

Shared Experience in NASA Projects

Some Tips and Observations

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It has been a real opportunity to serve in all but the first five of the 30 years of U.S. spaceflight. For program and project managers, these three decades have been filled with enormous challenge and exciting opportunities, mainly because there have been no clear precedents for managers. In those early years, we had to progress incrementally, if you wish. Each step along the way, NASA and industry expanded the knowledge base and technological capabilities to a point where each individual project became incrementally more complicated, expensive and challenging. Management of these projects--from the small unmanned payloads to the medium-sized Mercury-Gemini to the larger payloads of the Apollo-Skylab era--likewise presented new challenges and demands. The old ways of doing things simply did not work in this new complex and high-tech environment.

Nor will they work in the current phase of spaceflight development, with multiple payloads in the Shuttle era. New tools, new techniques are required as NASA and industry enter the long-term aspects of space station design, development and operations.

Yet, we all look back with pride to spaceflight programs of the past that worked efficiently. We respect the management tools that led to mission success in earlier projects. As we look toward the management challenges of spaceflight development of the 1990s, we must reflect on the accomplishments and failures of the past and apply the lessons learned in a constructive way. The NASA project manager represents the leadership of the U.S. in space exploration. It is critical that the NASA project manager learn from the past to build a space program second to none.

In other words, there are some things worth saving, others to discard and still more to build upon. When you add up all the marvelous advances and successful missions of the past 30 years of U.S. spaceflight, you can't help but think that the partnership between NASA and industry has become one of the more remarkable management feats of all time. The synergy and cross-fertilization of this partnership are worth exploring.

My purpose here is to provide a perspective of both NASA and industrial project management issues as they relate to research and development activities. NASA project managers represent the leadership of an organization. As such they have accepted a responsibility--better stated, an accountability--for the total aspect of a particular task. They must accept cost and schedule responsibility, along with the technical aspects of the assignment. A good manager views this assignment as if it were a personal business and tries to determine effectiveness by some predetermined measurement system. Following are observations on project management issues from both NASA and industry points of view.

First of all, the initial formulation of a NASA project is extremely critical to mission success. The advocacy phase must be carried out with very careful planning, timely marketing and with a clear understanding of the organization's mission and available resources. On the government side, the establishment of an approved project may take years. Early in the advocacy process, a strongly supportive outside constituency is needed, to help secure a budget line item for the next fiscal year. This

constituency should include several aerospace contractors willing to direct their new business resources toward the project in return for an opportunity to compete in the design and formulation phase.

The industry formulation process is not very different. Contractors have limited resources and a large spectrum of opportunities. The successful contractor gets involved early, assigns qualified people, provides adequate resources and maintains a strong relationship with NASA so that critical resources are focused to the project objectives. Contractors are available to help NASA in the selling of the project during the formulation period.

Accountability

In accepting accountability for an organization unit, make sure you understand its objectives. In addition, find out what inter-organizational relationships are required and where your resources and constraints will come from. Understand what is expected of your unit. Get a contract between you and your boss, you and center management, you and headquarters, you and your family. If internal and external forces are going to influence the performance of your unit, get a commitment to:

- Cost
- Schedule
- Technical performance
- Risk

Make sure you are given sufficient authority to carry out your task. Don't put yourself in a "no-win" position at the outset. Get an understanding--and then the commitment. A successful business always does.

When I look back on my NASA years, it strikes me that the government system ordinarily does not provide a natural environment for full accountability. The typical organizational structures and the non-profit environment are impediments to accountability. On the other hand, the industrial R&D managers assume fiscal responsibilities very early in their career and are better prepared for project management responsibilities. Perhaps NASA managers should develop their own methods outside

of the organizational system to provide the stimulus for accountable management. Essentially, the skill is there--but the environment is not.

Establish a Standard

After receiving a clear understanding of the management assignment and the resources and schedule constraints, make sure you develop specification, a standard of performance. Make your specification realistic and flexible. (Many a manager has died of hardening of the categories.) Divide your work into a logical structure. Avoid false competition, unnecessary overlap, or gaps. Find the right person for the right job. Delegate a portion of your contract to your subordinates and depend on them.

I believe that the discipline and the environment of NASA encourage individual performance in the development of hardware/software capabilities. Industry, driven by the profit motive, will find ways to meet performance requirements that avoid strict adherence to rules and regulations. NASA is experienced in setting standards but not compliance to them. Simply stated, it is easier to write the rules than to follow them. I believe that a healthy exchange of technical experience can benefit both parties.

Make a Plan

Establish an integrated plan. Assign accountability for accomplishment. Make sure you understand the critical elements and provide sufficient schedule margin for "work-arounds." Review performance versus plan, frequently. Detailed schedules should be realistic. (Be careful--do not become overly optimistic.) I believe in pressure scheduling only to meet a crisis. Crisis or stress management in a research environment should be the exception and not the rule. Schedules and plans should be highly visible.

There seems to be very little difference between planning in NASA and the aerospace industry. Both organizations are highly tuned and efficient in the aspects of integrated planning, and both have developed performance measurements systems significantly useful to the decision-making process. I cannot find any difference in technique, process, or effectiveness. Perhaps we have trained each other to

be consistently good and bad in the areas of planning, review and analysis.

Communications

A good manager is a good communicator. You should develop a motto of "no surprises." Communicate frequently. A few ideas:

- Weekly staff meetings
- Management by walking around
- Electronic management information systems
- Teleconferences with contractors and grantees
- Thorough requirement and design reviews
- Frequent status reviews
- Outside reviews
- Visits to outside work activities (and show interest)
- Finding a way to involve your boss
- An open-door policy for your people
- Curiosity (ask questions)

In my short time in industry, I have been impressed that industry is far more bureaucratic than NASA in its communication methods. For instance, customer briefings are critiqued to a far greater extent than I experienced at NASA. It is apparent that the success of the project and, in turn, the company, are critically assessed. NASA's approach is to assume a degree of confidence in the program and competence in its people. It is an attitude that I appreciated and somewhat miss.

Contract Management

The easiest way to improve contract performance is to concentrate on the selection process. Make sure your contractor has the experience and personnel to carry out the technical aspects of the contract. Remember, a bad marriage between the government and contractor will always lead to a costly divorce settlement for the government. Some thoughts to keep in mind:

- Guard against expansion of requirements
- Expect the unexpected technical problems
- Temper optimism regarding schedule and cost
- Watch for engineering changes that make things better instead of make them work
- Expect an underscoping of the project control function

In industry, the contracting relationship is normally between two aerospace contractors. There is far less formality in this type of a relationship and, as a result, a lot more difficulty in full compliance and implementation. Although I have found the NASA procurement process to be stifling, it has benefits in long term implementation and compliance.

Getting Your Vote Canceled

One barrier to effective communications is the fear of senior management involvement in detailed decision making. It has been my management philosophy that when my boss is in the same meeting with me, my vote is canceled. This concept places the manager in the delicate position of deciding which meetings the boss should attend.

The industry performance incentive program insures your boss's personal interest in anything you do that can affect the bottom line and the boss's paycheck. However, a successful project leader must have control of the resources necessary to ensure success.

The Golden Rule

In both NASA and industry, the golden rule applies. The manager with the gold-rules. Make sure you receive and control the money needed to accomplish your mission. If either your boss or your boss's boss controls the money, they in fact control the project. A project manager simply must control all the resources necessary for mission success, or some method of accountability must be devised.

Find Something to Count

After you understand your objectives, establish your baseline and obtain a contract and resources, it is then necessary to check your progress by frequent reviews and analyses. Managers in government

can't measure performance against the industry profit milestone. But they can find things to count and they can measure progress by establishing performance standards and by variance reporting. A few examples of countable items:

- Data points
- Computer runs
- Documents released
- Reports published
- Pieces of hardware
- Value of work performed
- Money spent
- Manpower expended
- Time lost or saved
- Test hours
- Major milestones reached
- Review points completed

Performance Feedback

Do not be afraid to alter plans, specifications, and resources, based on past performance and future expectations. Good managers know where they are going by a critical analysis of where they have been. When changing the baseline, make sure you communicate up and down and that all are working to the revised plan.

A good manager stays involved in the details through an effective review program. Stress early problem identification and aggressive application of remedial measures.

As in planning, both NASA and industry do an outstanding job of performance measurement. Mission success is a goal in both organizations, and management tools have been developed for effective control of large R&D projects.

Cost Management

The first rule of good cost management is to set aside dollars for a rainy day. Identify reserves and develop

a management plan for control and allocation of those reserves. Perform a risk analysis and identify the program cost drivers. Have a shopping list of cost offsets to provide additional margin. Make sure you can reduce performance and schedule constraints to reduce cost. My industry experience indicates that the ability to retain cash reserves for effective cost management is extremely difficult. Matrix organizations tend to assign resources to functional organizations, thereby making it difficult to retain reserves. Industry can learn much from NASA in the art of contingency planning.

A Strong NASA/Contractor Project Relationship

Experience shows that the best relationships hinge on two major factors. First and foremost, the two parties must establish a strong and active communication network. Every effort should be made immediately after contract to start to generate an effective reporting system with strong emphasis on the early identification of problems and improvements in communication methods and tools. The parties must also agree to complete near-term action items early, to identify "one-on-one" relationships clearly and to secure senior management participation.

The second factor is to establish an honest and open relationship. This usually takes hard work on the part of both parties. It is critical to the success of the project that both parties are dealing from the same data base when formulating policies and making decisions. Remember, the NASA and the contractor are both interested in the same result--a successfully completed project within the cost and schedule constraints prescribed by the NASA. Experience in industry indicates that the profit motive is important to the contractor but not at the expense of NASA dissatisfaction. I believe the long-term involvement in civil space and aeronautics is rated higher than profit. The challenges of a NASA program help attract new technical skills to a company, thereby fostering long-term growth.

NASA managers should be sensitive to this emphasis on long-term capabilities vs. short-term profit by stressing a complete and honest relationship. If changes are caused by a NASA decision or event, the NASA team should expect the contractor to receive a fair adjustment in both cost and fee. On the other hand, if contractors have performance problems, they should be prepared to fix the problems without

benefit of a fee adjustment. Both parties striving toward this type of open and honest exchange will establish the trust so critical to the achievements of project objectives and mission success.

This open and honest relationship between NASA and contractor hinges upon strong communication. The project manager can communicate in a number of ways: by computer, telephone, voice, the written word, gestures, tone, style, etc. But the successful project leaders communicate best by personal

example. They are role models for the next generation of managers. Their ideas and aspirations, especially their vision, are communicated even more clearly than their words. That vision will have impact far beyond the day-to-day project and will invariably extend to relationships within NASA, the cooperation of contractors, the team spirit for mission success and the users of the project--the customers, taxpayers and beneficiaries of an on-time, on-budget project. The ripple effects of a well-managed project (as we have seen from earlier spaceflight programs) will last for years if not generations.

My Lessons Learned

1. *Never lose your capacity for enthusiasm.*
2. *Never lose your capacity for indignation.*
3. *Never judge and classify people too quickly; first assume always that they are good.*
4. *Never be impressed by wealth alone or thrown by poverty.*
5. *If you can't be generous when it's hard to be, you won't be when it's easy.*
6. *The greatest builder of confidence is the ability to do something, almost anything, well.*
7. *When that confidence comes, strive for humility, for you aren't as good as all that.*
8. *The way to become truly useful is to seek the best that other brains have to offer. Use them to supplement your own, and be prepared to give credit to them when they have helped.*
9. *The greatest tragedies in work and personal events stem from misunderstanding. Communicate.*