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A Market Reaction to DoD Contact Delay

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THESIS

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Abstract

Development projects are occurring at a faster rate in the civilian world than for the Department of Defense (DoD). In the civilian world, faster development means quicker delivery and sales. In the DoD, quicker product development equates to a more capable warfighter. On average, DoD Acquisition Category One (ACAT I) development projects are approaching a 15 year procurement cycle. In the last three years, acquisition cycle time has grown nearly 20 percent. It turns out that the very companies that have learned to be faster, leaner and more effective in their civilian endeavors do not seem to be functioning the same on their DoD contracts. The impact to the tax payer, the warfighter and national security are the impetus for this research. This research examines the heretofore uninvestigated relationship between DoD delay and its impact on shareholder wealth. The results show positive generation of significant wealth for shareholders at the announcement of a DoD delay. This finding indicates a possible systemic incentive for the observed delays. At the very least, the generation of significant wealth for the owners of the firm does not dissuade firms from delay.

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Dedication

This work is dedicated to my wife who has supported my career for over 17 years.

Acknowledgements

I would like to express my sincere thanks to Major Sonia Leach and Major Jeff Smith without whom this would not have been possible. Thank you for the patience and mentorship in the finer points of economics and stats in the pursuit of a unique undertaking.

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Robert Carden

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Chapter 1

Introduction

Over the past 40 years, there has been a steady increase in the time it takes an acquisition program to produce a weapon system for the warfighter. McNutt (1998) described the magnitude of this problem by considering the history of acquisition cycle time of acquisition category I (ACAT I) programs. The data showed that in 1965, the average ACAT I program took 60 months (McNutt, 1998). By 1994, the average ACAT I program had extended to over 108 months (McNutt, 1998). In 1986 the Packard Commission warned of unreasonably long acquisition cycles, ten to fifteen years, as having negative impact on national security. The RAND Corporation performed the study *An Analysis of Weapon System Cost Growth* in 1993, and found that the trend had not diminished (Drezner, Jarvaise, Hess, Hough, & Norton, 1993).

The most up-to-date reviews of large weapon system acquisitions are accomplished annually by the Government Accountability Office (GAO, 2003, 2004, 2005). The GAO defines acquisition cycle time from the point of approval to initial operating capability (IOC). Delay is defined as an extension to the originally predicted cycle time. For standardization these definitions have been adopted for this research. In 2005, the GAO found that over the last three years, programs have increased their cycle time from 147 to 175 months, nearly 20 percent. Figure 1 shows that McNutt's predicted growth in cycle for 2000-2004 falls well short of the actual GAO data reported in 2005. Table 1 summarizes the cost and schedule growth of programs reviewed by GAO.

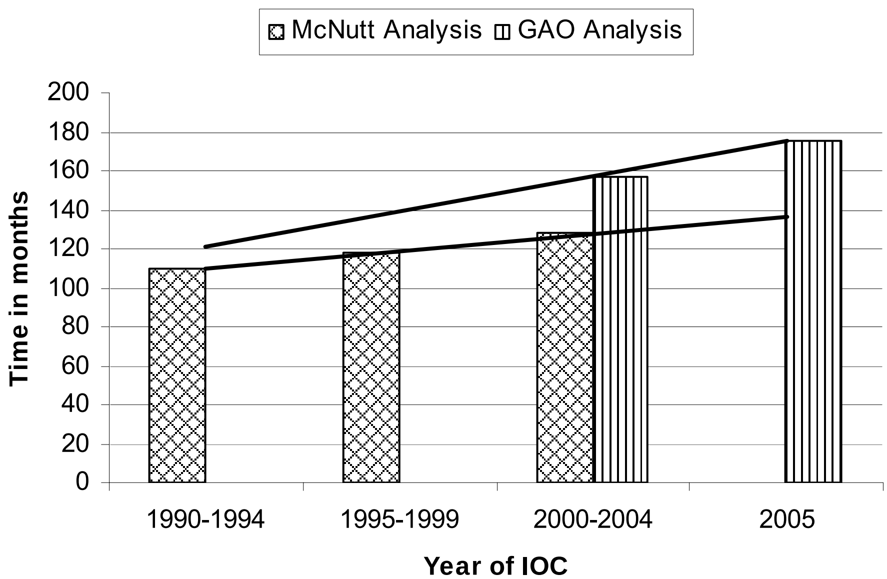

Figure 1. Comparison of Growth: McNutt (1998) prediction vs. GAO (2005) findings

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Table 1. Growth of the 26 Continuous Programs in the GAO (2005) Study

	2003	2005	% Change
Total Cost	$479.60	$548.90	14.5
RDT&E Cost	$102.00	$144.70	41.9
Acquisition Cycle Time	146.6 mo	175.3 mo	19.6

The Problem

The companies identified as having the largest cycle time growth, or delay, on DoD contracts, have also been lauded for their ability to develop and deliver products to their commercial customers faster, better, cheaper. Boeing, Pratt and Whitney (P&W), and Northrop Grumman have all been cited as industry examples for cycle time improvement but exhibit dichotomous behavior on their DoD work. For example, Boeing designed and built the 777 in six years, yet it took nearly 20 years to build the C-17 (Battershell, 1999). P&W's commercial engine division reduced cost by 35 percent and production time from eighteen to six months for airline industry customers (Womack & Jones, 1996). P&W also designed, built, and entered full rate production of the GP7200 engine for the A380 Airbus in less than 5 years (P&W, 2005). The engines for the F-22 developed by P&W at the same facility, however took more than 12 years for the development phase (Global Security. org, 2005; “Aeropropulsion Testing”, 1996).

Motivation

This research investigates a possible motivation for this behavior by examining the relationship between DoD contractual delay and the stock price of the company using event study methodology. The motivation for this research is twofold. At the most basic level, the taxpayers bear the burden for an extended acquisition process. It is reasonable for taxpayers to have an expectation that these companies should perform similarly in their government contracts as they do in their civilian programs. It is also reasonable for the warfighter to expect a product that provides the required capability in a time frame relevant to the threats. Defense acquisition professionals have voiced concerns at the highest levels. Paul Kaminski, Undersecretary of Defense for Acquisition and Technology, summed up the issue in 1995 when he addressed the Senate:

> The Department of Defense cannot afford a 15-year acquisition cycle time when the comparable commercial turnover is every 3 to 4 years. The issue is not only cost. The lives of our soldiers, sailors, marines, and airmen may depend upon shortened acquisition cycle times as well. In a global market, everyone, including our potential adversaries, will gain increasing access to the same commercial technology base. The military advantage goes to the nation who has the best cycle time.

Hypothesis

The hypothesis of this research is that there is a significant market reaction to delay that is represented in the market returns on given companies stock. By viewing this relationship in terms of the open market, it may be possible to identify systemic motivators that may contribute to extended cycle times on DoD contracts. By examining the corresponding market reaction to an announced contract delay, the valuation of the event by the stockholders can be examined.

Chapter 2

The Realm of Research Conducted

The hypothesis that contract delay does or does not impact stock prices contains several supporting topics that must be investigated to gain a full understanding of the topic at hand. A review of current cycle time and production literature, contracting, and event study methodology must be performed to allow development of a methodology and empirical test of the hypothesis.

Cycle Time: Identification of the Problem

Research accomplished by the two American leading cycle time and production schools, MIT's Lean Aerospace Initiative (LAI) and Harvard's Business Process Reengineering (BPR), provides an outstanding resource of success stories of companies in the civilian sector. Comparison of their reported outstanding civilian behavior to the negative behavior identified in GAO reports provided validation that a problem actually exists.

The trend in civilian cycle times in many industries is getting shorter and shorter. According to Wheelwright and Clark (1992), auto manufacturers, electronics firms, furniture makers, and aircraft manufacturers have all moved towards shorter production cycles. Wheelwright, similar to the GAO, defines the production cycle as the time it takes to design, develop and produce a new product for the customer (1992). Wheelwright and Clarks' assertion is that for companies to be competitive in a world of faster production cycles, they must reduce production cycle times. This has been described as a form of commercial Darwinism, where only the fastest survive (Armstrong, 2002). In their book, *Revolutionizing Product Development*, Wheelwright and Clark highlight several industries where companies have been forced to respond to faster production cycle times within their markets. This competition within industries has driven the automobile industry to reduce its production cycle from six years to less than two (Wheelwright & Clark, 1992). The electronics industry production cycle has dropped from two years to less than one (Wheelwright & Clark, 1992). The commercial aircraft industry has moved to match Boeings benchmark of six years set with their development and rollout of the 777 (Battershell, 1999).

The issue, and the point of this research, arises when this performance is compared to the performance of the same companies in their DoD endeavors. P&W is used as an exemplary case for the civilian work in a case study by Womack and Jones in their book *Lean Thinking.* Boeing has received the prestigious Malcolm Baldridge Award for their commercial Aerospace Support Division (Kosko, 2003). Northrop Grumman has won the prestigious Frost and Sullivan Award for their delivery of information systems and service (Jones, 2005). Within their DoD contracts however, these companies have yet to complete a project in the GAO study on their original schedules. In fact, they have delayed, and in many cases, stopped providing estimates for interim operating capacity (IOC) to the GAO. The Advanced Seal Delivery System (ASDS), for example, has no estimated delivery date after nearly eight years in development (GAO, 2005)

This review categorizes the literature on delay into two points of view: commercial and government. While the problems these two camps point out are certainly real, non-trivial issues that may result in delay, they appear to be aimed at the individual processes without considering any larger systemic issues. There are numerous theories, strategies and solutions aimed at improving cycle time. Libraries of business improvement methods exist considering things like management strategy (Clark & Takahiro, 1989, 1991; Wheelwright & Clark, 1992) and production capacity (Womack & Jones, 1996) or lack thereof, and even contract methodologies

(Anand & Gutierrez, 2005; Durbin, 1996; Natarajan, Sethuraman, & Surysekar 2005; Segal & Whinston 2003)

The government has, in many cases, attempted to adapt these theories to fit within the government system, but as the GAO data shows, program acquisition cycle time is still growing. Authors who are focused on the DoD side of cycle time point to the bureaucracy and the requirements for doing business with the government as the issue (Battershell, 1999). Requirements definition and changes (GAO, 2003) and program management issues (McNutt, 1998; Follmer, 1990; Boyd & Mundt, 1993; Wandlund & Wickman, 1993; Buchfeller, 1994; GAO, 2005) are implicated as reasons for the current state of the acquisitions cycle time.

While all of these are valid issues, they tend to view the problem from the point of view of traditional business models and disciplines. While it is clear that a problem exists, researchers, managers and policy makers appear to be trying to fix the system from within. This strategy has simply proved ineffective over the last 40 years. Stepping back and looking at the issue from a system level to identify possible systemic causes of delay has either received little attention or no one has chosen to publish their work. By looking at the problem from the systems point of view, at the level where the DoD is the principle and the firm is the agent, potential problems with the nature of the system can be investigated. While the GAO and others have said that acquisition cycle time is a problem, a measure of the firms activity with regard to delay should be developed. The value of the firm by its owner is a good proxy for their perspective. While the government considers contractual delay a problem, if stock prices react significantly to delay, the voice of the owners is reflected.

Contracting: The State of the System

It is impossible to answer any question as to the value of an activity occurring in a DoD contractual system without a basic understanding of the landscape in which the contractual relationship occurs. The level at which this research focuses is the market level, where the system is simplistic in its mechanism and well described in both classic and popular literature.

General Contracts

At the system level, the contract is a problem described by economists and lawyers as the principle-agent problem. It is an agreement between a principle or buyer, and the agent, or seller, for a good or service. This relationship is compounded by moral hazard and asymmetric information (Lafont & Tirole, 1993; Tirole, 2001; McAfee & McMillan, 1988). In this situation, the agent has information concerning the true cost of production and the principle uses contract types to screen agents and arrive at the optimal contract (Dewatripont & Maskin, 1995).

Bajari and Tadelis (2001) referred to this view of the relationship as mechanistic, in which the control of ex-ante information asymmetry is the concern in achieving the optimal contract. A different view exists and is supported in popular literature approaching the optimal contract problem from a risk and change point of view. The premise is that asymmetric information, while possibly present at the start of the contract, is not the prime concern in obtaining optimal contract type (Lee, 2001; McAfee & McMillian, 1987; Bajari & Tadelis, 2001). Other authors have identified that in a world of incentive contracts, uncertainty is the potential prime regulator for optimal contract type and that other mechanisms exist to deal with asymmetric information once the contract is under way (Bajari & Tadelis, 2001; McAfee & McMillian, 1987). Uncertainty at the outset, (product design, ultimate cost, regulatory issues, funding etc.) may drive lower initial contract costs, but increase the costs through renegotiation and may provide the agent asymmetric information advantage in the relationship.

Since the focus of this research is weapon system acquisitions, which are deliverable goods, service contracts will not be mentioned. For this research, only DoD relationships with publicly traded companies are considered. No effort has been made nor is evidence presented attempting to investigate whether non-profit or government agencies are experiencing the observed behavior.

DoD Contracts

Several researchers have cited that the government may choose incentive contracts for several reasons: ease of management (Lee, 2001), risk aversion by the agent (), ambiguity aversion by both (Mukerji 2003), and funding constraints (Battershell, 1999).

To understand the principles and guidance presented to contracts agents in the DoD, the Federal Acquisition Regulation (FAR) was reviewed. Contract types are described in the FAR and prescribed primarily according to DoD risk and specificity of the Government requirement. This approach seeks to prescribe an optimal contract type to an endeavor based on contractor risk level balanced with cost to the DoD. The two categories of contracts specifically outlined in the FAR are the Cost Reimbursable (CR) and Fixed Price (FP) type contracts. Within each category there are variations for a number of different conditions. These two types represent the end points of the contract continuum. At one end, high risk efforts are generally CR, where DoD risk in the program is high, the agents profit is relatively low. At the other end of the scale are FP type contracts, where the DoD's risk is low and the agent's potential for profit is high. In between these two extremes, the FAR identifies the continuum of FP and CR based contracts as incentive contracts. The incentives are tailored according to risk to fit the program. Incentive contracts may be of either type, CR or FP and their differentiation is the tailoring of the incentive structures.

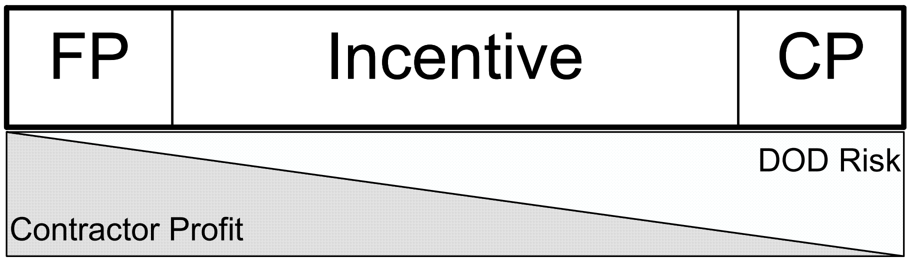

Figure 2. Contract type: risk vs. profit continuum.

The FAR prescribes the use of pure FP and CR contracts to a very specific set of conditions which do not lend themselves to weapon systems (FAR, part 16, 2005). Appropriately, there are very few strictly FP or CP contracts for major weapon systems acquisition within DoD (FAR, 2005; Bakkila, 1996; GAO, 1987). While there are minor differences between the two, the method of establishing the total cost and the agent's profit are very similar. Incentive type contracts use the agent's fair and reasonable estimate of the cost and then apply a formula or rate to determine profit or fee for the agent (FAR part16, 2005). The incentives used by the DoD are classified as cost, schedule or performance (FAR 16.402, 2005). A cost incentive is intended to motivate the agent to maximize cost control methods or minimize cost growth cost saving measures through the possibility of sharing in the cost savings (FAR 16.402.1, 2005). Schedule incentives provide a premium to the agent if schedule expectations are exceeded (FAR 16.402.3, 2005). Performance incentives provide the agent the ability to increase profit based on exceeding the minimum performance requirements of the contract (FAR 16.402.2, 2005).

Constraints on the DoD Contractor Relationship

While the GAO has shown that incentive contracts are somewhat effective, contracting under incentive methodology bears little on the ultimate performance of the contract once let (GAO, 1987). This is due to the landscape for government contracting being dominated by a lack of defined quality (Lee, 2001; Bajari & Tadelis, 2001) and Congressional Budget Authority (Title 31, US Code 1301). The term quality used in the popular contracting literature is not used as a damnation of products procured, but is simply a description of a system that enters a contractual agreement without the specifications of the product fully agreed to. This is the very nature of weapons system acquisition where products are actually developed during the acquisition program. The second factor, Congressional Budget Authority, is derived from the Constitution and is enforced by the Anti-deficiency Act, Title 31, US Code 1301 which states:

(1) An officer or employee of the United States Government or of the District of Columbia government may not—

(A) make or authorize an expenditure or obligation exceeding an amount available in an appropriation or fund for the expenditure or obligation;

(B) involve either government in a contract or obligation for the payment of money before an appropriation is made unless authorized by law;

(C) make or authorize an expenditure or obligation of funds required to be sequestered under section 252 of the Balanced Budget and Emergency Deficit Control Act of 1985; or

(D) involve either government in a contract or obligation for the payment of money required to be sequestered under section 252 of the Balanced Budget and Emergency Deficit Control Act of 1985.

The impact of the Anti-deficiency Act is that when Congressional appropriations are reduced, the programs' budget in the given year is also reduced. This leads to the conditions precisely spelled out by Lee (2001), where he identifies the issue based on information and commitment. The principle therefore cannot commit to a price since Congressional budget is not a fixed quantity and may be altered. The agent cannot commit to the quality of the product, specs, type, quantity and or performance, because they are subject to change as the procurement develops. The system essentially comprises a series of continually renegotiated contracts. Lee (2001) points out that as each of these de-facto short term contracts are renegotiated, the base price upon which profit is calculated, increases. Guesnerie and Tirole (1985) termed this upward escalation and reluctance to terminate government contracts as the "ratchet effect." In their description of the phenomenon, the motivation for continuance was reluctance to admit failure, difficulty in re-allocating funds and budgetary constraints of approval for any new contract. Commensurate with Guesnerie, Tirole and Lee's theories, the contract, once let, tends to have a life of its own. The government commits to short term dollars and the contractor commits to achievable quality within that limit and expends a commensurate amount of effort.

The Impact

The impact of this ongoing situation is that as changes occur, the contract is modified. In this environment, modifications of the budget or quality are reflected in the ultimate price or fee structure of the contract. Total price, or ceiling, is relevant to the question of profit when the price is reasonably based on equivalency of information between the agent and the principle (GAO, 1987). The total cost is now a function of effort expended within the allocated budget, regardless of initial contract type. The C-17, F-22, and F-35 all experienced delays which extended the period of performance, essentially providing a longer expectation of revenue for the firm. The agents, potentially aware of the situation and generally risk averse are willing to take the smaller profit margins at the outset of the contract with the knowledge that in all likelihood, it will extend.

Event Studies: Empirical Analysis of the Current State

To develop a methodology to quantitatively assess the impact of contractual delay on the firm, event study literature was reviewed. This area of economics is well documented and methods for conducting event studies have been tested extensively. Fama, Fischer, Jensen, and Roll laid the foundations of this methodology in their 1969 International Economic Review article *The Adjustment of Stock Prices to New Information*. Brown and Warner's 1980 paper presented in the *Journal of Economics, Measuring Security Price Performance*, tests, updates the methodology, and identifies the power of applicable models. Their later work in the 1984 Journal of Financial Economics Article, *Using Daily Stock Returns, The Case of Event Studies*, further validated the methodology and its use in the evaluation of daily stock returns for event studies.

Review of the state and evolving applications of the event study as an empirical tool was also performed. This review finds a large number of authors using the methodology to assess the impact of events on firms in areas such as intellectual property (Pearsall, 2002), and brand value (Mitchell, 1989). Major events have also been evaluated using the methodology: airline crashes (Chalk, 1987; Chance & Ferris, 1987); news announcements (Campbell, Andrew, & MacKinlay, 1996); corporate malfeasance (Bizjak & Coles, 1995; Bosch & Woodrow, 1991); and lawsuits (Bhagat, Bizjak, & Coles, 1998). Development and guidance of the specific methodology used in this research was also influenced by the work of Small and Jeff (2006) in their working paper, *The Hot Stock Tip from Debbie: Implications for Market Efficiency*.

Event study methodology was developed to test market efficiency and therefore cannot be divorced from it, or used without at least a basic understanding of market efficiency and its implications. Any review would not be complete without considering Eugene Fama's work substantiating market efficiencies (Fama, 1969, 1970, 1991, 1998). Market efficiency is described as the relationship between information and share prices in capital markets and the speed at which those markets reflect the information (Poshakwale, 1996). Fama categorized the efficiency of capital markets based on the relationship of information and stock price. In his work, Fama describes the weak efficiency relationship as one where the current price of a security fully reflects all the information contained in the historical prices of the security. A semi strong relationship is one where security prices instantaneously reflect new publicly available information. Finally, the strong relationship is one where information, public or private, is reflected in the stock price. The implication of this information-price relationship is that in an efficient market, prices of securities reflect the expected returns and risks based on the information that is known. Based on the efficient market theory, the ability to identify and earn higher than expected returns on undervalued securities, given their level of risk, is removed. Inefficient markets, on the other hand, would allow the ability to choose a security that could provide returns higher than that which is commensurate with the securities risk.

The assumption that markets are efficient allows the event study methodology to be useful. Market efficiency allows the development of models to measure the impact of an event on the firms affected. Brown and Warner's (1980, 1984) tests of various models on daily and monthly returns provide researchers a range of tools to assess the impact of an event on the returns of a firm. Brown and Warner (1984) showed that the common models (returns, mean adjusted returns, market adjusted returns and the market model) were all shown to be comparable in their ability to accurately identify the impact of an event on the stock.

Chapter 3

The hypothesis of this research is that DoD contractual delay significantly impacts the wealth of shareholders. Event study methodology provides a tool for the formation of the empirical test and hypothesis. Event studies estimate the abnormal returns (*AR*) associated with a distinct market event and compare them to the actual realized returns (*R*) of a firm (*i*) at the time of the event (*t*). This comparison allows a researcher to evaluate the impact of the event on the value of the stock. The hypothesis to test the theory that delay on government contracts has an impact on the value of the firm to the stockholders is:

H_o: Contract delay does not significantly impact the returns of the firm,

$$(AR_{it}=0_t)$$

H_a: Contract delay significantly impacts the returns of the firm,

$$(AR_{it}\neq 0_t)$$

Event studies utilize analysis of two periods of time to assess the impact of an event on the firm's returns (Fama et al, 1969). To do this, a period prior to the event, referred to as the estimation period, is used to estimate the relationship between a firms returns and the market. This relationship is used to estimate the normal returns of the firm surrounding the event, referred to as the event period. The Market Adjusted Returns model used in this research, estimates the event period returns with regards to the market at large without the event. Utilizing some applicable market benchmark such as the S&P 500, the Dow Jones Industrial Average, or the Russell 3000, a researcher is able to perform a regression that estimates the relationship between the market and the return of the firm in question. In utilizing the market returns model, the variance that is related to the greater market is reduced in the estimation of normal returns. The general market returns model utilized in the current literature is given in Equation (1):

$$\overline{R}_{it} = \alpha_i + \beta_i R_{mt} \qquad (1)$$

where,

$\overline{R}_{it}$ is the return for a given stock *(i)* at a specified time *(t)*

R_{mt} is the return for the given market index *(m)* at a specified time *(t)*

Regression is used to estimate the α_i and β_i parameters with the chosen market index as the independent variable and the firm's returns as the dependant variables. In doing so, normal post event returns (R_{it}) post event can be estimated to establish what normal returns would have been had the event had not occurred.

To determine if the actual post event returns are truly significant, they must be compared to the estimates of normal returns. This is done utilizing Equation (2),

$$AR_{it} = R_{it} - \left(\alpha_i + \beta_i R_{mt}\right) \qquad (2)$$

where,

AR_{it} is the abnormal return at a specified time *(t)*

R_{it} is the actual return of the given stock at the specified time *(t)*

$\alpha_i + \beta_i R_{mt}$ is the expected normal return with regard to the market returns at a specified time (t)

To test the null hypothesis, the cumulative abnormal returns (CARs) are summed for the post event period and tested to determine significance. Since theory predicts that in rational and efficient markets CARs ultimately sum to zero over time, any values significantly different from zero during the post event period are indicative of the events impact. Equation (3) determines the significance of the abnormal return by dividing it by the estimated standard deviation. To calculate that significance value Equations (4), (5) and (6) are utilized to calculate average car for the event period, standard deviation for the observation period and average abnormal return for the observation period.

$$\overline{A_t} / \widehat{S}(\overline{A_t}) \tag{3}$$

where,

$$\overline{A_t} = \frac{1}{N_t} \sum_{i=1}^{N_t} A_{i,t} \tag{4}$$

$$\widehat{S}(\overline{A_t}) = \sqrt{\frac{\left(\sum_{t=-210}^{t=-30} \left(\overline{A} - \overline{\overline{A}} \right)^2 \right)}{180}} \tag{5}$$

$$\overline{\overline{A}} = \frac{1}{181} \sum_{t=-210}^{t=-30} \overline{A_t} \tag{6}$$

While the methodology of an event study is mainly prescribed, there are several factors and considerations that must be taken into account when attempting its application, such as firm selection criteria, event determination, stock and index information and model parameters.

Determine the Selection Criteria of a Firm

For this research, the firms of Boeing traded, in the New York Stock exchange as BA, and Sikorsky, traded as UTX, were chosen from the list of those performing as prime contractors on ACAT I programs. United Technologies stock information was utilized since Sikorsky is a wholly owned subsidiary. The program chosen was the Comanche Helicopter for the availability of data and the ability to definitively identify its delay event. This event provides a unique opportunity to test the hypothesis since the impact of the same event can be studied with regard to the separate companies.

Determine the Event

The hypothesis that government contract delay influences stock price identifies the type of event to capture. In the current literature, publicly released information concerning a specific event is utilized to establish the event date in regards to a given firm. Publicly released information containing specific information about contract delay within the chosen acquisition program was compiled to determine the specific event horizon and allow testing using the prescribed analysis. Securities and Exchange Commission filings, newswire releases, journals, and non-classified government reports were used, since all are readily available to the general investor and published within a relevant time frame to the event. The delay chosen was the 18 April 2002 announcement by the Department of the Army that the period of performance (POP) for the Comanche Program was extended by five years.

Collect the Stock and Index Information for Analysis

For this study, the Daily Market Adjusted Returns model was used as specified by Brown and Warner (1984) to ensure that any resulting abnormal returns are event driven and not simply an effect of the larger market. The S&P 500 was chosen as the representative index for the larger market since Boeing and United Technologies are both listed in that index. All stock and S&P 500 data was gathered from the Yahoo!Finances database. The range of data gathered for the analysis was for 210 days prior to the event, 12 June 2001, to 21 days after the event, 17 May 2002. The closing price for each company and the index for each day were collected.

Run the Model

The data was downloaded into Microsoft Excel and daily returns were calculated for the S&P index, Boeing and UTX. The regression for the estimation of α and β was based on 181 samples, taken 30 days prior to the event horizon (n=181, (t-30)-(t-210)). The observation period of 180 days was chosen because it represents two business quarters of data and falls within the periods previously used in popular event studies. The time frame chosen for analysis of CARs varies highly within the literature as well as rational for the chosen length of the period. This research, undertaken as a case study, seeks to identify trends over time relevant to the delay event, so a rather lengthy daily returns event window was chosen. While 21 days is not unprecedented, it is at the high end of daily driven event studies. Popular news was checked for the dates within the event window to ensure that other events where not impacting the results of the study. This review showed a lack of news reported for either company that would have influenced the results of the event. While other authors use a large range of estimation periods, Brown and Warner identified that the period of observation for the regression made little difference in the power of the Market Adjusted Returns model (1984).

Chapter 4

The methodology previously described was used to identify abnormal returns for both Boeing and Sikorsky from the announcement of the delay 18 April 2002, to the end of the chosen event period, 17 May 2002. Table 3 summarizes the descriptive statistics for the regression variables for each company.

Table 2. Descriptive Statistics of Boeing and United Technologies Regressions

Dependant Variable Independent Variable	BA S&P 500	UTX S&P 500
Estimate of α	-0.001	0.001
Estimate of β	1.412	1.616
R^2	0.367	0.427
Standard Error	0.022	0.023

The regressions resulted in a high R^2 value, with similar studies reporting between .19 and .4 (Bhagat, Bizjak & Coles, 1998; Pearsall, 2002). This can be explained by the use of an index in which the dependent variables stocks also traded. The research literature has a wide range of R^2 values from as low as .19 to as high as .80 for indexes created for their specific studies. The estimates of α and β are also similar in value to those found in the literature.

Table 3 shows the abnormal returns of the event period summed to provide cumulative abnormal returns. The cumulative abnormal returns tested for significance using Equation (3).

Table 3. Cumulative Abnormal Returns and Significance for Boeing and United Technologies

ET	Date	BA CAR	T-Stat	UTX CAR	T-Stat
0	18-Apr-02	-0.034	-1.534	-0.035	-1.535
1	19-Apr-02	-0.056	-2.523**	-0.011	-0.496
2	22-Apr-02	-0.025	-1.117	0.025	1.08
3	23-Apr-02	-0.031	-1.366	0.027	1.177
4	24-Apr-02	-0.022	-0.099	0.026	1.138
5	25-Apr-02	-0.031	-1.407	0.038	1.673*
6	26-Apr-02	-0.021	-0.923	0.048	2.123**
7	29-Apr-02	0.045	2.026**	0.057	2.522**
8	30-Apr-02	0.053	2.364**	0.073	3.198**
9	1-May-02	0.061	2.731**	0.064	2.815**
10	2-May-02	0.050	2.245**	0.051	2.225**
11	3-May-02	0.060	2.678**	0.068	3.010**
12	6-May-02	0.060	2.67**	0.066	2.900**
13	7-May-02	0.059	2.637**	0.082	3.615***
14	8-May-02	0.036	1.608*	0.052	2.308**
15	9-May-02	0.070	3.125**	0.064	2.812**
16	10-May-02	0.064	2.867**	0.080	3.502***
17	13-May-02	0.053	2.385**	0.061	2.667**
18	14-May-02	0.051	2.285**	0.045	1.989**
19	15-May-02	0.039	1.751*	0.047	2.083**
20	16-May-02	0.040	1.812*	0.028	1.212
21	17-May-02	0.040	1.772*	0.021	0.926

*p<.1; **p<.05; ***p<.01

Analysis of the Data

The results of the data reject the null hypothesis for Boeing and United Technologies showing significant abnormal positive returns on each companies stock. Figure 3 graphically represents the CARs over the event period for both companies.

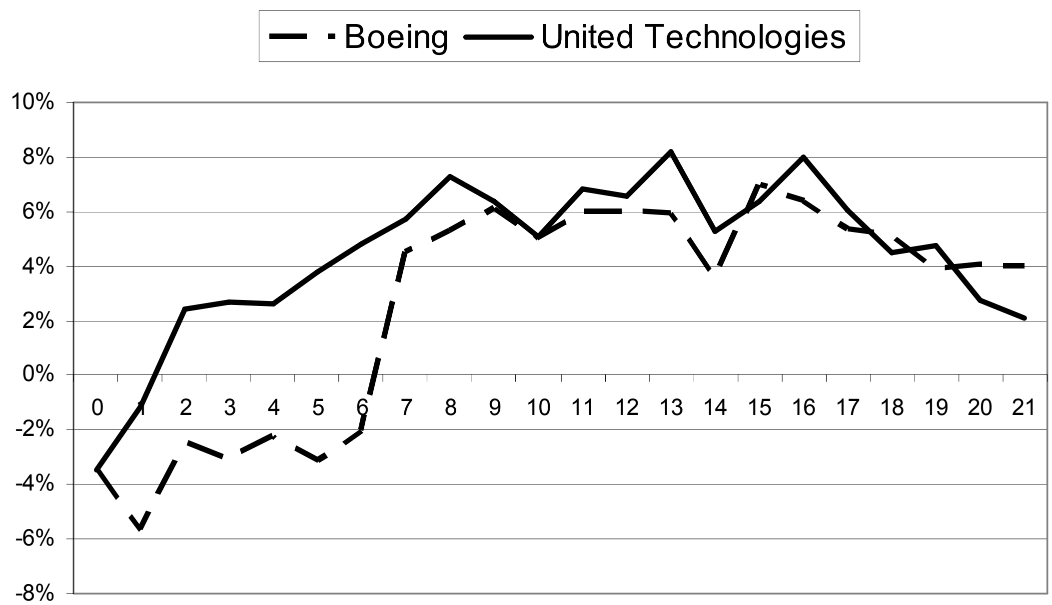

Figure 3. Cumulative abnormal returns for Boeing and Untied Technologies.

Following the delay announcement, Boeing experienced a one day, statistically significant decrease in stock value. A possible explanation of this reaction is that corporate traders and fund managers trading Boeing stock initially degraded the value of the stock. Neither company experienced any other statistically significant change to their stock for nearly five days following the event. This refractory period can be explained by the market digesting the information and determining its implication on value.

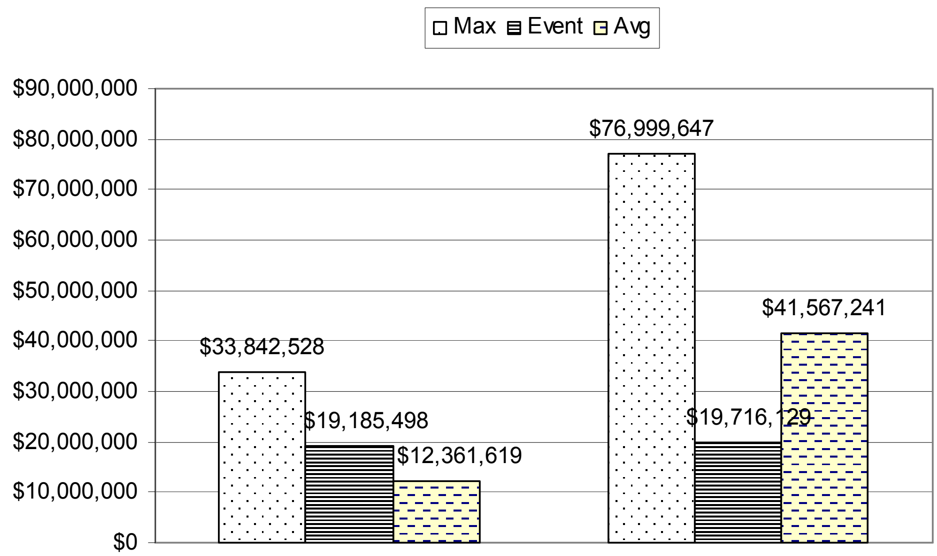

Figure 4. Summary of wealth creation.

Figure 4 shows the wealth created by the delay at key points of the event period. Included in Figure 4 are the maximum wealth created, wealth created for the total event period and the average wealth created as specified by Warner and Brown (1984). Both companies experienced a positive significant creation of maximum wealth for their shareholders at the announcement of the delay. At the height of the positive reaction, Boeing experienced $33.8 million and United Technologies experienced $76.9 million as shown in figure 4. Figure 4 also shows the wealth creation over the 21 day observation period to be similar for both firms, $19.2 million and $19.7 million respectively.

Chapter 5

Conclusion

DoD contract delay significantly impacts returns of the firm. In this case, the impact is significantly positive, generating wealth for the shareholders.

Observations and Discussion

This research was conducted for two companies and a single acquisition delay. While it is in and of itself non-conclusive as to the state of DoD acquisitions as a whole, it does provide a positive indication that an issue exists. To understand the ramifications of this issue, it must be studied further. While policy implications from these findings can only be speculative at this point, a broader study could lead to significant policy changes in the way the DoD acquires weapons systems. Finding that this is the general case in the market, where a mechanism exists that creates wealth when DoD contracts delay could lead to changes in the system that allow greater market regulation of DoD contracts.

The data indicate that the market response to the event was nearly identical in overall wealth creation for both Boeing and Sikorsky. This observation indicates that shareholder reaction to a government contract delay event is not necessarily company specific. This observation also has an interesting point in that the wealth created over the 21 day observation period, $19.2 million for Boeing and $19.7 million for United Technologies, was nearly identical. This data is remarkable given the pre-event value difference of the two companies; $485million for Boeing and $937 million for United Technologies. A possible explanation is that this represents the true market value of the event.

The period immediately prior to, and during the event period are devoid of extraneous news events that would have impacted the stock price of either company. The absence of other public information adds credence to the conclusion by not having to account for externalities that may have influenced the results. Future research to generalize the study to the acquisition system as whole may have significant issues establishing such clean events for other programs. Defense industry consolidation has led to multiple programs managed by the same company. For example, in the 2005 GAO Weapon Systems Review, Boeing is the contractor for 13 major systems. Finding a delay event in which some other event from another program is not also in the news is going to prove somewhat difficult. For companies with civilian sector work, the problem is only going to increase. Future researchers will have to screen the events carefully and replication of this research may not be possible on all programs in the DoD.

There is an observed reactionary delay of approximately five days by the market, based on the news. There are several plausible explanations for the initial reaction. Boeing stock reacted immediately negative to the news followed by a five day lull. United Technologies had no significant reaction for 5 days. The initial negative reaction in Boeing stock could be explained by corporate traders observing this as negative event for a company with a problematic contract history. As the information spread through the broader market, both companies reacted as the theory predicted and within 2 days of each other.

Follow up research

The study must be replicated on a larger scale to allow the conclusion that this is indeed an issue that has impact on the acquisition system. Performing this same study on the list of 26 programs in the GAO Selected Weapons System Review would provide a more definitive assessment that the problem is systemic. Failure to support these findings would also have merit as an indicator of an anomaly, specific to certain companies that do business within the DoD.

The continuation of this research should be approached in terms of defining the system, identifying the mechanisms of that system and then understanding the implications of those findings on acquisitions policy. Currently, acquisition reform and management regulation tends to consider only those things that the government can regulate as part of the system. This research has clearly shown that there are mechanisms at work that the government either not aware of, or not considering when it attempts to improve the process.

Caution should be used in future research not to seek policy changes to lessen a perceived profit. While it is possible that firms are managing to this phenomenon to bring wealth to their shareholders, full understanding of that mechanism must be obtained before attempting to impact it. Without understanding, the policy recommendations could have significant unwanted impacts.

Specific follow up research to identify the nature of the transmission mechanism should be conducted to answer several questions that have been raised from this research. Identifying why delay has value to the shareholders is a primary question that must be addressed. Investigating the relationships between the magnitudes of the wealth generated to several readily reported measures of corporate health would provide some indication of why delay has value. Earnings on capital for the quarter and year in which the delay occurred could provide indication that shareholder value delay to keep facilities and plants operating and not in a loss mode. The tax implications of future government work may prove to be the reason for the increased wealth observed. A valuation of the research and development to other programs, government and civilian, should be identified to see if that has bearing on the wealth created. The broader study, showing that delay creates wealth would be the stepping stone for gaining understanding.

The previous recommendations may lead to an understanding of why the delay has value to shareholders. To truly understand the system as a whole, understanding the value that delay has for the DoD is crucial. This type of research provides less available comparative measure and the researcher must determine how to measure value for the DoD. The DoD may be providing a value to the nation in terms of future continued employment, cash flow to operations, and research that no other customer can provide. The wealth created by a delay may represent the market value of the government's continuation at that point in time. The delay may also signal a vote of confidence to the market for the firm in question. The value of the delay to the DoD must be understood before policy recommendations can be made with full understanding of their impact.

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Vita

Capt Carden graduated from Marysville High School Marysville California in 1985 and entered the Air Force. His first assignment was to the 18th Tactical Fighter Wing at Kadena AB, Japan as a Weapons Load Team Member. In 1987, he was reassigned to Eglin AFB, as a member of the Load Standardization Team. In January of 1991, he was assigned to the 81st Fighter Squadron, Spangdahlem AB, Germany supporting the F-4/G Wild Weasels. From Germany, Capt Carden deployed to Saudi Arabia for operation DESERT STORM, and followed this with 3 consecutive deployments to Operations NORTHERN WATCH, SOUTHERN WATCH, and PROVIDE COMFORT. In February 1995, Capt Carden was assigned to the 5th Bomb Wing, Minot AFB, North Dakota where he assumed various duties including: Weapons Load Team Chief, Expediter and Weapons Production Supervisor. In June of 1998, Capt Carden was again assigned to Spangdahlem AB Germany, as the 52nd Equipment Maintenance Squadron Armament Support Chief. Capt Carden received his commission as a 2Lt in 2001 following attendance at Air Force Officer Training School (OTS), Maxwell AFB, Alabama where he earned the honor of distinguished graduate. Following OTS, he was assigned to the Ogden Air Logistics Center at Hill AFB, Utah where he served as the Deputy Program Manager for the Minuteman III ICBM Propulsion Replacement Program (PRP). In 2004, Capt Carden was accepted to the Air Force Institute of Technology Graduate Program at Wright Patterson AB, Ohio where he is currently seeking his Masters Degree in Research and Development Management. Upon graduation he will be assigned to Eglin AFB Fl, Air to Air Systems Wing.

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14. ABSTRACT
Development projects are occurring at a faster rate in the civilian world than for the Department of Defense (DoD). In the civilian world, faster development means quicker delivery and sales. In the DoD, quicker product development equates to a more capable warfighter. On average, DoD Acquisition Category One (ACAT I) development projects are approaching a 15 year procurement cycle. In the last three years, acquisition cycle time has grown nearly 20 percent. It turns out that the very companies that have learned to be faster, leaner and more effective in their civilian endeavors do not seem to be functioning the same on their DoD contracts. The impact to the tax payer, the warfighter and national security are the impetus for this research. This research examines the heretofore uninvestigated relationship between DoD delay and its impact on shareholder wealth. The results show positive generation of significant wealth for shareholders at the announcement of a DoD delay. This finding indicates a possible systemic incentive for the observed delays. At the very least, the generation of significant wealth for the owners of the firm does not dissuade firms from delay.

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