LESSONS LEARNED AND PROCESS IMPROVEMENT FOR PAYLOAD OPERATIONS AT THE LAUNCH SITE

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ABSTRACT

For every space mission, there are challenges with the launch site/field operations process that are addressed too late in the development cycle. This potentially causes schedule delays, cost overruns, and adds risk to the mission success. This paper will discuss how a single interface, representing the payload at the launch site in all phases of development, will mitigate risk, and minimize or even alleviate potential problems later on.

Experience has shown that a single interface between the project and the launch site allows for issues to be worked in a timely manner and bridges the gap between two diverse cultures.

KEY WORDS

Launch Site Operations, Payload Operations

INTRODUCTION

Spacecraft project management personnel are very knowledgeable about every phase of spacecraft design and operation except launch site operations and the associated time schedule. Management either assumes the support at the various launch sites already exists or was possibly implemented from a previous mission. On previous programs, launch site operations were not given much thought or attention until it was near the time to take the spacecraft to the launch site. Existing launch site resources and capabilities were frequently overestimated. Nearly every project erroneously assumes that they are either the only project or the most important project that the launch site is supporting. Typically a project attempts to define the launch site requirements and implementation with a variety of “part-time” and/or already “work overloaded” engineers. This results in additional responsibilities for the Integration and Test Manager, Lead Systems Engineer or a combination of the two. The project reasons that this “part time” effort will meet the needs of the launch site personnel. But to the contrary, history has shown this method is not efficient. These engineers are extremely focused on getting the spacecraft and its subsystems designed, built, integrated, functioning, and tested (as they should be). The immediate demands of spacecraft assembly, integration, and test logically take precedence over later-needed launch site planning. The launch site operations planning tends to take a “back seat” until some time is freed up, which is usually very late in the spacecraft processing schedule. Often, the project work on the launch site details is sporadic, thus creating a situation where requirements may be lost or misinterpreted.

By comparison, the launch site support team has a proven structure in place, with a single point of contact. A defined area of responsibility exists in both the launch vehicle processing facilities (VPF) and the payload launch site payload processing facilities (PPF). The launch site management assigns a single interface to work with the project early in the definition phase. This interface has a predetermined schedule (Figure 1) that must be adhered to if the project expects to launch on the agreed upon date. With a single interface on one side, and multiple interfaces on the other, several problems can and do occur, as discussed below.
WHAT WERE THE RISKS ASSOCIATED?

The recognition of launch site operations as a “part-time” job may breed “loose requirements.” In many cases the requirements are not defined at all. Important details are often overlooked or missed entirely. Implementing new and changing requirements in a timely manner is often difficult, labor intensive, and incurs schedule risk. Lack of coordination between the many project system leads (internal and external) who have been assigned to work the launch site requirements soon becomes evident.

There are three major problems expressed by launch site management that affect each and every program that is launched.

Identification of GSE Interfaces

Spacecraft Ground Support Equipment (GSE) electrical and physical interfaces (i.e. power or data connections) must be addressed in a timely manner. Too often, these interfaces are not clearly defined prior to spacecraft arrival at the launch site, thus creating a crisis in an attempt to minimize impacts to the schedule. In most instances, these situations could have been avoided with a single project interface.
Identification of Communication Requirements

Spacecraft communication (voice and data) requirements are frequently late arriving and incomplete. Implementation of some of the requirements could take weeks or even months to define, negotiate and finally put into operation. This may depend on the complexity of the design, or the involvement of the many agencies that are called upon to support the requirement.

Too Many Points of Contact (Interfaces)

Having too many points of contact typically leads to conflicting direction from separate project personnel to the launch site personnel. This causes confusion and extra effort on the part of launch site support personnel (basically what is deemed the “left hand/right hand syndrome”).

Minimizing delays in getting the spacecraft GSE configured and operational is critical to maintaining the schedule. Schedule slack is a precious commodity and becomes extremely important, as the launch date approaches. Reducing the points of contact to a single interface substantially mitigates launch site schedule risks, issues and concerns.

THE PREVIOUS METHOD WAS MORE CUMBERSOME

The receipt of late or incomplete requirements makes it extremely difficult for the launch site personnel to properly prepare for project arrival. Receiving missed or late requirements in “real-time” caused frustration, processing delays and created emergency situations. Additional funds were necessary to implement these requirements because they were now elevated to an “emergency” categorization. In some cases, substantial “lead-time” was required to procure some of the items and just could not be implemented in a timely manner. This caused undesirable work-arounds such as having to hardwire critical spacecraft GSE directly into power panels until the appropriate hardware could be procured, if at all. In many instances, resulting processing delays were simply unavoidable. Additionally, confusion factors occurred as a result of having too many people involved in the process. “I thought you took care of that” was a phrase heard too many times. Additional risk was introduced because the project personnel did not fully understand the culture, nor the launch site facility capabilities. Existing capabilities of the launch site were assumed and found to not be available when required.

Lack of a single project interface while processing at the launch site quickly became obvious. Project personnel were just stating many of their requirements for the first time. Interfaces between the project GSE and facility panels did not match. Requirements creep began to surface. Not that this was done intentionally; the requestors were not informed or up-to-date on what had been agreed upon in the Ground Operation Working Group (GOWG) meetings and what was specified in the launch site documentation.

The following illustrates how late requirements were received and how it impacted the team at the launch site:

- The first “new” request was cheerfully received and implemented.
The second request was received a little less enthusiastically as they were still working the first request.

The third request was also accommodated, although frustration began to emerge.

The fourth request showed a few signs of irritation.

The fifth request and on promoted new meetings to “renegotiate” the requirements not found in the documentation.

Historically it has been proven, too many interfaces, too late in program has resulted in not a good way of doing business.

THE “NEW” PROCESS

A “full-time” Launch Site Operations Manager (LSOM) position was created on the Small Explorers (SMEX) program. The LSOM was recognized as the project/payload representative at the launch site, and was there to protect the project’s best interests and requirements. This position was clearly defined as the single point of contact between all of the project personnel (Figure 2) and the launch site personnel from project inception through post-launch. The LSOM was the single point of contact for interfacing all payload requirements to the launch site personnel. It was understood by the launch site personnel that the payload (project) requirements would come solely from the LSOM. The LSOM was then responsible for identifying the project requirements through various means, including attending and/or representing the project at the Ground Operation Working Group meetings, interfacing with the launch site support entities and completing the proper documentation that each supporting entity required. Further responsibility included assisting in the engineering, implementation and testing of the project requirements at the launch site. The LSOM was to insure a “turn-key” operation would be in place prior to the projects arrival.

![Figure2. Launch Site/Payload Interfaces](image-url)
ADVANTAGES OF THE “NEW” PROCESS

The LSOM is designated as the project/payload representative for the launch site requirements. The LSOM is there to protect the project’s best interests. Knowing who to talk to, what to say, and what to ask for is crucial in saving time, money and resources. The LSOM ensures that day-to-day issues are resolved to the satisfaction of both parties (project and launch site). In addition, the LSOM is continuously planning for the upcoming project activities to ensure that little or no impact to the operations exists. Pre-coordination and scheduling replacement of consumable resources ensures the smooth continuation of the payload processing and operations.

Having a dedicated individual to facilitate the launch site operations optimally defines a single point of contact between the payload and launch site personnel. A rapport is developed through the requirements definition period and further enhanced in the field with the launch site personnel. Working with the payload personnel, the LSOM is dedicated to defining and ensuring correct implementation of the launch site requirements for the project. This allows for a smooth payload transition to the launch site processing facility. Using individuals that have previously performed this function further enhances the single interface concept.

Follow-on SMEX payloads benefited from this single interface at the launch site. By knowing ahead of time what the project requirements were going to be, the LSOM was able to save precious time and project funds by leaving equipment in place that was implemented for previous programs (i.e. cables left in place, A/C units, communications lines, etc.). This approach also reduced risk in the field, by having pre-qualified equipment and tested interfaces already in place prior to arrival of the next user.

Pre-coordinated office, facility and communication layouts saved significant time and enhanced the productivity of the project upon arrival at the launch site. The goal was, and still is, to have a turn-key operation from the beginning.

Quick resolution of anomalies/conflicts was easily achieved by the LSOM. This was attributed to the experience of knowing what the launch site facilities could or could not accommodate. This was particularly evident in an emergency situation. A major spacecraft project was moved from one payload processing facility to another to avoid a potential flooding situation. From flood alert until the spacecraft was secure in a facility on high ground took less than 6 hours and a multitude of diverse organizations working together. The LSOM and the close working network the LSOM had formed was key in executing this large effort in a timely manner.

If the launch site was unable to accommodate a request, then the LSOM would contact outside sources to meet the need, often well in advance of the need.

LESSONS LEARNED

A dedicated point of contact representing the payload has been the greatest single improvement in getting the project through the entire maze of field operations toward a successful launch. It is essential that the single interface attend all meetings in the field, and builds a trust and credibility.
with the launch site personnel. This not only improves communication between the project and launch site, but builds a relationship that is invaluable to this project and also future projects the LSOM may work on.

CONCLUSIONS

A single point of contact to interface with the launch site has proven to be a significant improvement over the old way of “part time” launch site engineering. Eliminating the extra responsibilities from these “work overloaded” engineers ensures a compatible processing schedule between both the project and the launch site. Requirements are submitted in a timely manner, thereby ensuring an efficient, cost effective implementation. By having this single interface, the project is able to focus on its primary function of building, testing and preparing the spacecraft for launch. The LSOM takes on those responsibilities for the project; attending meetings, working any issues, and ensuring the procurement of all of the necessary resources to fulfill the levied requirements. This method of operation has proven to be the most effective mechanism for achieving success, managing the complex field operations, minimizing costly slips, and keeping morale high during the on-site operations.

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