

GAO Report: "NASA: Better Mechanisms Needed for Sharing Lessons Learned" GAO-02-195, January 30, 2002.

Executive Summary

Purpose

In the early 1990s, the National Aeronautics and Space Administration (NASA) administrator challenged the agency to complete projects faster, better, and cheaper. The intent was to reduce costs, become more efficient, and increase scientific results by conducting more and smaller missions in less time. Although NASA maintained a high success rate under the faster, better, and cheaper strategy, a few significant mission failures also occurred—particularly the loss of the Mars Polar Lander and Climate Orbiter spacecraft. NASA investigations of these failures, as well as its review of other programs, raised concern that lessons from past experiences were not being applied to current programs and projects. At the request of the Chairman and Ranking Minority Member, Subcommittee on Space and Aeronautics, House Committee on Science, GAO assessed whether NASA has adequate mechanisms in place to ensure that past lessons learned from mission failures are being applied. Specifically, GAO (1) identified the policies, procedures, and systems NASA has in place for lessons learning, (2) assessed how effectively these policies, procedures, and systems facilitate lessons learning, and (3) determined whether further efforts are needed to improve lessons learning.

Background

NASA's procedures and guidelines require that program and project managers review and apply lessons learned from the past throughout a program's or project's life cycle and to document and submit any significant lessons to the agency's Lessons Learned Information System (LLIS) in a timely manner. NASA defines a lesson learned as knowledge or understanding gained by experience. The experience may be positive, such as a successful test or mission, or negative, such as a mishap or failure. A lesson must be significant in that it has a real or assumed impact on operations; valid in that it is factually correct; and applicable in that it identifies a specific design, process, or decision that reduces or eliminates the potential for failures and mishaps, or reinforces a positive result.

Results in Brief

NASA recognizes the importance of learning from the past to ensure future mission success and uses several mechanisms to capture and disseminate lessons learned. The principal source NASA has established for the agency-wide collection and sharing of lessons is the LLIS, a Web-based lessons database that managers are required to review on an ongoing basis. In addition, NASA uses training, program reviews, and periodic revisions to agency policies and guidelines to communicate lessons. Several NASA centers and key programs also maintain lessons learned systems that are geared toward their own staff. Recently, NASA has taken steps to improve the

way it captures and shares information by developing a business strategy called knowledge management. Knowledge management can be defined as the way that organizations create, capture, and reuse knowledge to achieve their objectives. According to NASA officials, knowledge management has the potential to link agency staff with the knowledge and resources they need to complete tasks faster, better, and cheaper. In pursuit of knowledge management, NASA has developed a strategic plan, established a management team to coordinate knowledge management activities at NASA's centers, and initiated several information technology pilot projects. Despite the processes and procedures in place to capture and share lessons learned, there is no assurance that lessons are being applied toward future missions success. A GAO survey of NASA program and project managers revealed weaknesses in the collection and sharing of lessons learned agency-wide. While some lessons learning does take place, our survey found that lessons are not routinely identified, collected, or shared by programs and project managers. Respondents reported that they are unfamiliar with lessons generated by other centers and programs. In addition, many respondents indicated that they are dissatisfied with NASA's lessons learned processes and systems. Managers also identified challenges or cultural barriers to the sharing of lessons learned, such as the lack of time to capture or submit lessons and a perception of intolerance for mistakes. They further offered suggestions for areas of improvement, including enhancements to LLIS and implementing mentoring and "storytelling," or after-action reviews, as additional mechanisms for lessons learning. While NASA's current knowledge management efforts should lead to some improvement in the sharing of agency lessons and knowledge, they lack ingredients that have been shown to be critical to the success of knowledge management at leading organizations. Cultural resistance to sharing knowledge and the lack of strong support from agency leaders often make it difficult to implement an effective lessons learning and knowledge sharing environment. We found that successful industry and government organizations have overcome barriers by making a strong management commitment to knowledge sharing, developing a well defined business plan for implementing knowledge management, providing incentives to encourage knowledge sharing, and building technology systems to facilitate easier access to information. The application of these principles could increase opportunities for NASA to perform its basic mission of exploring space faster, better, and cheaper more successfully.

Principal Findings

NASA's Policies and Procedures for Lessons Learning

NASA uses various mechanisms to communicate lessons garnered from past programs and projects. Policies and guidelines, programmatic and technical reviews, mentoring and training programs, the Academy of Program and Project Leadership, and LLIS are the mechanisms employed by NASA for capturing and sharing lessons learned. LLIS is the "official" agency-wide repository for such lessons. Lessons entered in the LLIS database are screened for relevance and to ensure that they do not contain sensitive or proprietary information. Initial reviews of lessons are usually conducted by the centers,¹ with a final review by the Office of Safety and Mission Assurance. After a lesson is entered into the system, it remains in the database indefinitely and is not reviewed for currency or relevance. Currently, the system contains over 900 lessons on topics ranging from program management to technical cause of

failure. In response to the Mars Program failures and the recommendations of agency reviews of program and project execution, NASA has recently taken action to improve its policies and practices for capturing and sharing knowledge by developing a business strategy referred to as knowledge management. Implementation of knowledge management can lead to increased productivity, collaboration, and innovation in the workplace. To coordinate and guide its efforts, NASA recently formed a knowledge management team, which developed a strategic plan that laid out broad goals and objectives for knowledge management. In addition, several pilot projects are underway at various NASA centers to enhance knowledge sharing.

Fundamental Weaknesses Exist in the Collection and Sharing of Lessons Learned

A survey we conducted of all NASA program and project managers revealed fundamental weaknesses in the collection and sharing of lessons learned agency-wide. Although NASA's processes and procedures require that program and project managers review and apply lessons learned throughout a program's or project's life cycle, our survey found that managers do not routinely identify, collect, or share lessons. Respondents indicated that LLIS, NASA's primary method for disseminating lessons learned agency-wide, is not the primary source for lessons learning. Instead, managers identified program reviews and informal discussions with colleagues as their principal sources for lessons learned. One reason LLIS is not widely used, according to one center official, is because its lessons cover so many topics that it is difficult to search for an applicable lesson. Another respondent indicated that it is difficult to weed through all the irrelevant lessons to get to the few "jewels" that you need to find. Respondents also identified challenges or cultural barriers to the sharing of lessons learned as well as areas of improvement. Managers noted that there is a reluctance to share negative lessons for fear that they might not be viewed as good project managers, and there is a lack of time for lessons learning to take place. One manager stated, "Until we can adopt a culture that admits frankly to what really worked and didn't work, I find many of these tools to be suspect." Managers suggested that NASA could improve lessons learning by implementing mentoring and "storytelling" activities, and it could enhance LLIS by increasing its search functions, including more positive lessons, and developing a mechanism to disseminate key lessons to users. In discussions with NASA officials, we found there was general agreement with the results of our survey as well as suggested improvements for lessons learning. Officials indicated that lessons learning has taken on greater importance in recent years due to the implementation of more programs and projects under the faster, better, cheaper strategy and the continuing loss of agency expertise due to attrition. They acknowledge that LLIS has not been an effective mechanism for agency-wide sharing of lessons. Although the system is viewed as providing a useful repository for storing lessons, officials agreed with managers' concerns about the difficulties involved in searching the system and finding relevant lessons, the inconsistent quality of information contained in the system, and the lack of lessons about positive project experiences. However, while program and project managers' suggested improvements would help increase the usability of LLIS, they have not targeted some of the more fundamental problems hampering NASA's ability to share lessons, such as persistent cultural barriers.

Creating an Environment for Lessons Learning through Knowledge Management

Leading organizations are discovering that actively managing knowledge creates value by increasing productivity and fostering innovation. Likewise, NASA's paramount concern should be about capturing and sharing organizational knowledge and using it to perform its basic mission of exploring space faster, better, and cheaper. Although NASA has recently taken action to improve the way in which the agency captures, organizes, and shares knowledge, these efforts do not fully address the fundamental weaknesses in lessons learning identified by our survey: namely, cultural resistance to sharing knowledge and the lack of an effective strategic framework and management attention for overcoming such resistance. NASA has made a reasonable start by developing a strategic plan for knowledge management, but the agency has not made a good business case for how it will implement and use knowledge management within the organization. In addition, while successful industry and government organizations have made a firm commitment to making knowledge management practices work, NASA has not provided the leadership, support, and resources needed for effective knowledge management to take place. Furthermore, knowledge management organizations have employed incentives, processes, and systems designed to address cultural barriers to continuous lessons learning and knowledge sharing. For example, organizations that value knowledge sharing have encouraged employees to spend time sharing knowledge, helped facilitate communities of practice based around common interests, and provided rewards when knowledge has been shared and applied. NASA has not done so on an agency-wide basis.

Recommendations

NASA needs to strengthen its lessons learning in the context of its overall efforts to develop and implement an effective knowledge management program. Improvement of NASA's lessons learning processes and systems can help to ensure that knowledge is gained from past experiences and applied to future missions. We recommend that the NASA administrator strengthen the agency's lessons learning processes and systems by

- articulating the relationship between lessons learning and knowledge management through an implementation plan for knowledge management;
- designating a lessons learned manager to lead and coordinate all agency lessons learning efforts;
- establishing functional and technical linkages among the various centerlevel and program-level lessons learning systems;
- developing ways to broaden and implement mentoring and "storytelling" as additional mechanisms for lessons learning;
- identifying incentives to encourage more collection and sharing of lessons among employees and teams, such as links to performance evaluations and awards;
- enhancing LLIS by coding information and developing an easier search capability to allow users to identify relevant lessons, including more positive lessons, providing a means to disseminate key lessons to users; and soliciting user input on an ongoing basis; and
- tracking and reporting on the effectiveness of the agency's lessons learning efforts using objective performance metrics.

Agency Comments and Our Evaluation

In written comments on a draft of this report, NASA generally concurred with our recommendations for improving the agency's lessons learned processes and systems. NASA stated that it must do a better job of communicating the various lessons learned sources to employees, improving mechanisms to link these sources, and ensuring appropriate training for employees in order to maximize lessons learning.