

# NASA Autonomous Rotorcraft Project

## *Project Management Leads to Industry Leader in Innovative Aviation*

Part of NASA's mission is to consistently develop innovative flight technologies to help advance America's prowess in aerospace and aviation. NASA embarked on the Autonomous Rotorcraft Project (ARP) as part of that mission.

The project goal was to develop an unmanned helicopter (rotorcraft) that would operate with the decision-making skill of a piloted aircraft. Facing technological complexities, management challenges and the coordination of multiple organizations, NASA used project management competencies to meet its goals while staying on-time and on-budget.

### Background

The ARP posed several challenges. Representatives from the Army/NASA Rotorcraft Division, the NASA Exploration Technology Directorate and the Flight Projects Office (FPO) made up the ARP team, which was comprised of experts in aeromechanics and flight control, autonomous executive software, helicopter dynamics and vehicle health management.

The ARP team hired a project manager who was responsible for:

- developing schedules, budget and project progression reports;
- communicating with stakeholders and upper management at NASA for approval on all tasks;
- overseeing hardware and software development;
- crafting risk analysis documents; and
- producing data and evaluations.

The two prototype autonomous rotorcrafts used for this project, named Ariel and Caliban, were modified Yamaha RMAX radio-controlled helicopters with additional planning software and flight control components.

NASA tasked the ARP team with developing, demonstrating and evaluating automated reasoning technologies for

rotorcraft. This would fulfill NASA's mission to extend its technology expertise in this field. Specifically, the team would create a flying laboratory consisting of advanced flight controls, a reactive planner, all-digital camera system with tracking and passive ranging capabilities and real-time health management systems.

By completing the above tasks, the ARP team hoped to develop a rotorcraft that could:

- maneuver around obstacles without human supervision,
- accomplish top-level mission goals,
- conduct vehicle health management activities (i.e. diagnose and fix problems on the rotorcraft automatically), and
- re-plan the mission should unforeseen circumstances occur.

### Challenges

Coordinating the ARP project team was one of the initial challenges as it was comprised of people from various organizations with different experience, backgrounds and working styles.

The project manager also had to report to two supervisors—NASA and the Computing, Information and Communications Technology Program (CICT)—which sometimes had different priorities for the project or ways they wanted information relayed to the team.

### Solutions

To keep team members informed and ensure stakeholder expectations were met, the ARP manager used project management to define the project scope. The team then presented this project scope to stakeholders, who then discussed and negotiated all points with team members.

Team members could then incorporate the changes and agree on responsibilities. This allowed them to carry out their tasks in a more efficient manner with a clearer picture of the end result.

The combined team used project management techniques to establish motivational tools and near-term focus deadlines to ensure success. The main technique was to schedule regular demonstrations of the teams' accomplishments, ensuring a specific amount of the work was completed before it was presented.

Following these presentations, the ARP manager could determine and provide the additional resources and supplemental information the team needed, and follow up to review the team's progress and the challenges it faced in reaching its end goal.

The team planned and maintained communication throughout the project using project management techniques. The ARP project manager housed both his team and the hanger team together for easier communication; he could also receive instant updates of project status.

An ARP Project website was created to keep NASA Computer, Information and Communications Technology Program upper management and stakeholders aware of the project's progression.

The team also provided project updates to potential customers of the finished rotorcraft, including the Department of Homeland Security, the National Technology Transfer Center and other NASA researchers. This offered the dual benefits of marketing the rotorcraft and maintaining team morale by cultivating project support. In addition, all material presented in the updates was accessible to the team via the website, including flight plans, authorized documents, scheduling, photographs and videos.

The Safety of Flight Review Board was also active in the project by making periodic approval checks throughout the process. Having these approvals completed throughout the project meant there would be no significant delays. Flight plans were also tested and reviewed by peers to ensure the results were meeting NASA's goals. The ARP manager was able to select these reviewers from a pool of highly qualified NASA researchers.

In order to combat risk, the project manager found potential weaknesses in plans and prepared responses to any major delays or crises. All of these risk management strategies were shared with the team in weekly meetings, and therefore, the

entire team knew how to respond to any incident that could occur.

## Results

The project manager learned early to meet the needs of each team member and communicate individual responsibilities, ensuring deadlines were established and met. The manager also sought each team members' opinion to find the best possible solution; team members felt they were truly a part of the team.

In addition, when the project manager learned the time spent scheduling flight tests was more than he expected, he allotted more time and energy into scheduling to ensure it would not cause future delays.

The ARP team was able to assist the CICT Program in meeting its goal of developing and testing the fundamental technologies of automated reasoning. The ARP project also helped serve as a stepping stone to the 2005 fiscal year and future NASA projects. Without the extremely disciplined project manager on the ARP team, the project would not have given NASA the knowledge they sought in the autonomous field.

## Key Achievements

- The ARP satisfied all of NASA's success factors, including meeting or exceeding client needs, and meeting or improving on budget.
- The ARP met all scheduling goals, completing each phase with no scheduling delays.
- NASA expressed a high level of satisfaction with the finished project and supported the ARP team's nomination for PMI's 2005 Project of the Year.