sample was chosen from the SBA Pro-Net database sampling frame. This sampling frame may be inherently biased by its nature and not be an accurate representation of the population under study. The population is all American small businesses that are currently in or considering

entering the DoD aerospace manufacturing and parts supplier market. Small businesses desiring to conduct business with the Government register in Pro-Net. This sampling frame may not be a representative sample because those businesses that have previously chosen not to do business with the Government, for whatever reason, may not be listed in the Pro-Net database and included in the sampling frame. The amount of small business participation has been on the decline for several years. Those businesses that have previously voluntarily or involuntarily removed themselves from doing business with the government may not have been included in the study. Future research should include the Thomas Register and Dun & Bradstreet databases in the sampling frame. The Thomas Register and Dun & Bradstreet databases are more comprehensive and include companies wishing to do business with both the government and the commercial markets. These databases were not included in this study's sampling frame due to limited time and funding resources. Dooley states that any results of a study taken from a sampling frame can only be generalized to that sampling frame (Dooley, 2001:127). To extrapolate the results of this study to another sampling frame would be risky and may be unreliable.

A second limitation of this study involves order effect. Dooley defines order effect as, "Earlier items may influence the responses to later ones. Order effect may be a significant issue when comparing answers with the same item across different surveys" (Dooley, 2001:136). Although the questions' order and combination of factor treatments was randomized, all of the respondents received the same survey. Ideally, participants would have received different versions of the same instrument with reversed item order. Doing so would have allowed comparisons between the groups to identify

either order effect or any true differences in the samples. (Dooley, 2001:136) A paired t-test was conducted on the responses of questions one through eight and nine through sixteen. The t-test suggested that there was not a significant difference between the responses to the first half and the last half of the questions.

The response style on the survey may lower the validity of this study and is a third limitation. Response styles reflecting the tendencies to be agreeable, disagreeable or to select the extreme answer options may have occurred in this study (Dooley, 2001: 88). "Response style contributes an unwanted but reliable component to test scores, thus tending to lower the validity of a measure. A score consisting largely of response style, in effect, measures the response style instead of the target construct" (Dooley, 2001:88). Using the R-squares (explained variability) as a measure of the decision-maker's internal consistency and reliability and subsequently removing any individual respondent's data with an R-square below 0.085 ($\alpha = .05$) helped control for random responses or "pencil whipping". However, this check does not control for response style.

A fourth limitation is that because a repeated measures design was used, the respondents may have become over-sensitized to the variables under study and may have been able to infer the research hypotheses. Knapp (1985) identified that using a repeated measures design may yield results influenced by experimental demand – that is, subjects attempting to respond cooperatively with the researchers' hypotheses. In this study, the wording of the survey instructions, definitions, and scenarios were worded in as neutral a manner as possible to reduce the probability of any experimental demand.

Fifth, relying on the expertise of the thesis committee members in order to test content validity can have some limitations. This methodology relies upon the judge's

subjective judgment. It has been shown that this approach may be too subjective and imprecise for many scientific purposes (Dooley, 2001: 90). Additionally, according to Dooley, "Items with content validity tend to be obvious in their intent, and items that give away tests may lead to incorrect measurement" (Dooley, 2001: 90).

Lastly, though the respondents were asked to make market entry decisions based upon hypothetical situations, they were not making actual market entry decisions. These responses were from a simulation rather than from actual data and market conditions.

Recommendations for Future Research

Future research should improve on the limitations involved in this research effort. One possible recommendation for future research is to replicate this study and address the sample bias and order effect concerns. The sample could be made more representative of the true population under study by expanding the sampling frame and including other databases, such as Thomas Register and Dun & Bradstreet. Possible order effect bias could be addressed by using different versions of the same survey instrument with reversed item order.

In an effort to make the survey instrument more manageable and increase the response rate, this research effort focused upon four of the nine Lean PSM principles identified by Cook and Graser (2001). Supplier qualification and certification, long-term relationships, communications with suppliers, continuous improvement, and supplier kitting are principles being implemented in the lean aerospace manufacturing environment and were excluded from this study. A potential and important area of

research is to study these five principles and their effects upon small business subcontractors.

The analysis of this research effort's data identified many instances among the individual survey respondents where electronic data interchange and just-in-time delivery were either significant positive or negative factors in making their market entry decisions (Table 7). When electronic data interchange was significant at the individual level, it was a significant positive factor 48 percent of the time and a significant negative factor 52 percent of the time. When just-in-time delivery was significant at the individual level, it was a significant positive factor 42 percent of the time and a significant negative factor 58 percent of the time. Comparing these findings to the demographic information did not yield any potential correlation between the demographical information and the companies' positive and negative significance. A future research effort could further study the principles of EDI and JIT while collecting more detailed and in-depth demographic information such as the training received. The demographic information collected did not identify training that a company had received. It may be possible that companies not having training in EDI and JIT view these principles as market entry deterrents while those companies having training do not.

Based upon the results of this research effort, there is evidence to support the hypotheses that target costing and supplier management of inventory at the customer's facility are acting as entry barriers for small businesses attempting to enter the DoD aerospace parts supplier/manufacturing market. What is being done to help train small businesses in these areas? A potential area for future research would be to study the effectiveness of existing training programs within SAF/SB. Is the Manufacturing

Technology Assistance Pilot Program (MTAPP) providing training in these areas? If so, how MTAPP membership and training affects the ability to compete between small businesses that are members of MTAPP and those that are not members could be examined.

Conclusion

This chapter provided a brief summary of this research effort. Areas addressed included the benefits of this research, the research's limitations, and suggestions for future research.

Appendix A: Survey Instrument

INSTRUCTIONS AND DEFINITIONS

This survey instrument consists of an aerospace parts manufacturing/supplier market entry decision-making exercise. During the exercise, please assume that you are responsible for making market entry decisions for your firm. You will be deciding whether or not to enter the parts manufacturing/supplier market as a subcontractor to a large aerospace firm. This exercise consists of 16 market conditions and corresponding entry decisions. Each market condition consists of four attributes the prime contractor is specifying as being a requirement in making their subcontract award decision. **Each of the four attributes has either a HIGH or a LOW level of implementation by incumbent subcontractors**. The four attributes and their corresponding levels are defined as follows:

Electronic Data Interchange (EDI): The computer-to-computer exchange of common business documents and information. The prime contractor uses EDI as its means of transferring and receiving information and will require any subcontractors to use EDI as well. Be sure to consider the costs to fully implement EDI -- hardware, software, technical expertise, and employee training.

- A "**HIGH**" level of Electronic Data Interchange means that the incumbent subcontractors have already invested in and successfully implemented EDI. Incumbent subcontractors may have a significant advantage in that any new entrants may need to invest in and implement EDI while trying to compete with incumbents.

- A "**LOW**" level of Electronic Data Interchange implies that the incumbent subcontractors generally have neither invested in nor implemented EDI. This situation provides little to no advantage for incumbent subcontractors.

Target Costing (TC): A prime contractor conducts a market analysis to identify the market price for a product. The prime contractor then works backward from the overall price of a product and determines what the individual component or material costs need to be in order to be competitive. The prime contractor then passes the individual component and material costs on to subcontractors that can comply with the identified target costs. The prime contractor intends to award subcontracts to firms that have successfully adopted and implemented the capabilities to enter into target costing with the prime contractor. Target costing requires a high degree of trust and information sharing between the prime contractor and subcontractor. Additional target costing requirements include an adequate accounting (costing) system and skilled personnel.

- A "**HIGH**" level of Target Costing implies that incumbent subcontractors have already invested in and successfully implemented target costing. Incumbent

subcontractors may have a significant advantage in that any new entrants may need to invest in and implement target costing while trying to compete with the incumbents.

- A "**LOW**" level of Target Costing implies that the incumbent subcontractors generally have neither invested in nor implemented any target costing. This situation provides little to no advantage for the incumbent subcontractors.

Just-In-Time Delivery (JIT): JIT delivery is having the capability to provide the right product at the right place at the right time. The supplier delivers a specific quantity of parts to customers when the parts need to be used. The prime contractor is operating in a JIT environment and will require JIT capable subcontractors. A continuous and open two-way communication system, like EDI, skilled personnel, and efficient distribution channels are essential components.

- A "**HIGH**" level of Just-In-Time Delivery means that incumbent subcontractors have already invested in and successfully implemented JIT. Incumbent subcontractors may have a significant advantage in that any new entrants may need to invest in and implement JIT while trying to compete with the incumbents.

- A "**LOW**" level of Just-In-Time Delivery means that the incumbent subcontractors generally have neither invested in nor implemented JIT. This situation provides little to no advantage for the incumbent subcontractors.

Supplier Management of Inventory at Customer's Facility (SMI): Instead of the customer (prime contractor) taking responsibility for materials upon delivery, the supplier (subcontractor) owns and manages its customer's (prime contractor) inventory at the customer's facility. The materials become the customer's when they are actually needed in production or assembly. The prime contractor intends to award subcontracts to firms capable of meeting this requirement. Costs to consider in implementing include any additional personnel, training, and communication systems.

- A "**HIGH**" level of Supplier Management of Inventory at Customer's Facility means that incumbent subcontractors have already invested in and successfully implemented these principles. Incumbent subcontractors may have a significant advantage in that any new entrants may need to invest in and implement supplier management of inventory at customer facility while trying to compete with the incumbents.

- A "**LOW**" level of Supplier Management of Inventory at Customer's Facility means that the incumbent subcontractors generally have neither invested in nor implemented these principles. This situation provides little to no advantage for the incumbent subcontractors.

Your voluntary participation in this study is vital to its success. All survey participants will remain anonymous. Please read each question carefully. **Answer each of the 16 market entry decisions by circling the probability you would recommend market entry based upon your company's current capabilities, financial strength, and the corresponding market conditions.** Questions 17 through 29 are demographic and open-ended questions. There are not any correct answers to any of the questions. Again, please answer the questions like these were actual market conditions facing your business. An example is provided for you on the next page before you start.

EXAMPLE

Please assume that you are making the decision to enter or not enter the market as a subcontractor to a large aerospace firm. Each market condition specifies attributes the prime contractor is requiring in making its subcontract award decision. In each condition and decision, consider your company's current capabilities, financial strength, and any costs necessary for you to implement the required attributes. With the level of the incumbent subcontractors' implementation for these 4 attributes in mind, please indicate the chance you would decide to enter the market. Assume an average profit margin.

MARKET CONDITION

Attribute Required by Prime Contractor	Incumbents' Level of Implementation
Electronic Data Interchange	HIGH
Target Costing	LOW
Just-In-Time Delivery	LOW
Supplier Management of Inventory at Customer's Facility	LOW

Example Decision: Please circle your probability of entering the example market condition.

(No Chance) 0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 100% (Definite)

In this example, the existing subcontractors that you would be competing against have already invested in and successfully implemented Electronic Data Interchange (EDI). Because any new entrants into the market may have to invest in and implement EDI, it is possible that the incumbent subcontractors may enjoy a significant cost advantage over new entrants. This may not always be the case – it is possible for new entrants in the market to have EDI capabilities or the resources readily available to implement EDI and thus neutralize the incumbent advantage. Low levels for Target Costing, Just-In-Time Delivery, and Supplier Management of Inventory at Customer's Facility mean that the incumbent subcontractors have generally not invested in nor fully implemented these attributes. Therefore, the incumbent subcontractors have little to no advantage in these attributes over new market entrants.

The decision maker in the above example condition considers EDI to be somewhat of a market entry barrier for his/her firm. It could be that this decision maker's firm does not currently have EDI capabilities and the costs of implementing EDI (hardware, software, technical expertise, employee training) are somewhat substantial. Because the incumbent subcontractors have already invested in and successfully implemented EDI, they may have a significant cost advantage over new market entrants. Therefore, this decision maker suggested only a 40% chance of entering this particular market condition.

Please note that the example condition and decision are hypothetical and should not influence your decisions in this exercise. Please complete the following 16 market-entry conditions since each is different.

Please assume that you are making the decision to enter or not enter the market as a subcontractor to a large aerospace firm. Each market condition specifies attributes the prime contractor is requiring in making its subcontract award decision. In each condition and decision, consider your company's current capabilities, financial strength, and any costs necessary for you to implement the required attributes. With the level of the incumbent subcontractors' implementation for these 4 attributes in mind, please indicate the chance you would decide to enter the market. Again, remember that the HIGH/LOW level is the level of implementation by incumbent subcontractors that you will be competing against. Assume an average profit margin.

MARKET CONDITION #1

Attribute Required by Prime Contractor	Incumbents' Level of Implementation
Electronic Data Interchange	HIGH
Target Costing	LOW
Just-In-Time Delivery	HIGH
Supplier Management of Inventory at Customer's Facility	HIGH

Decision #1: Please circle the probability of your entering market condition #1.

(No Chance) 0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 100% (Definite)

MARKET CONDITION #2

Attribute Required by Prime Contractor	Incumbents' Level of Implementation
Electronic Data Interchange	LOW
Target Costing	HIGH
Just-In-Time Delivery	HIGH
Supplier Management of Inventory at Customer's Facility	HIGH

Decision #2: Please circle the probability of your entering market condition #2.

(No Chance) 0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 100% (Definite)

MARKET CONDITION #3

Attribute Required by Prime Contractor	Incumbents' Level of Implementation
Electronic Data Interchange	HIGH
Target Costing	LOW
Just-In-Time Delivery	LOW
Supplier Management of Inventory at Customer's Facility	LOW

Decision #3: Please circle the probability of your entering market condition #3.

(No Chance) 0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 100% (Definite)

Please assume that you are making the decision to enter or not enter the market as a subcontractor to a large aerospace firm. Each market condition specifies attributes the prime contractor is requiring in making its subcontract award decision. In each condition and decision, consider your company's current capabilities, financial strength, and any costs necessary for you to implement the required attributes. With the level of the incumbent subcontractors' implementation for these 4 attributes in mind, please indicate the chance you would decide to enter the market. Again, remember that the HIGH/LOW level is the level of implementation by incumbent subcontractors that you will be competing against. Assume an average profit margin.

MARKET CONDITION #4

Attribute Required by Prime Contractor	Incumbents' Level of Implementation
Electronic Data Interchange	LOW
Target Costing	HIGH
Just-In-Time Delivery	LOW
Supplier Management of Inventory at Customer's Facility	HIGH

Decision #4: Please circle the probability of your entering market condition #4.

(No Chance) 0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 100% (Definite)

MARKET CONDITION #5

Attribute Required by Prime Contractor	Incumbents' Level of Implementation
Electronic Data Interchange	LOW
Target Costing	LOW
Just-In-Time Delivery	LOW
Supplier Management of Inventory at Customer's Facility	LOW

Decision #5: Please circle the probability of your entering market condition #5.

(No Chance) 0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 100% (Definite)

MARKET CONDITION #6

Attribute Required by Prime Contractor	Incumbents' Level of Implementation
Electronic Data Interchange	HIGH
Target Costing	HIGH
Just-In-Time Delivery	LOW
Supplier Management of Inventory at Customer's Facility	LOW

Decision #6: Please circle the probability of your entering market condition #6.

(No Chance) 0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 100% (Definite)

Please assume that you are making the decision to enter or not enter the market as a subcontractor to a large aerospace firm. Each market condition specifies attributes the prime contractor is requiring in making its subcontract award decision. In each condition and decision, consider your company's current capabilities, financial strength, and any costs necessary for you to implement the required attributes. With the level of the incumbent subcontractors' implementation for these 4 attributes in mind, please indicate the chance you would decide to enter the market. Again, remember that the HIGH/LOW level is the level of implementation by incumbent subcontractors that you will be competing against. Assume an average profit margin.

MARKET CONDITION #7

Attribute Required by Prime Contractor	Incumbents' Level of Implementation
Electronic Data Interchange	HIGH
Target Costing	LOW
Just-In-Time Delivery	LOW
Supplier Management of Inventory at Customer's Facility	HIGH

Decision #7: Please circle the probability of your entering market condition #7.

(No Chance) 0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 100% (Definite)

MARKET CONDITION #8

Attribute Required by Prime Contractor	Incumbents' Level of Implementation
Electronic Data Interchange	LOW
Target Costing	LOW
Just-In-Time Delivery	LOW
Supplier Management of Inventory at Customer's Facility	HIGH

Decision #8: Please circle the probability of your entering market condition #8.

(No Chance) 0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 100% (Definite)

MARKET CONDITION #9

Attribute Required by Prime Contractor	Incumbents' Level of Implementation
Electronic Data Interchange	LOW
Target Costing	HIGH
Just-In-Time Delivery	HIGH
Supplier Management of Inventory at Customer's Facility	LOW

Decision #9: Please circle the probability of your entering market condition #9.

(No Chance) 0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 100% (Definite)

Please assume that you are making the decision to enter or not enter the market as a subcontractor to a large aerospace firm. Each market condition specifies attributes the prime contractor is requiring in making its subcontract award decision. In each condition and decision, consider your company's current capabilities, financial strength, and any costs necessary for you to implement the required attributes. With the level of the incumbent subcontractors' implementation for these 4 attributes in mind, please indicate the chance you would decide to enter the market. Again, remember that the HIGH/LOW level is the level of implementation by incumbent subcontractors that you will be competing against. Assume an average profit margin.

MARKET CONDITION #10

Attribute Required by Prime Contractor	Incumbents' Level of Implementation
Electronic Data Interchange	HIGH
Target Costing	HIGH
Just-In-Time Delivery	HIGH
Supplier Management of Inventory at Customer's Facility	HIGH

Decision #10: Please circle the probability of your entering market condition #10.

(No Chance) 0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 100% (Definite)

MARKET CONDITION #11

Attribute Required by Prime Contractor	Incumbents' Level of Implementation
Electronic Data Interchange	HIGH
Target Costing	HIGH
Just-In-Time Delivery	LOW
Supplier Management of Inventory at Customer's Facility	HIGH

Decision #11: Please circle the probability of your entering market condition #11.

(No Chance) 0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 100% (Definite)

MARKET CONDITION #12

Attribute Required by Prime Contractor	Incumbents' Level of Implementation
Electronic Data Interchange	HIGH
Target Costing	HIGH
Just-In-Time Delivery	HIGH
Supplier Management of Inventory at Customer's Facility	LOW

Decision #12: Please circle the probability of your entering market condition #12.

(No Chance) 0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 100% (Definite)

Please assume that you are making the decision to enter or not enter the market as a subcontractor to a large aerospace firm. Each market condition specifies attributes the prime contractor is requiring in making its subcontract award decision. In each condition and decision, consider your company's current capabilities, financial strength, and any costs necessary for you to implement the required attributes. With the level of the incumbent subcontractors' implementation for these 4 attributes in mind, please indicate the chance you would decide to enter the market. Again, remember that the HIGH/LOW level is the level of implementation by incumbent subcontractors that you will be competing against. Assume an average profit margin.

MARKET CONDITION #13

Attribute Required by Prime Contractor	Incumbents' Level of Implementation
Electronic Data Interchange	LOW
Target Costing	HIGH
Just-In-Time Delivery	LOW
Supplier Management of Inventory at Customer's Facility	LOW

Decision #13: Please circle the probability of your entering market condition #13.

(No Chance) 0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 100% (Definite)

MARKET CONDITION #14

Attribute Required by Prime Contractor	Incumbents' Level of Implementation
Electronic Data Interchange	LOW
Target Costing	LOW
Just-In-Time Delivery	HIGH
Supplier Management of Inventory at Customer's Facility	HIGH

Decision #14: Please circle the probability of your entering market condition #14.

(No Chance) 0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 100% (Definite)

MARKET CONDITION #15

Attribute Required by Prime Contractor	Incumbents' Level of Implementation
Electronic Data Interchange	LOW
Target Costing	LOW
Just-In-Time Delivery	HIGH
Supplier Management of Inventory at Customer's Facility	LOW

Decision #15: Please circle the probability of your entering market condition #15.

(No Chance) 0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 100% (Definite)

Please assume that you are making the decision to enter or not enter the market as a subcontractor to a large aerospace firm. Each market condition specifies attributes the prime contractor is requiring in making its subcontract award decision. In each condition and decision, consider your company's current capabilities, financial strength, and any costs necessary for you to implement the required attributes. With the level of the incumbent subcontractors' implementation for these 4 attributes in mind, please indicate the chance you would decide to enter the market. Again, remember that the HIGH/LOW level is the level of implementation by incumbent subcontractors that you will be competing against. Assume an average profit margin.

MARKET CONDITION #16

Attribute Required by Prime Contractor	Incumbents' Level of Implementation
Electronic Data Interchange	HIGH
Target Costing	LOW
Just-In-Time Delivery	HIGH
Supplier Management of Inventory at Customer's Facility	LOW

Decision #16: Please circle the probability of your entering market condition #16.

(No Chance) 0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 100% (Definite)

17. Please identify all that apply to your business:

____ Large Business

____ Small Business

____ 8(a)

____ Woman-Owned

____ Small Disadvantaged Business

____ Veteran-Owned

____ Historically Underutilized Zone (HUBZone)

18. Is your company in the aerospace manufacturing industry, parts supplier industry, or both? MANUFACTURING PARTS SUPPLIER BOTH N/A

19. Do you make market entry decisions for your company? YES NO

20. How long has your company been in business?

21. Does your company primarily focus on the commercial aircraft market, the Department of Defense (DoD) market, or both? COMMERCIAL DoD BOTH

If BOTH, please distribute 100 points to indicate the approximate proportion of your company's business allocated to the commercial and DoD aircraft markets.

Commercial _____ DoD_____

22. What does your company primarily produce?

23. How many years of experience do you have in your current position?

24. What is your job title within your business?

25. How many employees work in your business?

26. If not already in the DoD aerospace market, how long has your company been trying to enter this market? (enter 0 if already in the market)

27. If not already in the commercial aerospace market, how long has your company been trying to enter this market? (enter 0 if already in the market)

28. Are you currently or have you previously been involved in any Small Business sponsored program? (such as Manufacturing Technology Assistance Pilot Program - MTAPP, Mentor-Protégé, HUBZone, etc…) YES NO

If YES, please list which program(s): _____

29. What other factors does your company consider in entering either the commercial or the DoD aerospace market?

Thank you very much for your time and effort in completing this survey. All of the information you have provided will remain anonymous. If you would like feedback information or results of this study, I can be contacted at:

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Appendix B: Survey Cover Letter

DEPARTMENT OF THE AIR FORCE
WASHINGTON DC 20330-1000

OFFICE OF THE UNDER SECRETARY

07 OCT 2002

Dear Recipient:

Congratulations on your selection to participate in an Air Force Small Business Office (SAF/SB) sponsored study of small businesses within the Department of Defense Aerospace Industry. You were chosen based on your company's registration in the Small Business Administration's Pro-Net, Thomas Register, or Dun and Bradstreet database. The study is being conducted by the Air Force Institute of Technology.

Your voluntary participation in this study is vital to its success – I highly encourage your participation! This study will potentially help all small businesses and could result in policy changes. It is important that we do all that we can to maintain a vigorous base of small companies that possess the kinds of skills and capabilities that are important to industry, the Air Force, and the nation. Please take the time to carefully complete the web-based survey. We're interested in your candid responses, as your information will be kept in strict confidence.

If you have any questions about the survey or this research project, the principal researcher can be reached at (937) 878-5576 or via e-mail at james.hageman@afit.edu. Your assistance is greatly appreciated and highly valued.

Sincerely,

JOSEPH G. DIAMOND
Director
Air Force Office of Small and
Disadvantaged Business Utilization

Appendix C R-square Cut-Off Calculation

We now from the theory of the General Linear Model that

$$F(R2, n, k) := \frac{\left(\frac{R2}{k}\right)}{\left[\frac{1 - R2}{(n - k - 1)}\right]}$$

thus we can solve for R2 in terms of F

$$R2(F, k, n) := \frac{\left(\frac{R2}{k}\right)}{\left(\frac{1 - R2}{n - k - 1}\right)} = F \text{ solve}, R2 \rightarrow F \cdot \frac{k}{(n - k - 1 + F \cdot k)}$$

Defines R2 in terms of the F statistic...

Now we find a Critical Value of F that meets our criterion for a Level of Significance...

$k := 4$ $n := 111$

Selected Alpha. ..(Blue Shading Below) $\alpha := .05$

$maxF := 6$

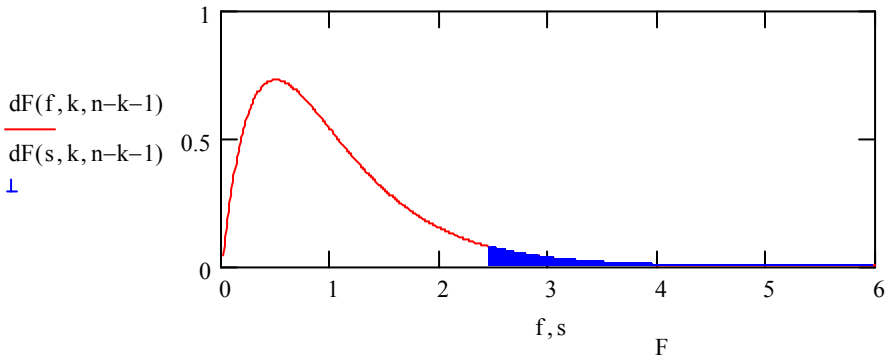
$F_{crit} := qF(1 - \alpha, k, n - k - 1)$

we could use F-star here...

$f := 0.01, .02.. maxF$ $s := F_{crit}, F_{crit} + .001.. maxF$

Achieved α

$$1 - pF(F_{crit}, k, n - k - 1) = 0.05$$



$R2(F_{crit}, k, n) = 0.085$

The R-squared CRITICAL value that is based on the given α and the F-Test to be made when assessing the significance of the MLR.

$\alpha = 0.05$

Created by Professor Daniel E. Reynolds

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Vita

Captain James A. Hageman graduated from Hoven High School, South Dakota in May 1986.

He enlisted in 1988 as a Communications-Computer Systems Operator, attaining the rank of Staff Sergeant during a seven year enlisted career, with assignments at Patrick AFB, Florida; Taif AB, Saudi Arabia; and Hill AFB, Utah. He was decorated for action during Operations DESERT SHIELD and DESERT STORM. He earned Hill AFB Airman of the Quarter Awards, the Airman of the Year, and nomination for AFMC's Airman of the Year. He also garnered the Commandant's Award from Airman Leadership School.

Captain Hageman earned an Associates of Applied Science degree in Information Technology from the Community College of the Air Force in 1995. He accepted a Reserve Officer Training Corps (ROTC) scholarship and graduated with a Bachelor of Science degree in Accounting from Weber State University in 1997. He was commissioned through ROTC in 1997.

He was assigned to the United States Air Force Academy, Colorado and Minot AFB, North Dakota. He was decorated, and won squadron-level CGO of the Quarter and Year Awards. In July 2001, he entered the Graduate School of Engineering and Management, Air Force Institute of Technology. Upon graduation, he will be assigned to Los Angeles AFB, California. Captain Hageman is married and has a son and a daughter.

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14. ABSTRACT

The Small Business Act requires that small business concerns be afforded the maximum practicable opportunity to participate in Federal contracts and subcontracts. The contract dollars awarded to small businesses by the Air Force have been on the decline for several years and the Air Force is not meeting its small business award goals. This thesis is a follow-on research effort to that conducted by Mr. Bruce Miller (GAQ-02M) who proposed a connection between the Lean Aerospace Initiative's (LAI) Purchasing and Supplier Management (PSM) principles and declining small business participation. The purpose of this research is to determine if the LAI's PSM Principles are acting as entry barriers to small manufacturing/parts supplier businesses attempting to enter the DoD aerospace market. Market entry barriers discourage new entrants into a market, thus providing an advantage to firms already within a market. This advantage or lack of competition can result in higher prices which are paid with taxpayer funds out of dwindling Air Force budgets. If market entry barriers do exist, efforts can be taken to "level the playing field", increase competition, expand the industrial base, and ultimately make more efficient use of dwindling funds. A decision-making exercise was sent out to a sample of small businesses. Regression and repeated measures ANOVA analyses were conducted to identify specific PSM principles that are acting as market entry barriers for small businesses attempting to enter the DoD aerospace market. The results of this study may assist SAF/SB in shaping its training programs and in making intelligent and informed changes to its policy and procedures. These changes may help SAF/SB achieve its goals and more importantly increase the amount of small business participation.

15. SUBJECT TERMS

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