MISSION TO MARS:

A Project Management Retrospective Analysis

By

Muhammad Salim
Gilberto De la Rosa
James Kinoshita
Julio Canelo

Engineering Systems Management

Professor Edward Camp

City College of New York

Summer 2004
# TABLE OF CONTENTS

List of Figures ................................................................................................................................. ii

Executive Summary ............................................................................................................................ 1

Section I: Project Management at NASA ...................................................................................... 3
  1.0 Background ............................................................................................................................... 3
  1.1 Project Management Approach ............................................................................................... 4
    1.1.1 Strategic Enterprises ......................................................................................................... 5
  1.2 Risk Management .................................................................................................................... 8
    1.2.1 NASA’s Past Management Approach ............................................................................. 9
    1.2.2 Fundamental Risk Management Requirements ........................................................... 9
    1.2.3 Requirements of Risk Management .............................................................................. 10

Section II: Mars Climate Orbiter .................................................................................................. 12
  2.0 Background ............................................................................................................................. 12
  2.1 Project Management Aspects ................................................................................................. 13
    2.1.1 Project Objectives/Goals Approach ............................................................................... 13
    2.1.2 Project Timeline .............................................................................................................. 14
    2.1.3 Project Management Approach ..................................................................................... 15
  2.2 Lessons Learned ..................................................................................................................... 16
  2.3 Recommendations .................................................................................................................. 18

Section III: 2001 Mars Odyssey ................................................................................................... 20
  3.0 Background ............................................................................................................................. 20
  3.1 Project Management Aspects ................................................................................................. 20
<table>
<thead>
<tr>
<th>Number</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.1 NASA’S Crosscutting Processes</td>
<td>12</td>
</tr>
<tr>
<td>1.2 Interrelationships of PAPAC Sub-processes</td>
<td>13</td>
</tr>
<tr>
<td>1.3 Continuous Risk Management process</td>
<td>14</td>
</tr>
<tr>
<td>2.1 Evolution of Faster, Better Cheaper Products</td>
<td>16</td>
</tr>
</tbody>
</table>
EXECUTIVE SUMMARY

As time progresses and demand to produce product with very restrictive timelines and low cost increases, the project manager and its management team have to be able to address issues such as risk, as well as having to mitigate potential problems such as development cost and communication issues between the teams working on the project.

The National Aeronautics and Space Administration (NASA) is an excellent example with their Mars Program, specifically their Mars Surveyor Program that was established in 1993. The objective of the Mars Surveyor Program is to conduct a series of missions to explore the Martian surface. A Mars Program Office was established and given the responsibility of defining objectives for sending two missions to Mars at each biennial launch opportunity, culminating in the return of a sample of Martian surface material back to Earth. For each launch opportunity, the Jet Propulsion Laboratory established a project office to manage the development of specific spacecraft and mission operations. The Mars Surveyor Program is an aggressive, but cost constrained program to explore the red planet over the decade extending from 1997 through 2006.

This research paper covers three different projects within the Mars Surveyor Program with the aim of investigating NASA’s project management approach, as well as their way to address risk. In order to accomplish this, the report is organized as follows: It introduces NASA’s project management guidelines, as well as their definition on risk management and processes. This is important in order to understand NASA’s position on project management and how this affects their projects and programs. After NASA’s project and risk management is introduced several projects, each with their own
successes and failures, are presented in order to determine the reasons for success and failure and how they related to NASA’s guidelines. This is in addition to determining the management approach used. The projects covered in this paper are: the Mars Climate Orbiter (1999), 2001 Mars Odyssey, and 2003 Mars Exploration Rovers.

It has been determined that the reasons for the failure of one of the aforementioned projects was due to the fact that the project manager and management teams did not follow the proper procedures, as outlined by NASA, in addition to employing poor risk management. The reasons for the success of other projects lay in proper risk management techniques along with good communication between the project manager and project teams, and proper in-between team communication.

It is recommended that engineers who wish to enter the complex field of project management (and management in general) be acquainted with research similar to this group project where unsuccessful projects are analyzed with recommendations are made for the potential of use in future assignments. In addition, the elements constituting a successful project are studied in order to for them to be implemented in future projects.

This research paper will prove to be useful to engineers in positions of management. The reason being that one can learn about real issues that occur while managing projects and apply the lessons learned from previous projects to prevent a potentially harmful situation. In addition, the practicality of project management will be revealed in the analysis of both successful and unsuccessful projects; thus proving to be a “net plus” for the engineer’s development in the management field.

Muhammad Salim  Gilberto De la Rosa  James Kinoshita  Julio Canelo
1.0 Background

NASA has established a management system that governs the formulation, approval, implementation, and evaluation of all of its programs and projects dedicated to Provide Aerospace Products and Capabilities (PAPAC). This system is intended to support the accomplishments of NASA programs and projects while being consistent with established agency strategic planning, and by satisfying the requirements of multiple stakeholders and customers.

Under NASA regulations, programs are defined as major activities within an enterprise that have defined goals, objectives, requirements and funding levels, that can consist of one or more projects. Whereas, projects are substantial proceedings designated by a program and characterized as having defined goals, objectives, requirements, life cycle costs, a beginning, and an end [1].
1.1 Project Management Approach

Successful management of programs and projects has always been the number one priority for NASA in accomplishing its work. To obtain this, NASA:

- Emphasizes that safety of the public, its flight crews, its employees, and its critical assets are of supreme importance
- Promotes efficiency in processes, with the application of innovative methods and tools to reduce the cost and the product development cycle time, while ensuring that the resources to do the job are available
- Relies upon individual and organizational commitment to responsibility and accountability for doing the job right the first time
- Invests in an educated and empowered workforce to assure the application of a rational program, project management, and engineering practice
- Invests in rational technology programs aimed at future needs, and encourages the infusion of those technologies

In the past, NASA projects were long-lasting, large, and expensive; but today a major emphasis is being placed on executing projects sooner, more economically, and with superior results. This new approach by NASA comes as a result of the lessons learned from the experiences of project managers and programs [1]. Successful NASA managers identify technical and management requirements early in the program or
project life, openly concentrate on strategies for risk mitigation, continuously assess the feasibility of meeting commitments, and involve customers extensively.

1.1.1 Strategic Enterprises

In order for NASA to realize its mission and to communicate with external customers and stakeholders, the agency has developed the NASA strategic plan, which institutes a framework of five strategic enterprises: (a) Aerospace Technology, (b) Biological and Physical Research, (c) Earth Science, (d) Human Exploration and Development of Space, and (e) Space Science.

The ways in which each enterprise develops and delivers products and services to its respective internal and external customers are established in the NASA Strategic Management Handbook [2] in the form of the following four critical crosscutting processes. These processes are as follows: Provide Aerospace Products and Capabilities (PAPAC), Manage Strategically, Generate Knowledge, Communicate Knowledge. Figure 1.1 shows the interaction of these processes with each other, as well as with customers and stakeholders.
The “Manage Strategically” process provides policy, objectives, priorities, and resources to allow the agency to develop, conduct, and evaluate programs and projects. The PAPAC process delivers space, ground, aeronautical systems, technologies, services, and operational capabilities to NASA customers so they can conduct research, explore and develop space, and improve life on Earth. The PAPAC process includes both, technology development to meet unique programmatic requirements, and crosscutting technology development programs that support multiple applications. The “Generate Knowledge” crosscutting process provides a framework for ensuring that NASA's basic and applied research is consistent with the Agency's strategic plans and that the quality of the research is maintained to the highest possible standards. The “Communicate Knowledge” process serves to disseminate this knowledge to increase the understanding.
of science and technology, advance its broad application, and inspire achievement and innovation.

The PAPAC process is sub-divided into four sub-processes to accomplish activities for both programs and projects: Formulation, Approval, Implementation and Evaluation. The interrelationships of the four PAPAC sub-processes are illustrated in Figure 1.2.

![Diagram showing the interrelationships of the four PAPAC sub-processes](image)

**Figure 1.2 The interrelationships of the four PAPAC sub-processes [1]**

The function of the formulation sub-process is to define a program or project concept and plan for implementation to meet mission objectives or technology goals specified in the Enterprise Strategic Plans. The formulation sub-process deals with the full range of implementation choices, including concepts, technologies, and operations approaches; establishes the internal management control functions that will be used throughout the life of the program or project. The purpose of the approval sub-process is
to decide initially on a program/project's readiness to proceed from formulation to implementation. NASA will only approve the baseline of those programs and projects that have firm life-cycle cost and schedule. The function of the implementation sub-process is to deliver the products and capabilities specified in the approved program and project requirements. Finally, the function of the evaluation sub-process is to provide independent assessments of the continuing ability of the program or project to meet its technical commitments and to provide value-added assistance to the program/project managers.

1.2 Risk Management

Under NASA guidelines and regulations [3], risk management is a continuous process that identifies risks. It attempts to understand their impact and prioritizes them; develops and carries out plans for risk mitigation, acceptance, or other action. Also, risk management tracks risks and the implementation of mitigation plans; supports informed, timely, and effective decisions to control risks and mitigation plans; and assures that risk information is communicated among all levels of a program/project. Risk management begins in the previously explained formulation phase with an initial risk identification and development of a risk management plan and continues throughout the product’s life cycle through the disposition and tracking of existing and new risks. The importance of managing risk lies in the following criteria:

- Early identification of potential problems
• Increase probability of project success

• Enable more efficient use of resources

• Promote teamwork by all stakeholders

1.2.1 NASA’s Past Risk Management Approach

The former NASA risk management policy was based on the disconnection from early program planning. Therefore, the reviews of the program management plan, program requirement document, and the program technical requirement systems tended to occur after their developments. This policy placed NASA in a position of always trying to “catch-up”. NASA selectively used their Safety and Mission Assurance (S&MA) policy for many projects, leaving the decision up to the program manager. Consequently, S&MA support occurred irregularly as opposed to continuously. This approach resulted in projects that were sub-optimized, with limited databases and with poor communication of overall impacts.

1.2.2 Fundamental Risk Management Requirements

• Program and project decisions shall be made on the basis of an orderly risk management effort
• Risk management includes identification, assessment, mitigation, and disposition of risk throughout the project formulation, approval, implementation, and disposal phases

• Project/Program Manager (PM) has the overall responsibility for the implementation of risk management, ensuring an integrated, coherent risk management approach throughout the project

• Risk management planning will be developed during the project/program formulation phase, included in project/program plans, and executed during the implementation phase

• Programs and projects will develop and maintain prioritized risk lists

1.2.3 Requirements of Risk Management

First, there should be risk management planning in place that is developed during the formulation phase and executed or maintained during the implementation phase. Secondly, each program/project should follow a continuous risk management process similar to the one illustrated in Figure 1.3. This process will be iterated throughout the program/project life cycle.
The risk management process starts with identifying the program/project risks and making an evaluation of its constraints. Then one should continue with the analysis, planning, tracking and control of all the risks. The risk management functions described in figure 1.3 shall be summarized as follows:

- **Identify**: State the risk in terms of condition and consequence(s)
- **Analyze**: Determine risk probability, impact/severity, and timeframe (when action needs to be taken)
- **Plan**: Assign responsibility, determine approach (research, accept, mitigate, or monitor)
- **Track**: Acquire/update, compile, analyze, and organize risk data; report tracking results
• Control: Analyze tracking results; decide how to proceed. Execute the control decisions

• Communication and Documentation: These are present in all of the preceding functions and are essential for the management of risks. A system for documentation and tracking of risk decisions shall be implemented
2.0 Background

The Mars Climate Orbiter (MCO) was part of NASA’s Mars Surveyor program which was conceived in 1993. This project was developed with NASA’s “Faster, Better, Cheaper” project approach. The Mars Climate Orbiter was launched on December 11th, 1998, atop a Delta II launch vehicle from Cape Canaveral Air Force Station, Florida. Nine and a half months after launch, in September 1999, the spacecraft was to fire its main engine to achieve an elliptical orbit around Mars. On September 23rd, 1999 the Mars Climate Orbiter mission was lost when it entered the Martian atmosphere on a lower than expected trajectory [4]. The reason for the failure was due to the fact that the two project teams involved in the space probe development were using different systems of measurement (one was using the international metric system while the other was using the U.S. metric system). This caused the navigational routine to falsely predict the trajectory of the orbiter when it arrived at its Mars orbit path.

The Mars Climate Orbiter was designed to function as an interplanetary weather satellite and communications relay for the Mars Polar Lander. The orbiter carried two science instruments: a copy of an atmospheric sounder on the Mars Observer spacecraft
lost in 1993; and a new, lightweight color imager combining wide-angle and medium-angle cameras.

2.1 Project Management Aspects

In this section, project objectives, as well as the project management approach to the mission will be presented. This section will culminate in the analysis of the issues encountered and will explain why this project failed.

2.1.1 Project Objectives/Goals

Below, are the objectives of the project:

- Develop and launch a spacecraft to Mars during the 1998 Mars transfer opportunity
- The spacecraft will contain one orbiter
- Development cost capped at $183.9M
- Collect and return to Earth, science data resulting from the remote investigations of the Martian environment by the Orbiter spacecraft
- 400 km near circular, near polar mapping orbit
- 2 year science mapping, 5 year data relay mission
The goals, as mentioned in part by the background section, were to establish the orbiter as an interplanetary weather satellite and a communications relay for the Mars Polar Lander, which was to succeed the orbiter. In addition, it aimed to provide information about the cycles of water, carbon dioxide, and dust on Mars. The Orbiter was projected to study the planet's weather for one year; acquiring data to help scientists better understand the Martian climate. All of these objectives and goals were set in the planning/definition stage of the project.

2.1.2 Project Timeline

The Orbiter development timeline is not publicly available; therefore, the mission timeline is outline below:

- December 11, 1998: Launch
- September 23, 1999: Mars Orbiter Insertion
- September 27, 1999: Mars Aerobraking Begins
- November 10, 1999: Mars Aerobraking Ends
- December 1, 1999: Transfer To Mapping Orbit
- December 3, 1999: Mars Polar Lander Support
- March 3, 2000: Mars Mapping Begins
- January 15, 2002: Mars Relay Mission Begins
December 1, 2004: End Of Primary Mission

Although the first two target dates were met, all of the others were not completed since the project failed when the Mars Orbiter Insertion began and was lost.

2.1.3 Project Management Approach

The benefit or value of project management is better, faster, with fewer resources and more predictable, which can be summed up as improved delivery. The MCO mission was conducted under NASA’s “Faster, Better, Cheaper” philosophy, developed in recent years to enhance innovation, productivity, and cost-effectiveness of America’s space program.

The “Faster, Better, Cheaper” paradigm has successfully challenged project teams to infuse new technologies and processes that allow NASA to do more with less [5]. The success of “Faster, Better, and Cheaper” is tempered by the fact that some projects and programs have put too much emphasis on cost and schedule reduction (the “Faster” and “Cheaper” elements of the paradigm). At the same time, they have failed to instill sufficient rigor in risk management throughout the mission lifecycle. These actions have increased risk to an unacceptable level on these projects. Figure 2.1 is an illustration of the Paradigm.
Since this project was under the “faster, better cheaper” paradigm, the management approach was to complete the product (the Orbiter) as quickly as possible bypassing some redundancy testing and verification that would otherwise have delayed the project timeline. This proved to be a poor approach since indeed the Orbiter failed in its mission objectives (see section 2.2).

2.2 Lessons Learned

According to the Report on Project Management in NASA report [6], there were several aspects where lessons needed to be learned such as in systems engineering, project management, institutional involvement, communications among project elements...
and mission assurance. This report will focus on the lessons learned from the project management aspect.

In order to accomplish this very aggressive Mars mission, the Mars Surveyor Program agreed to significant cuts in the monetary and personnel resources available to support the Mars Climate Orbiter mission, as compared to previous projects. More importantly, the program failed to introduce sufficient discipline in the processes used to develop, validate, and operate the spacecraft; and did not adequately instill a mission-success culture that would shore up the risk introduced by these cuts. These processes and project leadership deficiencies introduced sufficient risk to compromise mission success to the point of mission failure. The following are specific issues that may have contributed to that failure:

- Roles and responsibilities of some individuals on the Mars Climate Orbiter and Mars Surveyor Operations Project teams were not clearly specified by project management:

To exacerbate this situation, the mission was understaffed, with virtually no Jet Propulsion Laboratory oversight of Lockheed Martin Astronautics’ subsystem development. Thus, as the mission workforce was reduced and focus shifted from spacecraft development to operations, several mission critical functions — such as navigation and software validation — received insufficient management oversight. Authority and accountability appeared to be a significant issue here. It was realized that the overall project plan did not provide for a careful handover from the development project to the very busy operations project. Transition from development to operations — as two separate teams — disrupted continuity and unity of shared purpose.
• Training of some new, inexperienced development team members was inadequate:

Team membership was not balanced by the inclusion of experienced specialists who could serve as mentors. This team’s inexperience was a key factor in the root cause of the mission failure (the failure to use metric units in the coding of the “Small Forces” ground software used in trajectory modeling). This problem might have been uncovered with proper training. In addition, the operations navigation team was not intimately familiar with the attitude operations of the spacecraft, especially with regard to the attitude control system and related subsystem parameters. These functions and their ramifications for the Mars Climate Orbiter’s navigation were fully understood by neither the operations navigation team nor the spacecraft team, due to inexperience and miscommunication.

• The project management team appeared more focused on meeting mission cost and schedule objectives and did not adequately focus on mission risk:

A critical deficiency in the Mars Climate Orbiter project management was the lack of discipline in reporting problems and likewise with insufficient follow-up. The primary, structured problem-reporting procedure used by the Jet Propulsion Laboratory — the Incident, Surprise, and Anomaly process — was not embraced by the whole team. Project leadership did not instill the necessary sense of authority and responsibility in workers that would have spurred them to broadcast problems they detected so those problems might be articulated, interpreted and elevated to the highest appropriate level, until resolved. This error was at the heart of the mission’s navigation mishap. If
discipline in the problem reporting and follow-up process had been in place, the
operations navigation team or the spacecraft team may have identified the navigation
discrepancies, using the “Incident, Surprise, and Anomaly process”, and thus the team
would have made sure those discrepancies were resolved. Furthermore, flight-critical
decisions did not adequately involve the mission scientists who possessed the most
knowledge on Mars, instruments, and mission science objectives. This was particularly
apparent in the decision not to perform the fifth Trajectory Correction Maneuver prior to
Mars orbit insertion.

2.3 Recommendations

The recommendations based on the “lessons learned” are as follows:

- Roles, responsibilities and accountabilities must be made explicit and clear for all
  partners on a project, and a visible leader appointed over the entire operation.
- A cohesive team must be developed and involved in the project from inception to
  completion.
- Training and mentoring using experienced personnel should be institutionalized
  as a process to preserve and perpetuate the wisdom of institutional memory as
  well as to reduce mission risk.
• Steps must be taken to aggressively mitigate unresolved problems by creating a structured process of problem reporting and resolution. Workers should be trained to detect, broadcast, interpret, and elevate problems to the highest-level necessary until resolved.

• Acceptable risk must be defined and quantified, wherever possible, and disseminated throughout the team and the organization to guide all activities in the context of “Mission Success First.”

It should be noted that these recommendations are based on the basic principles of project management and that the failure of the Mars Orbiter Project was due to poor project management: not following standard protocol and basic concepts on management (and of course the insufficient project budget played a significant role). The risk management approaches outlined in section 1.2.1 were not followed to the point of ultimately resulting in mission failure [6].
3.0 Background

The 2001 Mars Odyssey was an orbiting spacecraft designed to determine the composition of the planet's surface, to detect water and shallow buried ice, and to study the radiation environment [7]. The orbiter was planned to nominally orbit Mars for three years, with the objective of conducting a detailed mineralogical analysis of the planet’s surface from orbit and measuring the radiation environment. The mission had as its primary science goals: to gather data to help determine whether the environment on Mars was ever conducive to life, to characterize the climate and geology of Mars, and to study potential radiation hazard to possible future astronaut missions. The orbiter also acted as a communications relay for future missions to Mars over a period of five years. The orbiter was launched on April 7\textsuperscript{th} 2001 and the Odyssey was NASA's first mission to Mars since the loss of two spacecrafts in 1999 (the Mars Climate Orbiter and the Mars Polar Lander).

3.1 Project Management Aspects

The budget for this project, timeline, and management approach will be presented in this section.
3.1.1 Budget

Total cost of the mission was $300 million. It was broken down as follows:

- Development and construction: $165 million
- Launch: $53 million
- Operations: $79 million

3.1.2 Timeline

The specific project development timeline is not publicly available; therefore the mission timeline is outlined below:

- Launch: April 07, 2001
- Mars Orbit Insertion: October 24, 2001
- Aerobraking: Completed January 2002
- Mapping and Relay: 917 Earth Days – February 2002 to August 2004

The success of the above target dates depended on proper development and project management as well as operations management. This mission has been successful thus far.
3.1.3  Project management Approach

The 2001 Odyssey was one of the most well-reviewed missions NASA has flown. Both the space agency and the spacecraft’s builder, Lockheed Martin Astronautics (LMT), were relentless in trying to ring out risk while shoring up success. Numerous processes were put into place to review all of the systems development and to maximize a “mission success first” approach. The project manager implemented several courses of action in response to the NASA review board recommendations [on the 1999 Mars failures, see Section 2] to ensure mission success, such as adding additional staff and transitioning development personnel to operations planning [8].

Additionally, the project team examined the people, processes, and designs to understand and reduce mission risk. George Pace, 2001 Mars Odyssey project manager at NASA's Jet Propulsion Laboratory, stated: “We haven't been satisfied with just fixing the problems from the previous missions. We've been trying to anticipate and prevent other things that could jeopardize the success of this mission.”

In the end, risk management, as well as proper project management ensured “mission success first.” Therefore, the management approach was based on the lessons learned from the Mars Climate Orbiter failures and the recommendations made by the investigation board [6].
3.2 Success

The success of this mission is credited to each of the Odyssey team member’s individual efforts and the lesson they have learned in their early failures. It is important to note that teamwork played a very important role since engineers and scientists from various groups worked together on this project.
4.0 Background

The Mars Exploration Rover Mission, launched in June and July, 2003, consists of two identical rovers designed to cover roughly 100 meters each Martian day. The rovers, named Spirit and Opportunity, carry five scientific instruments and an abrasion tool used to determine the history of climate and water on Mars where conditions may once have been favorable to life [9].

The objective of the two mobile laboratories on the surface of Mars is to conduct robotic geological fieldwork, focusing on the examination of rocks and soils to reveal a history of past water activity.

4.1 Project Management Aspects

The budget, management techniques, challenges, and risk mitigation techniques will next be presented.
4.1.1 Budget

The Mars Exploration Rover Mission cost an approximate $820 million, with $645 million devoted to spacecraft and scientific instrument development, $100 million for the launch, and $75 million for mission operations and data processing.

4.1.2 Challenges and Team Characteristics

The Mars Exploration Rover program was managed for NASA by the Jet Propulsion Laboratory (JPL), a division of the California Institute of Technology, located in Pasadena, California. The main challenge was posed by the project’s tight three year schedule, with a deadline of a summer 2003 launch date. In addition, this project faced undue pressure resulting from the 1998 Mars Climate Orbiter and Mars Polar Lander failures.

The Mars Exploration Rover (MER) team characteristics are as follows [10]:

- Selected a core Project/System management team with “hands-on” experience from Cassini, Galileo and other Mars projects
- Established rover-knowledgeable, MER dedicated team
- Maximized the use of experienced Mars Pathfinder system engineering and mechanical engineering design team personnel, particularly for entry, descent and landing (EDL)
• The Project, Mission and System Team formed a seamless relationship with the Principal Investigator (PI) and science teams, including the Odyssey and Mars Global Surveyor

• The Project management team had open, frequent communications with the JPL technical line management, senior JPL management and the NASA HQ program office

• Safety and Mission Assurance team personnel were embraced by the Project management team throughout the project lifecycle.

The characteristics, just mentioned, were vital to the success of the project.

4.1.3 MER Implementation

The MER project received all the requested funding since the management team, as well as upper level management at NASA, focused on “mission success first”. In addition, all the resources requested for the project were granted for the same reason. In light of that, the implementation is as follows:

• Two flight vehicles were developed providing mission redundancy and system test flexibility

• Fully embraced the JPL Flight Project Practices and Design Principles

• Fully engaged the technical line management throughout the project lifecycle

• Incorporated a hardware-rich development to facilitate testing
• Provided multiple test beds (Software and hardware) to facilitate testing

• Developed a comprehensive, incompressible test list (ITL) identifying the mandatory system verification/validation tests to be performed

• Performed extensive system level, off-nominal, robustness/stress testing

• Used technical peer reviews and Red Team reviews

• Developed and maintained a weekly up-to-date work plan with priorities

• Generated and kept current the Project “Top Ten” risk list every two weeks

• Held weekly meetings between Project and senior JPL management to discuss/review risk items and budget/schedule status

The actions mentioned above demonstrate the commitment by NASA to make sure this project was a success.

4.1.4 Risk Assessment

Besides the weekly meetings between project and senior management to discuss risk items and the two week “top ten” risks, a peer review process was implemented to limit/reduce risk exposure. The following are the characteristics of such reviews [10]:

• Peer reviews were convened by the responsible Directorate, the Project management team or the responsible technical division prior to making a major design decision/commitment

• Peer reviews were used to evaluate the integrity of the technical design and implementation, to identify/evaluate risk and to suggest/recommend risk mitigation actions

• Peer reviews used non-Project personnel (and non-JPL) with expertise to penetrate all critical technical aspects of the design and implementation

• Peer review results and disposition of suggested/recommended actions were presented and discussed at the next higher level review.

4.2 Success

Due to all of the established processes to mitigate risk, proper human and material resources allocated to this project, along with the proper communication taking place between management and project teams, this project was a success resulting in the launch and landing of the rovers. At the time of the completion of this research paper, the rovers were still conducting their mission exploring the Martian surface in compliance with their scientific mission objectives.
CONCLUSION

A retrospective analysis in project management has been presented regarding the Mars Surveyor Programs and its projects.

Project Management at NASA as well as the project management approach and risk management within different projects of the Mars Program were presented to provide the reader with a better understanding of the issues at stake when managing projects constrained with a restricted budget and timeline, as well as projects in general.

It is imperative to note that based on the information found in this research paper, project failures are usually attributed by management not following proper procedure or upper level management not providing enough of a budget for the project (this of course translates into poor planning). Besides project failures, successes were presented where proper budgeting as well as proper risk management tools and processes were put into place. This tells us that one must “fall back to the basics” when managing critical projects with very small room for error such as the ones presented on this paper. This “falling back to the basics” constitutes the management principles outlined in “Managing Engineering and Technology”. A project Manager must be able to mitigate risk as well as widening communication channels between project teams.

As product demand increases and development times decreases due to demand, the engineering project manager must keep “the lessons learned” in his/her pocket from past projects in order to properly employ the “project success first” approach.
REFERENCES


