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PUBLIC SPACE LAUNCH ACQUISITION: A COMPARATIVE CASE STUDY

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The opinions and conclusions in this paper are those of the authors and are not intended to represent the official position of the DoD, USAF, or any other government agency.

ABSTRACT

This study analyzes three commonly practiced approaches to Government acquisition of space launch services. These approaches are employed by the U.S. Air Force, the National Aeronautics and Space Administration, and the Strategic Defense Initiative Organization. Launch contracts which were representative of each organization's acquisition procedures were investigated and evaluated along several critical issues and elements of the space launch acquisition process. These issues included payload characteristics, government oversight, contractor incentives, insurance, liability and cost. The critical issues and elements were determined by using the Delphi method to survey 25 experts in the space launch field. Archival contractual data from the three government agencies were obtained and analyzed. The study found many inconsistencies among the different agencies' acquisition procedures. The paper ends with a recommendation for a hybrid acquisition approach encompassing the strengths of the three cases. The approach entails the use of positive and negative Contractor incentives, Government self-insurance, and streamlined commercial-like acquisition procedures.

RESEARCH FOCUS

The researchers conducted a case study that attempted to identify the differences among three commonly implemented approaches to government space launch. These three mechanisms included: 1) the Air Force approach to launch, which utilizes limited commercial procedures and significant government oversight; 2) the NASA launch service approach with contractually integrated government oversight; and 3) the establishment of a launch service contract that was purported to involve exclusive contractor supervision and liability. The Strategic Defense Initiative Organization (SDIO) has contracted for launch services in this manner.

The Delta II launch vehicle was selected as a common reference of comparison for the case study. Documentation from the following Delta II launch contracts was obtained and analyzed in order to provide a comparison of acquisition processes: 1) Air Force - Delta II Follow-on, #91C0031, 2) NASA - MELV (Medium Expendable Launch Vehicle) Contract, 3) SDIO - Launch of the LACE/RME mission on a Delta II vehicle.

DELPHI

Before the case study could be initiated, the researchers had to identify the areas (issues and elements) of the launch process that space launch experts believed to be critical for analysis. These areas were then examined in all three of the cases chosen for the study. In order to validate and determine the final list of critical issues and elements on which the three launch processes were compared, the researchers chose to employ the Delphi method. This technique is popular for gathering the judgements of experts on a particular subject (Ref. 6).

The experts who participated in this study were identified by the researchers through a literature search, and through personal interview. The recruiting of participants was accomplished through the use of an introductory letter.

The researchers then developed an open ended questionnaire that asked the respondents to identify and define what they considered to be critical issues and elements of the space launch acquisition process. Once the first set of responses were received, the results were summarized and reported back to the experts in the form of a second survey. This follow-up survey asked respondents to choose, on a five point Likert scale from Strongly Disagree (1) to Strongly Agree (5), if a particular critical issue/element should be included in the study. From these two iterations of the delphi survey, the researchers reached a consensus of the critical areas of the space launch acquisition process.

CASE STUDY

A case study methodology was selected as the mechanism for comparing the three space launch approaches. This mechanism allowed for an in-depth study of the complexities and varieties of space launch service contracting.

The researchers established contacts at each of the three government agencies to act as the focal points for data collection. Archival data in the form of contract documentation and interoffice memoranda were collected for each launch in the study. Once collected, this written documentation was then segregated by issue or element and reviewed for completeness. If an area was not adequately described by the archival data, deficiencies were noted and questions that addressed the needed information were generated. Any questions that could not be answered in detail by the point of contact were noted. This point of contact was further queried for the names of experts that could finalize the unanswered questions. These persons were contacted in order to complete the collection of data.

DELPHI FINDINGS

In the open-ended survey, many of the respondents used bullet/outline format to list their responses, while other individuals used essay format to convey their thoughts. The

researchers organized the results based on certain key words or concepts that were repeated by the respondents. When one of these key words or concepts appeared on the answer form, the researchers noted it, and kept a running tab on each category. The researchers organized the information into 13 separate categories which comprised the second iteration of the delphi survey. Respondents were asked to score each category and sub-category on its relative criticality using the five point Likert scale previously mentioned. After each category, respondents were given space for additional comments.

The means and modes for every item on the second survey averaged well over the Neutral (Likert scale 3) category. This finding suggests that a consensus of the experts felt that most of the items were, to some degree critical. The following list summarizes the final results of both iterations the the delphi survey, and was used as the outline by which comparisons were made across the three cases:

1 - Typical Payload Char.
2 - Oversight to Include:
  Contractor Required Tasks
  Contract Data Requirements
    Listing (CDRLs)
  Military Specification
  Insight vs. Approval
  Launch Authority
3 - Contractor Incentives
4 - Liability/Insurance
  Third Party
  Government Property
  Launch Vehicle
5 - Cost of Launch Service
6 - Reliability

Findings of the Case Study. Typical Payload Characteristics Many Government officials have indicated the need for more oversight involving missions with high complexity, costly payloads, and national security implications. The intent of the comparison is to determine the relative expendability of the payload. This considers mission complexity, cost, and national security issues.

The Air Force Delta Launch Contract is primarily concerned with launching one satellite, the Navstar/GPS. The GPS will eventually include 21 of these $65 million satellites. The standardization that is a result of repeated missions has contributed to decreased mission complexity.

Virtually every payload, thus nearly every launch, under the NASA MELV Contract is unique. Although these scientific payloads do not necessarily have national security implications, most of these one-of-a-kind payloads are expensive (over $200 million). Like many of the NASA missions, the SDIO LACE/RME was a one-shot, highly complex, expensive mission (approximately $300 billion for the satellites). Unlike NASA, LACE/RME was directly linked with

national security concerns. For these reasons, LACE/RME would be considered the least expendable payload of the three cases studied.

It follows that critical missions like LACE/RME should command more oversight throughout the procurement process. As the following analysis indicates, the researchers have perceived this to be the opposite.

Oversight. Of the three cases studied, the Air Force Delta II Follow-On Contract appeared to support the most government involvement and oversight. Contractor required tasks were listed in greater number and detail than in both the NASA and SDIO launch contracts. The Air Force contract mandated almost every aspect of the launch process.

The NASA MELV contract focused on two critical Contractor requirements, both of which required Government approval and inclusion into the contract as compliance documents. The Mission Specification Document serves as a type of Contractor-prepared statement of work for the payload interface, environmental and vehicle system requirements. The other significant NASA document is the Performance Assurance Implementation Plan (PAIP). It is a Contractor-developed/Government approved document that deals with oversight functions such as safety, configuration management and reliability. Through these documents, NASA is able to ensure a significant level of oversight throughout the launch process.

The comparison of CDRLs among the three contracts produced similar results. The Air Force, once again, posted the highest number of Contractor required submittals. All of these mandatory documents required acceptance via a DD Form 250, and many required Government approval. This burden is somewhat eased by the fact that many of the 83 CDRLs are only required when the Contractor is launching a unique payload.

Although, the NASA CDRLs were not available, the existence of 50 such submittal requirements approximates the Air Force contract documentation work load. This is especially true if one considers that nearly every NASA mission is unique and that many of the submittals will have to be altered significantly or reaccomplished for each launch.

The SDIO LACE/RME launch contract made use of only 12 CDRLs. None of these submittals required DD Form 250 acceptance or approval. In general, the intent of the CDRLs was to foster communication between the Contractor and the Government, and not dictate requirements.

Before comparisons are drawn concerning reliance on military specifications and standards, it is important to note that all Delta II vehicles are manufactured under the same quality processes, and to identical specifications (Ref. 7). Many of these standards have been implemented by Air Force contracts throughout the history of the system. In essence, the Air Force has provided the direction for the vehicle production. This is probably due to

the fact that the Air Force helped to develop the Delta vehicle, and has continued to be the largest customer for the Delta market. These realities are reflected in the disparity among contracts as to the number of compliance standards listed by each contract (Air Force-30, NASA-6, SDIO-1). The Air Force total is largely comprised of production standards. It was not possible to determine which standards are currently contributing to the overall success of the Delta system.

The Government holds final launch authority in all three cases, whereas, in a commercial launch, the service provider would make final decisions as to launch go/no-go. This is most likely due to the Government's insistence on self-insuring the payloads, and its ownership of all launch facilities. It would be impractical to give the Contractor the final say when it holds virtually no liability for the success of the mission. This is in contrast with a commercial launch, where the service provider is typically liable for the payload and launch facilities.

Throughout the analysis, it was readily apparent that the Air Force launch contract interjects Government involvement and oversight into the launch process to a greater degree than the NASA and SDIO contracts. The effect of the Air Force practices is to move away from the procurement of launch services in the pure sense (placement of a payload into a specified orbit for firm price). The SDIO contract, on the other hand has implemented a bona-fide performance specification for the LACE/RME launch. From an oversight perspective, SDIO has utilized commercial space launch procurement techniques. NASA's insistence on documents such as the PAIP have placed it in a position somewhere between the Air Force and SDIO on the oversight spectrum.

The most interesting aspect of the comparison in government oversight materializes when the mission and payload characteristics are considered. The Air Force contract deals with the most expendable payloads and the most standardized launch process of the three cases studied. However, it is the most oversight intensive document. Conversely, the oversight-scarce SDIO launch involved the least expendable payload and a fairly sophisticated launch process.

Contractor Incentives. One would expect that a contract with less oversight would require a greater degree of contractor incentives to ensure performance and vice versa. This expected correlation was exactly reversed for this case study. The Air Force contract contained the strongest form of Contractor incentive of the three cases. This was the requirement to re-fly any mission that failed as a result of Contractor error, at no cost to the Government. This translates into the potential for a contractor loss of approximately $40 million.

NASA also made use of a negative incentive, however, it was less sever than the Air Forces's. The NASA contract could penalize the contractor up to $5,330,000 for a mission failure, but could not request a reflight.

In the Air Force and NASA launch agreements, the Contractor could also earn additional sums of money for successful or exceptional performance. The Air Force award fee criteria focused primarily on the processes that the Contractor implements throughout many phases of the contract. If, over time, the Contractor does an exceptional job of complying with the standards that the Air Force has mandated in the contract, the Contractor stands to receive the full $3 million award fee.

NASA's positive incentives differ substantially from the Air Force's. A $1 million bonus is paid for each consecutive full mission success. The award fee is only tied to the final performance of a launch. NASA appears to be more concerned with the outcome of the launch and less concerned with the execution of certain launch processes. This is a step in the direction of commercial launch practices.

The SDIO LACE/RME procurement did not employ any special contractual incentives. The Contractor was guaranteed the full contract price regardless of the mission outcome. In fact, the Contractor was immediately paid $4.5 million at contract award. The reasoning for these payment procedures are not listed in the contract. Interestingly, the Advanced Payment Clause which would normally be required in this circumstance, was also missing. The ramifications of the lack of incentives in the SDIO contract are discussed in further detail in the following section on liability.

Liability/Insurance. With respect to third party liability, all three cases have chosen similar paths. In each contract, the Government relies on the Contractor's current insurance policy to form a base level of coverage, then the Government indemnifies the contractor for any liability over the amount of this coverage. In each circumstance, the Government would have been required to reimburse the Contractor for any additional insurance coverage over the amounts that the Commercial Space Launch Act requires the Contractor to carry. The Government has obviously decided that the risk is not great enough to justify extra expense.

A similar indemnification process occurs with regard to Government property (the most notable of which is the payload). In all three cases the Government has self-insured the payload and launch facilities. The alternative to this is to pay a higher price per launch to handle the additional insurance requirements that would be forced upon a liable contractor. In the Air Force and NASA launch scenarios, the Contractor still has a significant incentive to carry out the mission to a successful conclusion, even though it has no liability for a lost payload. The previously mentioned contractual incentives insure this.

The SDIO LACE/RME contract does not, however, use mission success as a factor when determining how much to pay or penalize the Contractor. The Contractor receives the full contract price no matter what happens to the payload or facilities. Because, the LACE/RME launch contract also released the Contractor of liability for the payload, there is a question as to what incentives are left

to steer the Contractor towards a successful conclusion to the mission. This dilemma is accentuated by the fact that the SDIO launch contained relatively little Government involvement.

Cost of Launch Services. A court injunction levied against the release of the NASA contract and threatened against the Air Force limited the researchers' comparison of the three agencies' cost data. The researchers were able to obtain the SDIO cost data, which places the cost for services at $35 million and range support at $3 million.

The researchers originally hoped to try to develop a relationship between the cost of launch services, and the amount of Government oversight in the contract. Without detailed cost breakdowns, the researchers were unable to accomplish this task.

Reliability. The Delta II launch vehicle is an extremely reliable ELV, especially in recent history. The relatively small population of Delta II launches and the fact that virtually every launch has been a success, make it difficult to draw a correlation between reliability and procurement method. However, the level of oversight and use of military standards throughout the production of the vehicles, may be a driving force behind the system's success. One of the most significant factors that may affect the system's reliability is that the Delta has had the opportunity to mature of a span of three decades.

CONCLUSIONS/RECOMMENDATIONS

The Air Force, NASA and SDIO Delta II launch acquisition process may not be individually classified as "good" or "bad," "efficient" or "inefficient," "commercial" or "non-commercial." Each of the agencies' processes has aspects that may be desirable if developing "an ideal" Government launch procurement process.

Oversight. By employing the streamlined procurement methods prevalent in the SDIO contract, such as decreased Contractor surveillance, fewer paperwork requirements, and the use of a performance oriented specification, the Government would be able to ease the Government and Contractor administrative burdens. It would essentially acknowledge that the Contractor is indeed the true expert. This would allow the Contractor the flexibility to innovate, and thus become more efficient. This increased efficiency could be transferred to the commercial sector, and foster the development of the industry.

Reflight and Award Fees. There are many ways for the Government to inspire successful performance. Reflight provisions and award fees serve as a potent stimuli for Contractor behavior. The Air Force Delta II reflight requirements are a desirable incentive because it could potentially affect the Contractor's profitability. NASA's performance based award fee is also an indispensable incentive that could work in conjunction with a reflight provision. Performance is the bottom line. These positive and negative incentives ensure it, while helping build improved, and more trusting relationships

with contractors. This can only lead to more efficiency and effectiveness.

Government Self-Insurance for Payloads. Payload insurance can place a significant monetary burden on the Contractor, which is ultimately passed on in the form of higher fees to the Government. Self-insurance is an acceptable risk for the Government if reliability remains consistently high. However, Government self-insurance must be used in conjunction with Contractor incentives in order to manifest the Contractor's stake in the successful performance of the mission.

The Role of the Air Force. The Air Force is by far, the largest, most influential customer in the domestic space launch market. The Air Force effectively drives the Commercial Space Launch Industry. Therefore, the Air Force must also play the lead role in developing more efficient, effective, and responsible space launch acquisition processes.

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