

**Recommendation of a More Effective Alternative to the
NASA Launch Services Program Mission Integration
Reporting System (MIRS) and Implementation of Updates
to the Mission Plan**

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Recommendation of a More Effective Alternative to the NASA Launch Services Program Mission Integration Reporting System (MIRS) and Implementation of Updates to the Mission Plan

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Abstract

Over the course of my internship in the Flight Projects Office of NASA's Launch Services Program (LSP), I worked on two major projects, both of which dealt with updating current systems to make them more accurate and to allow them to operate more efficiently. The first project dealt with the Mission Integration Reporting System (MIRS), a web-accessible database application used to manage and provide mission status reporting for the LSP portfolio of awarded missions. MIRS had not gone through any major updates since its implementation in 2005, and it was my job to formulate a recommendation for the improvement of the system. The second project I worked on dealt with the Mission Plan, a document that contains an overview of the general life cycle that is followed by every LSP mission. My job on this project was to update the information currently in the mission plan and to add certain features in order to increase the accuracy and thoroughness of the document. The outcomes of these projects have implications in the orderly and efficient operation of the Flight Projects Office, and the process of Mission Management in the Launch Services Program as a whole.

Nomenclature

| | | |
|-------------|---|---------------------------------------|
| <i>BOSS</i> | = | Business Operating Success Strategies |
| <i>FPO</i> | = | Flight Projects Office |
| <i>GOWG</i> | = | Ground Operations Working Group |
| <i>LSP</i> | = | Launch Services Program |
| <i>MIRS</i> | = | Mission Integration Reporting System |
| <i>MIC</i> | = | Mission Integration Coordinator |
| <i>MIT</i> | = | Mission Integration Team |
| <i>MM</i> | = | Mission Manager |
| <i>PIM</i> | = | Program Integration Manager |
| <i>VPN</i> | = | Virtual Private Network |

1. Introduction

NASA procures expendable launch vehicle services for its scientific and operational missions from commercial providers through the Launch Service Program (LSP). This summer, I worked in the Flight Projects Office (FPO) of LSP. The job performed by the Flight Projects Office, and by LSP as a whole, is to integrate and manage those launch services for NASA missions. LSP also serves to provide leadership and expertise, and to ensure that all NASA regulations and protocols are met, maximizing the chance for mission success. The Flight Projects Office is home to the Mission Managers (MMs). MMs serve as project leads for each mission and are the primary spacecraft customer interface for mission-specific integration. Each MM directs a multi-discipline Mission Integration Team (MIT), whose members perform different duties pertaining to launch vehicle engineering, analysis, and integration for their assigned mission.

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Since 2005, the Flight Projects Office has utilized a web-accessible database application, called the Mission Integration Reporting System (MIRS), to manage and provide mission status reporting for the LSP portfolio of awarded missions in flow. MIRS is a multi-user tool that allows members of the MIT to input discipline-specific data into the system. The system then outputs overall mission status using red-yellow-green ("stoplight") indicators, and includes detailed reports on cost, schedule, and the status of technical/risk issues for a mission. Over the years, many of the MIRS system users have commented that the system is outdated and no longer an effective tool for communicating mission status. In addition, the Flight Projects Office noticed that the mission status reports received from its spacecraft customers have come from newer, more effective reporting systems. The MIRS reporting system, however, has not gone through any major updates since its implementation in 2005.

Another tool that the Flight Projects Office uses in the process of mission management is the Mission Plan. The Mission Plan is a document given by LSP to the Spacecraft customer which outlines the life cycle of a mission. Contained in the Mission Plan is a breakdown of everything that happens from the time a mission is awarded until after it has launched, including both an overview of the mission at hand as well as general life cycle information that applies to every mission. This is provided so that the customer has an understanding of the different phases of the mission life cycle, LSP capabilities, important meetings and reviews, and major deliverables developed throughout the process of preparing a mission for launch.

The two main projects that I worked on this summer dealt with these tools, MIRS and the Mission Plan, both of which are crucial in the operations of the Flight Projects Office and the process of mission integration. Because of this, they are certainly related in many ways. However, I have dealt with the two projects separately and will continue to do so in this report.

In addition to my two projects I was given a great deal of exposure on the operations of the Flight Projects Office and LSP as a whole. I had many opportunities to engage in activities outside my projects, and these activities gave me an even greater understanding of the whole process of putting a satellite into orbit, and also valuable experience working in an engineering office.

2. MIRS Project

The main objective of my project was to research MIRS, become familiar with how it has been used in the past, and then formulate a new report format to better communicate cost, schedule, and technical mission status in a more streamlined and effective manner than the current MIRS status report. In support of the MMs, I was tasked with providing the Flight Projects Office with a clear, concise recommendation for a new report format that can then be handed over to the ELVIS 2 Contractor and translated into system requirements for an update to the tool.

2.1 Technical Approach

To accomplish this objective, I began acquainting myself with MIRS and with the overall process of Mission Management shortly after arriving in the office. I interviewed a handful of the MMs over the course of my first few weeks. My goal in these interviews was to learn how each MM utilizes MIRS and collect their thoughts on the system. I learned that the MIT handles the input of information into MIRS for each mission, and certain members of the team handle different inputs. For example, the Program Integration Manager (PIM) handles the financial aspects of the mission, and is responsible for making sure that the fields in MIRS relating to the business side of the mission are up to date each month. The MM, as head of the MIT, handles a significant amount of the input of general mission status information into MIRS. Once the information is in MIRS, the system generates a report which outlines the status of the given mission. This report is then used to brief LSP management, as well as the rest of the program, on the status of LSP's missions during the Monthly Program Review meetings. I took the findings from my interviews with the MMs and met with Amanda Mitskevich and Chuck Dovale, the LSP Manager and Deputy Manager. I was able to get their feedback on the information I had collected from the MMs, and also their management perspective on MIRS. This was especially valuable, as one of the main stated purposes of MIRS is to be able to bring the program management up to speed on a mission's status. I then met with representatives of some of the other divisions within LSP that have a hand in the input of data into MIRS, including the Business Office, Safety and Mission Assurance, Ground Systems Integration, and Mission Integration. I collected the findings of these interviews as detailed in the following section. Based on these findings I developed a product to accompany my recommendation, a generic draft of MIRS report charts as I would recommend they appear after the changes have been implemented (see Figures 1-4).

2.2 Findings

After my meetings with the various groups involved in the operation of MIRS, I was able to determine that the foremost issue with the system is that it presents a great deal of information, much of which is of questionable utility, and at the same time does not portray what the MIT is actually working on. This is the problem I put a great deal of the project's focus on. In addition to this, there are a number of minor complaints and issues that the MMs noted, mostly dealing with the operation of the system and input of information. While the MMs have become accustomed to working around or "living with" these problems, they do impact the efficiency and operation of the system and need to be addressed.

The main issue I have outlined deals primarily with the presentation aspect of MIRS. The MIRS report format is very structured and consistent from mission to mission. It grants each facet of the mission the same small space on a chart, leaving to the presenter the responsibility to explain or clarify the details of a certain risk or issue. At the same time, the report reserves space to status a number of other facets that are breezed over or not discussed at all on presentation day. But in practice, each mission has its own unique issues and challenges. The original intent of MIRS was to reinforce that the MM was in charge of the mission, but at this stage in the program's maturity it is clear that the MM is in charge, and so it is not as necessary for MIRS to underscore this. Additionally, the MIRS report format is not able to accomplish the goal of satisfactorily bringing management up to speed on a mission's status. It is not able to do much beyond give an overall "fever" evaluation of the mission in question, and when the report format puts so much emphasis on the presenter to convey what the charts actually mean, there are bound to be missed details, redundancies, and confusion, which all lead to an inefficient system.

The secondary issues I have encountered mostly deal with the input side of the process. They are fairly isolated, minor problems with the interface and operation of the MIRS system as listed below.

- The system is difficult to access remotely, as it requires the user to connect through a Virtual Private Network (VPN). The connection takes up a lot of bandwidth and in turn the system operates very slowly.
- The system is not very consistent with its prompts to the user.
- If the user leaves a page without saving progress, the system does not save automatically or warn the user before leaving the page, leading to frequent loss of data.
- It is difficult for the user to enter any notes alongside an issue or risk to explain his/her reasoning to other users
- The MM cannot change launch date or current phase in the system; instead he/she must go to the Mission Integration Coordinator (MIC) to get it changed.
- When the user first goes in to select a mission, all of the closed missions still in the system come up first and the user must scroll through them to find the mission he/she is currently working.
- The system is overall very tedious to operate; input of information requires clicking on links which then open up new windows, making for a very sluggish process.

In addition to the minor issues noted by the MMs, I encountered similar complaints from the representatives of the other branches that I spoke with. They echoed many of the interface issues noted above, as well as more branch-specific issues.

2.3 Recommendation

I believe MIRS should use a more flexible reporting format, particularly for when it is used to present in monthly meetings. This report should be able to give management, as well as other offices, a quick but thorough update on the mission in question. This includes a fever evaluation of the mission from a technical/schedule/cost standpoint, the risks the team is aware of, and a summary of major recent accomplishments and upcoming milestones. In other words, this report would include all of the significant information from the current MIRS report, but compressed down to about 3 slides as opposed to 7 or more.

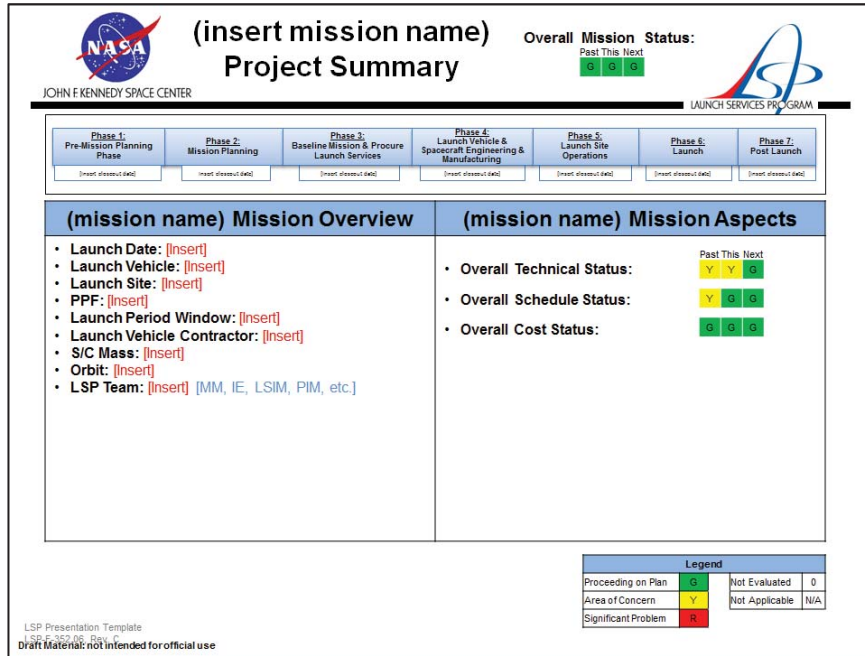


Figure 1. Project Summary. This slide shows basic mission overview information along with quick evaluations of each major aspect of the mission and an overall timeline of the mission phases.

The first slide (Fig. 1) would contain a general overview of the mission, as well as a very general status report of the mission. The second slide (Fig. 2) will remain relatively unchanged from the current MIRS report, showing the open and accepted risks for the mission and where they fall on the risk matrix. In addition to this information, it would be valuable to have a few slides behind these first pages which the team can use to provide more details on whatever they feel needs to be explained further, whether that be details of a technical issue that the team is facing, a summary of a budget problem they are dealing with, or anything they think is pertinent to the progress of the mission (Fig. 3). In this way, the report is able to be adapted to the unique needs and challenges of each mission. Finally, the report should include some sort of schedule tool. For this, I recommend that MIRS make use of the schedule generated by the Business Operating Success Strategies (BOSS) program (see an example in Fig. 4). This schedule includes all the major events in the mission life cycle, including meetings, reviews, and other milestones that occur for a mission.

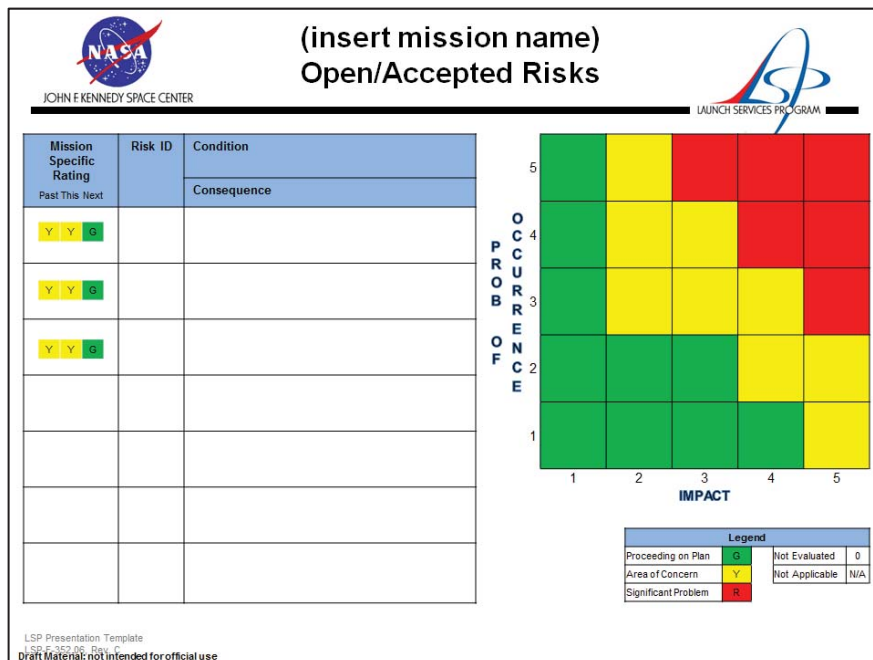




Figure 2. Open/Accepted Risks. This slide gives information on each of the mission's risks and also shows where they fall on the risk matrix.



(insert mission name)

Project Summary



• [free-form space for use on whatever issues are most pressing or need further explaining]

LSP Presentation Template
LSP-F-352.08, Rev. C
Draft Material: not intended for official use

Figure 3. Free-form slides. These slides can be added, as needed, behind the Project Summary and Open/Accepted Risk slides, but before the BOSS Schedule slide.

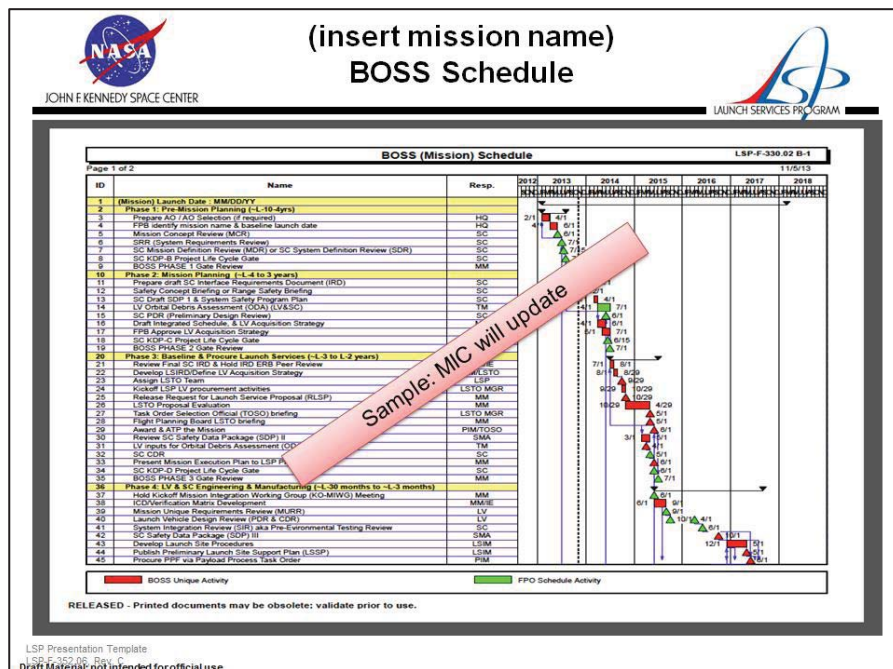


Figure 4. BOSS Schedule. This slide consists of the schedule from the BOSS, which contains all the major events in the mission life cycle. Above is a generic example of a BOSS schedule.

Also, my recommendation is to downsize the existing input format, as well as to make fixes to the secondary issues I have enumerated above. The status fields shown on the current MIRS report charts are only a few of the many that are filled out each month. For example, the PJM must input a great deal of information into MIRS, which is then boiled down to the two categories seen on the current charts. This same circumstance occurs across many of the parties involved in the input of information to the system. Additionally, all of these groups handle issues internally, using their own systems of reporting, and only take them up to the program management level in extreme cases. Because of this, the report charts end up being almost completely green. When I spoke with the program manager and deputy program manager, their perspective was one of “no news is good news,” and the current MIRS report does not support this idea. I recommend that MIRS be changed so that any particular issues that arise, whether in budgetary concerns, Communications and Telemetry, Launch Site facts, or any other category, it is up to the MIT

lead for that aspect of the mission to include that issue in the free-form slides of the MIRS report. This way management is only briefed on issues that are current and pertinent, instead of having to search for the needle that is the few unresolved issues in the haystack of green “non-issues.” Furthermore, MIRS should be scaled back so that each branch is not wasting their time inputting information that is of no use to them or to program management. I have found that in nearly every case, the large amounts of information input by the different parties is seen as an unnecessary nuisance, only causing a waste of time. I recommend that there be a more in depth study of the necessity of each branch’s inputs to confirm this.

Most of the secondary issues I encountered involve fairly simple programming fixes that can be made to the software. In terms of the remote access VPN issue, I recommend that MIRS be changed to operate from the LSP Portal, similar to other computer-based systems such as the Engineering Review Board Information System (ERBIS). Beyond this, the efficiency and ease-of-use of the system would be greatly increased by updates to the user interface, namely to resolve the other secondary issues listed in the above section. I would also recommend a review of the overall structure of the interface in an effort to decrease the number of clicks required of the user and increase the efficiency of the system from a purely process-oriented standpoint.

3. Mission Plan Project

The objective of this project was to begin the process of adapting the Mission Plan to a more efficient method of use that better fits the way missions are handled. I first had to make sure that the information in the Mission Plan was up-to-date and accurate, and then I began the process of updating and adapting it through the addition of features and the increase of the scope of the Mission Plan itself. My updates to the Mission Plan can now be handed over to a team tasked with making more broad changes to the mission life cycle, and the team can be confident that they are working with the most accurate information.

3.1 Technical Approach

I began by familiarizing myself with the Mission Plan. As it exists now, the mission life cycle is made up of seven phases, ranging from Pre-Mission Planning to Post Launch. In the past, the Mission Plan was given to the customer after the mission was awarded in the Baseline Mission & Procure Launch Services Phase (Phase 3). It contains introductory information on everything from the MIT and what areas each member represents, to export control, to important meetings and review that occur throughout the process of preparing a mission for launch, and more. This is a lot of information for the customer to receive at once, and it was the thought of the Flight Projects Office to break the Mission Plan up into more clearly divided sections that can then be given to the customer a little at a time. This would make the Mission Plan more flexible and adaptable across different launch timelines. There is a MM assigned to each phase, and after familiarizing myself with the Mission Plan I met with these MMs. I went through their assigned phase with them and we determined all of the corrections that had to be made to bring the Mission Plan up to date. I then worked to implement the redlines that the MMs and I had made, as well as add a couple of features as suggested by Albert Sierra, the chief of the Flight Projects Office.

3.2 Findings

In each phase of the mission life cycle I was able to, with the help of the MMs, make numerous changes to the wording used in the phase overviews and the items included in the various categories. Under most of the phases, these categories are “Key Mission Integration Activities and Meetings,” “Major Deliverables,” and “Intent of Phase” (an example of the phase overview charts can be found in Fig. 5). I was also able to make a few changes to the life cycle and Mission Plan as a whole. On the mission life cycle timeline, the Mission Readiness Review (MRR) was incorrectly placed under the Launch phase (Phase 6), when it actually belongs under the Launch Site Operations phase (Phase 5). I was also able to update the Mission Plan from the former usage of the “Spacecraft Flight Readiness Review” to what is now the Mission Readiness Review. Finally, I created a new, updated version of the “Meeting & Review Description Table,” which provides summary information on all of the major meetings and reviews that take place throughout the process.

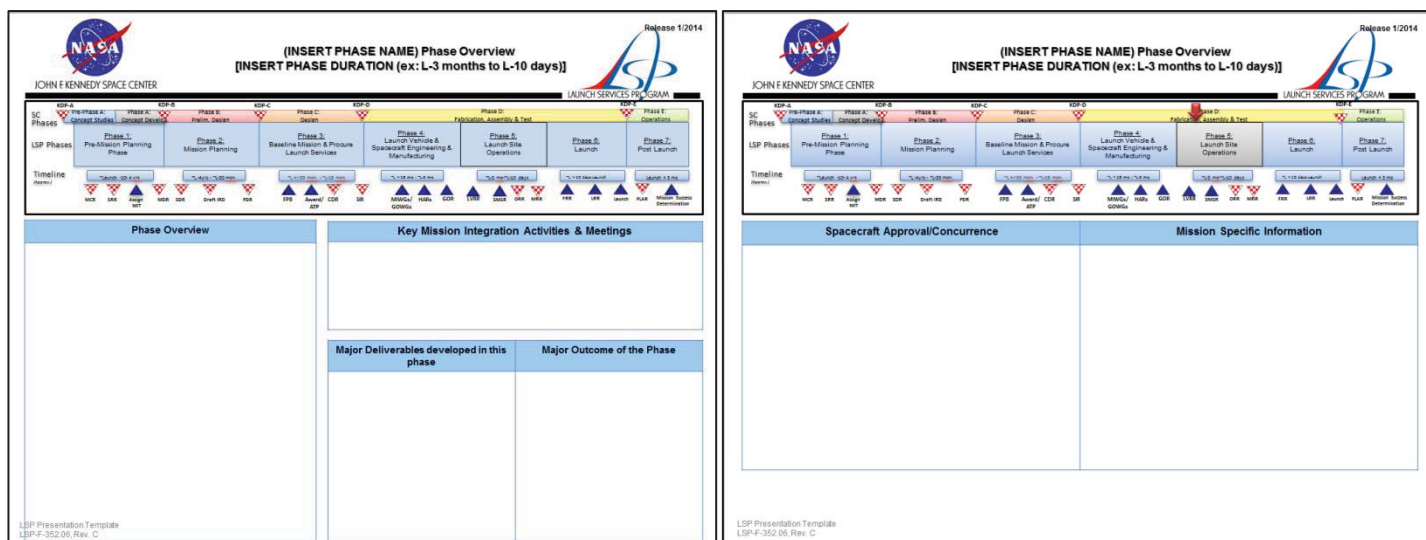


Figure 5. Mission Plan Phase Overview Charts. Above is a generic example of what the phase overview charts might look like for a given phase in the mission life cycle. I worked to update the information that already existed and to add in some new fields (such as Spacecraft Approval/Concurrence and Mission Specific Information).

In terms of the new features that I added to the Mission Plan, they mostly took the form of added categories under each phase. I added to each phase a section for “Spacecraft Approval/Concurrence” and “Mission Specific Information.” The first section gives the customer a summary of all documents that LSP will need to get their approval or concurrence on, and the second leaves a blank space for any mission-unique information to be filled in as it pertains to that phase.

3.3 Results

At the end of my work with the Mission Plan, LSP now has an up-to-date product to use as a springboard into more sweeping changes to the mission life cycle in general. The revised Mission Plan is more complete, as it encompasses all seven phases of the mission life cycle (as opposed to just five as it had previously). It also accounts for recent changes in wording used by LSP.

4. Other Experiences

On one of my first days as an intern, I was told by a retired NASA employee that my most important job this summer was “to be a sponge,” to collect as much information as I could. Throughout my time in the Flight Projects Office, I was given the unique opportunity to experience all of the aspects of a mission, from the early stages of development to the process of launch vehicle/spacecraft integration to the launch itself. I sat at my desk every day among the Mission Managers, who came from diverse backgrounds of education and experience and were a wealth of knowledge about LSP and the launch process in general. I was able to sit in on a variety of meetings including an Engineering Review Board (ERB) for the Geostationary Operational Environmental Satellites R Series (GOES-R) mission, a MIT meeting for the Magnetospheric Multiscale (MMS) mission, and various small work groups for different projects. I was also able to attend a Ground Operation Working Group (GOWG) meeting for the MMS mission, which was held off-center at Astrotech, the primary Payload Processing Facility for most missions that launch out of Cape Canaveral. At the GOWG I was able to learn about the massive logistical operation that is involved in transporting the spacecraft to the launch site and preparing it for launch. I was also able to sit on console for the launch of the Orbiting Carbon Observatory 2 (OCO-2) mission, which flew out of Vandenberg AFB in California. This was one of the most memorable experiences of my summer. The launch was scheduled for six o’clock in the morning Eastern Standard Time, and I arrived on console a little after midnight, only to sit through a scrub. The next night, thankfully, saw a successful launch and spacecraft separation, and it was a great experience all around. Even the scrubbed launch was a valuable learning experience, as I was able to see firsthand how the team goes about handling an unexpected problem. Even on top of these experiences in LSP, I was able to get a firsthand look at the progress being made in the manned spaceflight side on the Orion project. I was able to get an up-close view of the Orion space module and crew module, and a look around the facilities where the spacecraft was built and is currently being tested. This was a truly awesome opportunity and something I will not soon forget.

On top of all of my great experiences at NASA with the LSP team and otherwise, I was able to meet a number of other interns and make some very good friends from a variety of different backgrounds. It was great just to be able to sit down to lunch with some of the brightest young people from across the country. I can already say that my experience this summer at Kennedy Space Center will have an impact on the rest of my education and my work into the future.

5. Conclusion

Throughout my time in the Flight Projects Office I had the opportunity to work on two projects that are of significance to the operation of the program. MIRS is a system that serves an important purpose, but it was not accomplishing its most important goals, nor was it operating smoothly and efficiently. I worked to provide a solution to this that allows MIRS to accomplish those goals, and does so in a more dynamic, more concise manner. It is my hope that my recommendation will be able to provide a unique perspective on the issues present in MIRS, and that my feedback will be useful in the upcoming revision process. Though it was a more straight-forward project, the Mission Plan was a document that needed a good bit of work to bring it up to date on the current workings of LSP. Since I was able to provide that attention that it required, it is now ready to be utilized in the manner that the Flight Projects Office has envisioned. Both of the products that I worked with will benefit greatly from the updates I have recommended, and will be able to serve their stated purposes into the future. On top of my work, I was fortunate to have many outside opportunities to broaden my experience while on center. Taking advantage of these opportunities gave me a heightened appreciation of the spectrum of projects at Kennedy Space Center and also the significance of NASA's work at Kennedy Space Center and mission as a whole.

Acknowledgments

Chiefly, I would like to acknowledge the Flight Projects Office for welcoming me with open arms. Every week I had new people offering to take me to different meetings or show me around somewhere new, and it contributed so greatly to my experience this summer. I know that, wherever my career takes me, I will be hard pressed to find another working environment so welcoming and fun, right from the get-go. I would also like to mention my mentor, Elaina McGhee, who was invaluable in helping me with the work I did on my two projects.

References

Most of the information I used in my projects was gathered from informal conversations and interviews. Contained below is a comprehensive list of those people that I spoke with or received information from, along with the subjects that they contributed on.

1. Calero, Diana
Mission Manager, LSP Flight Projects Office; MIRS
2. Calvert, John
Mission Manager, LSP Flight Projects Office; MIRS, Mission Plan Phases VI and VII
3. Divertie, Reed
Communications Engineer, LSP Ground Systems Integration; MIRS
4. Dovale, Chuck
Deputy Program Manager, LSP; MIRS
5. Engelhardt, Rex
Mission Manager, LSP Flight Projects Office; MIRS, Mission Plan Phase IV
6. Ferland, Peter
Mission Assurance Manager, NASA Safety and Mission Assurance; MIRS
7. Gnan, Bobbi
Chief, LSP Program Business Office; MIRS
8. Green, Jay
Lead Engineer, Facilities Services Branch; MIRS
9. Hall, Jim
Mission Manager, LSP Flight Projects Office; Mission Plan Advanced Planning/Early LSP Capabilities
10. Jagdman, Jason
Integration Engineer, LSP Mission Integration Branch; MIRS

11. McGhee, Elaina
Engineering Project Manager, LSP Flight Projects Office; MIRS, Mission Plan
12. Mitskevich, Amanda
Program Manager, LSP; MIRS
13. Nguyen, Chuong
Mission Manager, LSP Flight Projects Office; Mission Plan Phase III
14. Piloto, Armando
Mission Manager, LSP Flight Projects Office; MIRS
15. Reid, Bruce
Mission Manager, LSP Flight Projects Office; MIRS, Mission Plan Phase V
16. Sierra, Albert
Chief, LSP Flight Projects Office; MIRS, Mission Plan
17. Skrobot, Garrett
Mission Manager, LSP Flight Projects Office; MIRS
18. Tatro, Chuck
Mission Manager, LSP Flight Projects Office; Mission Plan Phases I and II

In addition to these conversations, I also referenced the current Mission Plan template for my work on that project:

LSP-F-332.02 Mission Plan Template (Rev. Basic), 2009