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ASK

INTERVIEW

Dennis McCarthy

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Inside

APPL

My philosophy was to delegate and empower people. To me, that's the job of the project manager: empowering and removing obstacles.

—Dennis McCarthy, from his *ASK* interview (p. 33)

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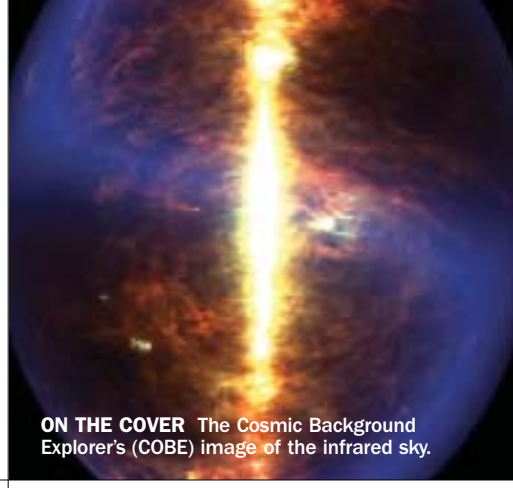

ON THE COVER The Cosmic Background Explorer's (COBE) image of the infrared sky.

APPL
appl.nasa.gov

APPL DIRECTOR AND PUBLISHER
Dr. Edward Hoffman
ehoffman@hq.nasa.gov

EDITOR-IN-CHIEF
Dr. Alexander Laufer
allaufer@eng.umd.edu

EDITOR
Jessica Simmons
jsimmons@edutechltd.com

PROJECT MANAGER: KNOWLEDGE SHARING
Denise Lee
dlee@edutechltd.com

KNOWLEDGE SHARING MANAGER
Therese Salmon
tsalmon@edutechltd.com

CONTRIBUTING WRITERS
W. Scott Cameron
Terry Little
Ray Morgan
Scott Tibbitts

EDITORIAL ASSISTANT
Michael Derocher
mderocher@edutechltd.com

DESIGN
Hirshorn Zuckerman Design Group, Inc.
www.hzdg.com

SENIOR PRINTING SPECIALIST
Jeffrey McLean
jmclean@hq.nasa.gov

PRINTING
Fontana Lithograph, Inc.

WELCOME TO THE ACADEMY OF PROGRAM AND PROJECT Leadership (APPL) and *ASK Magazine*. APPL helps NASA managers and project teams accomplish today's missions and meet tomorrow's challenges by providing performance enhancement services and tools, supporting career development programs, sponsoring knowledge sharing events and publications, and creating opportunities for project management collaboration with universities, professional associations, industry partners, and other government agencies.

ASK Magazine grew out of APPL's Knowledge Sharing Initiative. The stories that appear in *ASK* are written by the "best of the best" project managers, primarily from NASA, but also from other government agencies and industry. These stories contain knowledge and wisdom that are transferable across projects. Who better than a project manager to help another project manager address a critical issue on a project? Big projects, small projects—they're all here in *ASK*.

Please direct all inquiries about *ASK Magazine* editorial policy to Jessica Simmons, EduTech Ltd., 8455 Colesville Road, Suite 930, Silver Spring, MD 20910, (301) 585-1030; or email to jsimmons@edutechltd.com.

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It's Showtime

I was hired to fill some pretty large editorial shoes

I'M THE NEW EDITOR OF THIS WELL-ESTABLISHED, AWARD-winning magazine known in the project management community for its innovative knowledge sharing approach. So the writing skills wouldn't be enough. I knew I needed to really *get inside* the culture of NASA and good project management.

When you know there is a lot to be learned, I've found that humility is the best way to go. Acknowledge your weaknesses, ask questions of the right people, and hopefully turn those weaknesses into strengths. Sometimes you have to push a little, like Dennis McCarthy tells us in his interview about finding a rocket to launch COBE. The best thing is to get on the agenda of the people who know the answers; I didn't only rely on books, I pushed for people to *show* me what they know.

Who was I getting to answer all my questions about this new culture? Other APPL team members, *ASK* staff, and mainly the storytellers themselves. Yes, the best lessons I learned were from the *ASK* archives—straight from the mouths of the project managers. The magazine has always picked the best of the best and hoped that their examples would help others. So I went straight to *ASK*'s website and started observing project managers in their natural habitat.

My research paled in comparison to the methods Owen Gadeken describes in his story, "In Search of the Ideal Project Manager." In the end, he realized that there is no "single" way to project management success. Yet he and others helped me see some common attributes in successful managers: the real role models are those who get results while being true to themselves and their teams. Ken Szalai gives us an example of such a role model in his mentor, Cal Jarvis, and how his vision and his focus on results pushed their project to success.

Not every article in *ASK* is a success story; each shows the struggles of being a leader. The storyteller takes the temporary role of the mentor, and like Terry Little writes in his article on the topic, the students of the audience get to ask, "Is this something worth emulating? Is it something to avoid?" The stories are a way for readers to observe project managers in action from afar.

While much of my cultural education can best be written in outline form, like you'll see in Alex Laufer's piece on "Managing Projects in a Dynamic Environment," the lessons can best be "illustrated" by referencing the *ASK* examples used to hammer home his many points. In the short time I've worked with Dr. Laufer, he's told me repeatedly to "show, not tell." And he's right—we need to see the action, to decide who to emulate, to figure out what qualities we respect.

On that note, I hope that you will let Linda Rutledge and Ed Hoffman show how balancing your career and home life enhances both, let W. Scott Cameron show you just how valuable communications skills are to engineers, allow Ron Zellar to show how a little music and candy go a long way towards creating team spirit, and observe the actions—some fruitful, some not—that our other featured storytellers show us in their narratives.

I feel honored to have been given the opportunity to join the team that brings you these narratives. So sit back, relax, and enjoy the *show*. •

JOHN BRUNSON of the Marshall Space Flight Center, Systems Management Office, is a member of the NASA Program Management Council Working Group. He supports the Agency's Chief Engineer Office and MSFC in the review/development of Agency and Center Program/Project Management and Systems Engineering policy. He led the development of MSFC's Project Management and Systems Engineering Handbook as well as in-house training modules in these areas. He served as project manager for three separate microgravity payloads that flew on various Spacelab missions. Prior to his project management experiences he served as the Integration and Test Team Lead for the Tethered Satellite System Mission. His career with NASA began in the late 1980's as a member of the Space Shuttle Main Engine Engineering Team.

DR. MICHELLE COLLINS works in the Spaceport Engineering & Technology Research Group at Kennedy Space Center. She has over twenty years experience in aerospace spanning engineering, R&D and project management. She is on the Florida Institute of Technology Department of ChE Industrial Advisory Board, the National Fire Protection Association's Technical Committee for Halon Alternatives, and the United Nations Environmental Programme Halon Technical Options Committee.

HECTOR DELGADO is Division Chief of the Independent Technical Authority in the Independent Technical Authority and Systems Management Directorate at the Kennedy Space Center. Previously Hector was the Division Chief of Process Tools and Techniques in the Safety, Health and Independent Assessment Directorate. In 1995, he served as Senior Technical Staff to the NASA Chief Engineer at NASA Headquarters in Washington, D.C. He has received many honors and awards including the Exceptional Service Medal, Silver Snoopy Award, and various achievement awards.

DR. OWEN GADEKEN is a Professor of Engineering Management at the Defense Acquisition University where he has taught Department of Defense program and project managers for over 20 years. He retired from the Air Force Reserve as a Colonel and senior reservist at the Air Force Office of Scientific Research where he helped manage the basic research program for the Air Force. He holds adjunct faculty appointments at the Federal Executive Institute and the Center for Creative Leadership. Owen is a frequent speaker at project management conferences and symposia.

DR. MICHAEL HECHT has been with NASA since 1982 at the Jet Propulsion Laboratory (JPL). He is instrument manager and lead investigator for the MECA soil-analysis payload on the 2007 Phoenix mission to Mars, reprising a role he played on the cancelled 2001 Mars Surveyor Lander mission. In the course of his JPL career, he has served in line, program, and project management, and has participated in research ranging from fundamental semiconductor physics to martian geophysics.

JODY ZALL KUSEK coordinates results based management at the Africa Region of the World Bank. She is currently involved in supporting the efforts of several African governments to move to a focus of performance-based management. She has spent many years in the area of public sector reform, serving the Vice President of the United States, the U.S. Secretary of the Interior and the U.S. Secretary of Energy in the areas of Strategic Planning and Performance Management.

DONALD MARGOLIES retired from the Goddard Space Flight Center in January 2004. He was Project Manager for the Advanced Composition Explorer (ACE) mission, launched in 1997 and still operating successfully. He received the NASA Medal for Outstanding Leadership for his work on ACE, and a NASA Exceptional Service Medal for the Active Magnetospheric Particle Tracer Explorers (AMPTE) mission.

DR. GERALD MULENBURG is a member of the Systems Management Office at the NASA Ames Research Center in California specializing in project management. He has project management experience in airborne, spaceflight, and ground research projects with the Air Force, industry, and NASA. He also served as Executive Director of the California Math Science Task Force, and as Assistant Director of the Lawrence Hall of Science.

JOAN SALUTE is the Associate Director for Projects in the Information Science and Technology Directorate at the Ames Research Center. Joan currently is on detail to NASA Headquarters. Joan previously was the Associate Director of Aerospace. She has managed many NASA projects including those involving flight testing of thermal protection materials, commercial technology, commercial applications of remote sensing, and remote sensing science projects. Joan has been at Ames for 22 years, and recently completed the Sloan Fellowship to attend the Stanford Graduate School of Business.

HARVEY SCHABES is the Systems Management Lead in the Systems Management Office at NASA's Glenn Research Center. He is responsible for providing oversight for independent assessments of programs and projects and for defining Center strategic plans and policies. He is also leading the Knowledge Sharing activities at GRC in collaboration with APPL. He started his career with NASA in 1983 in Icing Research, and since then has served in numerous organizations in support of the Space Station Program.

CHARLIE STEGEMOELLER has served as the Associate Director, Space and Life Sciences Directorate, Office of Bioastronautics at the Johnson Space Center since 2002. The Office for Bioastronautics is responsible for coordinating and implementing the NASA Bioastronautics Strategy—the pursuit of tools, techniques, and policies to reduce risks, improve efficiencies, and return benefits to earth through the conduct of human space flight operations and research. He joined JSC in 1985 and has served within the JSC Comptroller's office, the former Space Station Freedom Project Office, and as a key member of the NASA/Mir Phase One Program. He received the NASA Exceptional Service Medal in 1996, and became a member of the Senior Executive Service in 2002.

HUGH WOODWARD is the President of Macquarie Business Concepts, a consulting firm specializing in effective project portfolio management. Before this position, he had a 25-year career with Procter & Gamble. He served as the Chairman of the Project Management Institute (PMI) for consecutive terms in 2000 and 2001. He was elected to the Board of Directors in 1996, and before being elected as the Chair, served as vice chair and in several other key leadership roles.

Life in the Fast Lane

Stream-of-consciousness commentary on the hectic life of a NASA manager

I HAVE HATED WRITING THE COLUMN FOR THIS ISSUE. This is unusual since I tend to look forward to writing for *ASK*. At this time, however, I resent its intrusion as another requirement in a whirlwind of short actions, constant travel, and little chance to reflect or contemplate. I hate knowing that I am way past deadline, and if I don't get this in tomorrow I slow down the issue. Can't let that happen; sit down and write. Now.

This is the problem, I feel too busy, with no end in sight.

There is so much going on at NASA. More tasks, more changes, more deadlines, more reviews, more phones ringing, more meetings—more, more, more. (Wasn't that a disco song in the '70s? Is it obvious my mind is starting to turn to mush? Was it only yesterday that I was young? Someone did call me "old NASA" the other day. Hmmm.)

The number of project assignments is incredible. Lengthy preparation for a major program review, organizational assessment interviews and reports, on-going budget preparations, the list goes on.

Then there is the travel. Over the last two months alone I have visited Houston three times, Los Angeles twice, Denver once, Albuquerque once, Hampton once (let's not consider that travel since it's only 250 miles from home.) On two of my trips, flight crews of United and Southwest Airlines greeted me by my first name. The only travel I would really appreciate at this time is a trip to Australia—24 hours of uninterrupted, no cell phone flying.

Surrounding all of my chaos is NASA 2004. Perhaps it is me, but it seems as though the organization is flying faster than the speed of light. The rumor mill is buzzing with change. My phone is ringing with questions of, "What have you heard, what do you know?" It is embarrassing to admit, but I usually know nothing. I usually hear about what happened when I walk down to breakfast, and my wife reads from the *Post*. She'll ask, "Did you know about that?" and I'll say, "No, I just work there."

So things are crazy. People ask, "Ed, when will you get a minute to talk?" I'm thinking, "*Talk*, are you kidding? When will I have a chance to sleep through a night?"

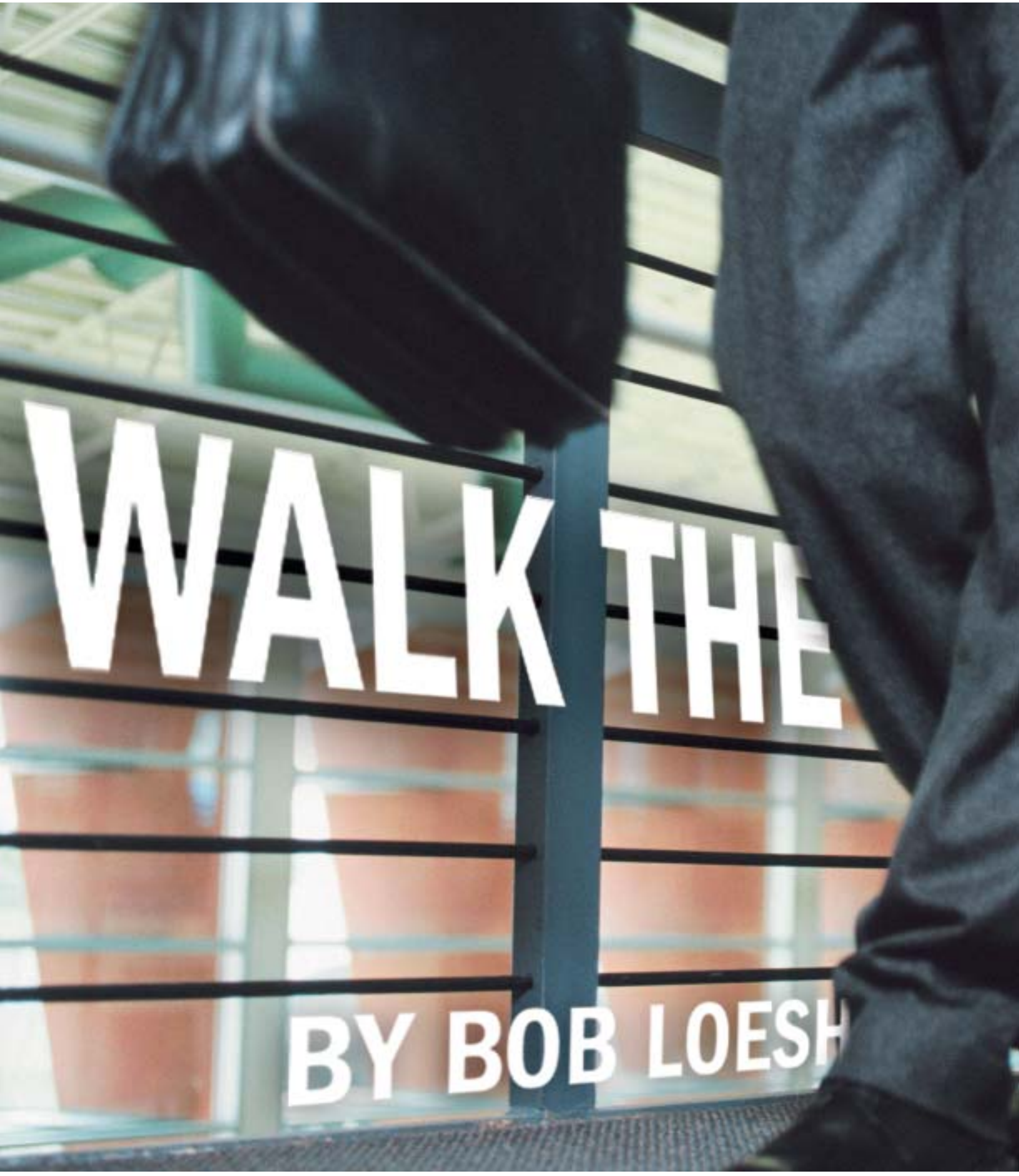
This doesn't seem like the way it should be. Have I missed something? Is my leadership style the cause of my problems? I wonder how does this affect the team?

It is now midnight, which is becoming common. My writing assignments are increasingly being done at 11 p.m. or 4 a.m.. Everyone else is comfortably asleep, and I am not taking time away from anyone or anything else. Another bonus of such hours is that in a strange way I feel I have stolen time. During these hours I get to catch up, or at least get closer to the moving target. Of course sleep deprivation is probably not a good thing, but let's assume this is a short-term fix. Tomorrow, order will settle in, and balance will return. Keep thinking those thoughts.

So what can be concluded from organizational life in the fast lane? Is it appropriate to have more questions than answers? Ronald Heifetz of Harvard University has a whole book entitled *Leadership Without Easy Answers*—so maybe it's not just me.

At any rate, I just seem to keep piling up the questions. Have I flunked the balanced life test? Is the world moving that much faster, or am I falling behind? When will the chaos become order? Can this be the new steady state? Is confusion and ignorance a good thing? (Definitely don't want to seem complacent or comfortable these days.) Maybe this state represents a readiness for new challenges, changes and exciting work? Whatever it is, how come no one ever mentioned this stuff in my Organizational Behavior or Leadership textbooks?

Certainly no coverage on this in any Project Management writings or courses I have come across. Heifetz's book will have to be my guide, because this is where my column ends, a lot of questions and no clear answers. At least no easy ones. •


WALK THE
BY BOB LOESH

I joined the Viking project in its early days in 1971 as the Orbiter Software System Engineer and stayed on board through several months after launch. Viking was a significant step in the technology of onboard computers and software for NASA and the Jet Propulsion Laboratory (JPL). But with those advances came many problems to solve. We've come a long way since then as well, but some of the fundamental issues, the problems we faced, and the solutions we found are all still relevant today.

I WASN'T EXPECTING TO RETURN TO THE VIKING PROJECT, but as they were approaching the encounter, my division manager called me into his office and said, "Bob, I really need your help." When my division manager started talking to me like that, I knew I was going to say "yes" before I even heard what he needed me to do.

PINPOINTING THE PROBLEM

The First-Order Image Processing and Enhancement System (VISRAP) group had run into some problems. The supervisor in charge of that group had gotten heavily involved in trying to get new state-of-the-art hardware to work and wasn't managing the software development too well. They were partially through coding and trying to integrate the software and were running into major difficulties. It just flat out didn't run.

One of the objectives was to get Viking Orbiter image data to the scientists as fast as possible so that they could make the best decision about where to land the Viking Lander on Mars. They wanted to make a pass of the planet in order to send back the Orbiter image data in real time. They would then process and enhance the images so they could use them to choose the best landing spot.

As soon as I came on board, I realized that the group's problems had less to do with technology than with poor development processes and communications. Due to the schedule pressure the programmers had stopped documenting design changes that they were putting into the code. I had run into this problem before on other projects. The programmers got so caught up in the coding and testing that the design documents were never updated, and the other team members had outdated versions of the interface design and functions between the design elements. When they went to test or use the software, new versions of the code had different functions and interfaces than the design documentation specified, and those that other team members were

I CAME IN AND SLAMMED ON THE BRAKES. I SAID, "WE'RE TURNING THIS SHIP AROUND..."

The Viking lander model.

using for their code. The design elements were incompatible and would not operate together.

By the time that I was called in, several months of not keeping the design documents updated had passed and the programmers couldn't remember all they'd designed and coded. They had to analyze the code to determine the correct interfaces and functions, and there were no updated design documents to help them. They also had not updated the test documents; so they had to spend five or ten times as long to fix a problem during integration that could've been easily solved if the documentation was current and correct. Months on the project had gone by like this. When the team put their software together for integration and testing: the software failed. There was no current documentation to help them understand why.

I saw it primarily as a management issue. The programmers and the other team members had not been given the direction, disciplined process, and motivation to ensure successful development and integration of the product as a whole. Staying on schedule was stressed as a major priority, and they lacked the focus to understand what it would take to deliver on time. They followed no system for coding and documentation; basically, there was no control.

CRACKING THE CODE

So recognizing the problem is one thing, but solving it is another.

I understood how they had gotten themselves into this mess. In fact, it was learning from my own mistakes that helped me begin to tackle their problem. When I'm in the creative mode of coding, I can think of a million things I should have done better in the design phase. It takes a lot of discipline not to just throw the changes into the code without concurrently coordinating the design and updating the design and test documents. I knew I would have to do my best to provide the team with that same discipline.

The programmers were anxious about my takeover as soon as JPL management made the announcement. First, they didn't like me because I was an outsider. Second, these were programmers who previously had the freedom to do all the coding they wanted without documentation. Then I came in and slammed on the brakes. I said, "We're turning this ship around and going back to the drawing board."

The first thing I did was to shut everything down. I said, "There will be no more coding, designing, or fixing of errors until we've caught up the documentation." I'm still looking for the first programmer that would rather do documentation than code, so let's just say that they were not happy campers! I laid out a controlled process to keep these problems from repeating: coordinate the design to resolve the interface and incompatibility problems, document the agreed-upon design changes, and correct the code to reflect the coordinated and compatible design.

To do this, we had to keep programmers who knew—and hopefully could remember— what they had done huddled around the machine. It was a really inefficient way to do business, but my plan was for this to be the last time we'd be wading through all the old code. Now each time we found a problem, it was coordinated across the team and documented.

Because of this "catch up" process, several weeks were tacked onto our already stretched schedule to get the design understood, coordinated, and put to use. But I was convinced that we could make up some of the time by testing efficiency; we'd perform the team coordination and keep the design and test documents current. Each time they completed a certain amount of the design updates, we reviewed them together. They made it clear that they were still annoyed with me, but that was okay. We were on the road to recovery.

Once we had a handle on the documentation, they resumed coding and testing. I would schedule updates every two to three weeks to address changes that had been agreed upon by all affected staff. After the schedule was coordinated and everyone agreed to it, the entire team got a copy of our new plan.

When we got started on coding the coordinated changes, for a while I still went to their offices every day and asked them to "show me your documentation." My intent was not to micromanage, but to hammer home the importance of working as a team. They started doing it on their own, at first out of resentment to show me they could. But my strategy worked. Believe it or not, they began to see that

I MANAGED THE PROJECT BY WALKING AROUND AND INTERACTING WITH THE TEAM.

other people's documentation was useful. They could get things done quicker and with a lot less stress and effort.

After several weeks, the system started showing signs of working correctly during the integration testing. And for accomplishing the integration, the level of team efficiency improved by orders of magnitude. The success and pride that came from making the system work was a huge motivator.

HERE TO STAY

At this point I continued to make it my job, several times a day, to hand-carry proposed changes to each person. I'd say, "Let's talk about these changes," and they'd tell me they didn't have the time. So I'd ask them, "What do you need to be able to get the time this afternoon?" Before long, people started realizing that I wasn't going away.

As I managed the project by walking around and interacting with the team, I got to know which people were a little quicker and which ones had more trouble. I also got to know which people weren't good at managing their workloads. I kept the lines of communication open about how much work each team member was carrying, and which person was the best choice to implement new changes.

I also got to actually see the work that was taking place rather than reading an email or hearing about it on the phone. It took a lot of personal time; but after making major process changes and overcoming huge setbacks, the last thing I wanted was for the project to fail because of bad work habits or the lack of interest on my part.

The time I invested paid off in the end. The images of Mars were delivered by this group to the scientists and mission designers on schedule, and they were used to accomplish a successful landing. •

Lessons

- Discipline AND creativity are the keys to getting a software project completed on time.
- A direct contact, communication-by-walking-around management style can be the most effective control system.

Question

To be a good project manager, is it necessary that your team likes you?

An artist's rendering of the Viking spacecraft.

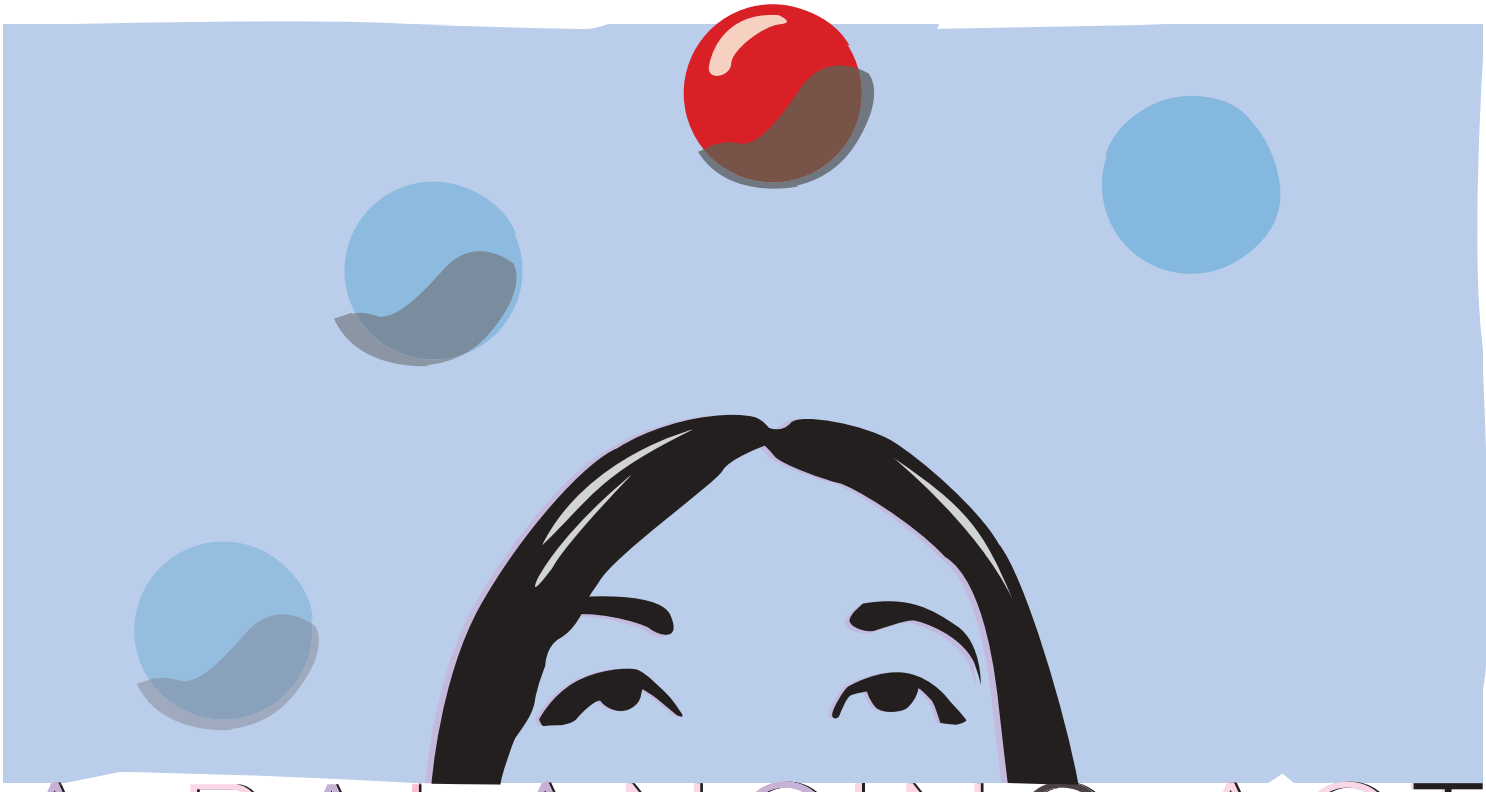
WATCH AND LEARN

BOB LOESH has figured out a few things over the length of his 47-year career, which he began as a programmer at the RAND Corporation in 1957. Currently he is the Director of Engineering and Technology Development at Software Engineering Sciences, Inc., but the majority of his time was spent at the Jet Propulsion Laboratory working on high profile projects including Viking and Galileo. During that time, he served as NASA's "go-to" guy for software problems, uncovering what he believes to be the major obstacles keeping software project managers from reaching their full potential.

"Number one, we don't have any basic, formal training—either at the universities or in companies—for our software project manager people," says Loesh. "We put them on a project, they get along with people, they relate to management, and we promote them." But he says there is no training or formal way for them to learn techniques. And because of this, there are not many good models of successful software project managers for them to emulate.

This goes hand in hand with what Loesh describes as a second major problem: lack of mentorship. "We don't mentor our people. We don't pass along our experiences, guide them through problems, or let them watch what we do and learn from it," he says. "You look at occupations like bricklaying or machine work, and there's an apprenticeship. They do that for a couple of years and they learn all the right things to do."

Without formal training or a way to learn from of others, each manager is thrust into their software project with only the lessons of their own experience. Each new project manager continually recreates the wheel. Loesh adds, "We're going to repeat these problems over and over again unless we figure out a way to effectively train new software project managers."



A BALANCING ACT

BY LYNDA RUTLEDGE

There are certain things that happen to you during your career that end up being the ultimate learning experiences. Not because you did the right thing, but because you did it completely wrong. You look back and ask yourself, "Why did I do this? It made no sense." Then you lay out all the ways that you could have handled the situation better.

For women especially, this type of situation crops up all the time. We are trying to pull our weight as contributing members of the workforce, but we also believe that we have to be perfect wives and perfect mothers. We want to maintain the 1950s sitcom home. And we want to do that while having a fulfilling career. It's like a juggling act, and every now and then we're going to drop a ball or two. That's when you figure out which balls really have to stay in the air. It's one of the learning experiences that I'm talking about.

My lesson came during an extremely stressful time in my career in the mid-'90s. I was working on an Air Force program using intense simulation techniques. This made it crucial that all five contractors involved, along with the Government, stayed on the same page. To achieve this, we were working six months of weekends and long hours.

Besides that, two hurricanes hit our area within three weeks of one another. There were homes upturned, insurance companies to deal with, and many people couldn't get to work. The base was shut down two or three times in the midst of the disasters.

Still, we were desperately trying to get on contract within six months. It seemed impossible, given all our obstacles, and our days got longer and longer. We ended up flying to meet other members of our simulation group for a weeklong session out of town. We were scheduled the following week to brief our Program Executive Officer, so we holed ourselves up to prepare.

DROPPING THE BALL…

At this time I had a Technical Director who was frequently out of work, and we'd have to bring her up to speed when she came back. We had worked to prepare for this weeklong session from seven in the morning to nine at night. She was out during this period as we attempted to lay out everything we'd need for the briefing.

With next week's deadline looming overhead, I knew that we'd have to start putting the actual brief together as soon as our meeting was wrapped up. We had a long flight home, so I approached my Technical Director about working on it then. "How about I get a seat next to you, we can work on the brief, and then I'll go off and generate it on my computer?" I asked her.

Initially she thought that this was a good plan. But when we got to the front desk to check in, she found out that there were not two seats available in the row she wanted. She insisted that she had to sit in the exit row. She told me, "I want to sit there, and I'm already not feeling good. We'll just come in tomorrow and work on it."

Tomorrow was Saturday. We'd already worked weekend after weekend. My daughter was home sick with

Sometimes you just have to say no, and I've said it since then.

bronchitis, and I didn't have a babysitter for her the next day. So I told her, "Well, I don't have a babysitter. I'd really like to do it tonight on the plane if we could, or I can come in on Monday and we can hit it first thing." We still had a few days left to do that. She said, "No. I want you to come in tomorrow." I didn't know what else to do, so I said okay.

By the time I got home though, my daughter sounded pretty bad. She was four years old and had always had respiratory problems. She was coughing really harshly, and I knew from the sound that she was going to need to go to the doctor. So I thought, I'll take her with me to work, we'll knock out the briefing in a couple of hours, and then I'll be able to take her to the doctor when we're finished.

So that's what I did. I went to my boss's office the next morning, and she was talking with an engineer. They were just chatting away. At this point my daughter was really hacking; I mean, she was sounding worse and worse. Every now and then I'd poke my head into her office—holding my sick child—and ask her if we could make another plan. "Do you want me to do it first thing Monday? Can I take my kid to the doctor and come back later? Do you want me to come in on Sunday?" But she just kept telling me, "No. Just wait."

I waited outside that door for four hours. And after four hours of standing there, she came out of her office and said to me, "You know, I'm kind of tired. Why don't you go on home?" I couldn't believe what I was hearing. By that time I had long ago missed my window for the doctor.

NOBODY'S PERFECT

As it turned out, I went in on Monday, finished the briefing, and the whole thing went off without a hitch. It could've waited—well, it did wait—and it was fine. My daughter though, coughed all weekend long, and there was a lot of guilt on my part.

This was a turning point in my career. I realized that I can't do it all. I won't be the perfect mother, I won't be the perfect wife, I won't be the perfect Project Manager, or worker, or whatever title I happen to have at the moment. I also realized that I would never let anything like this happen again. I would need to keep a clear focus on balance—balancing my career and my life—and I would have to prioritize when I was faced with a situation like this one. Sometimes you just have to say no, and I've said it since then.

In my head, I lay everything out. I say to myself, "This will take priority," and then I work the long hours, do the traveling, manage everything…but there are times when I just have to say no. People usually understand that, because not balancing your life is one of the pitfalls that many of us have experienced. You get caught up in the mission, the work, the it-has-to-be-done-right-now. Sometimes though, it can wait. Sometimes Monday is just as good as Saturday.

When you realize that, you start to realize that prioritizing your life doesn't have to come at the expense of your career. Balancing your family life and your work life actually makes you more productive. If you can balance your children, your husband, and your job, then you can start to balance your financial managers, your contracting officers, and your engineers. It's a skill that covers a broad spectrum, and one that makes you better at balancing all the aspects of Program Management. •

Lessons

- In a dynamic environment of ever-changing demands, choices, and opportunities, it is essential to learn when to say no.
- Once you have established a priority, don't be afraid to actively put it first.
- In the long run, maintaining a balance between your career and your personal life will enhance your focus and productivity on both fronts.

Question

When does trying to attain perfection in one aspect of your life mean neglecting another?

LEADING BY EXAMPLE

LYNDA RUTLEDGE knows how difficult it can be for a woman to juggle her family and a career in project management. But just because she recognizes these difficulties doesn't mean she wants special treatment. In fact, Rutledge wants just the opposite.

A program director once told her, "I just like to give women more latitude."

"That is when I told him, 'You're a male chauvinist,'" Rutledge says. "I could tell he was mortified. He asked me, 'What do you mean?' and I told him, 'You treat women differently than men. We don't want to be treated differently. What kind of example does that set for junior people when they see somebody senior behaving that way? Is that the example you want to set for future leaders?'"

Instead, Rutledge leads by her own example. She strives to balance her personal life with her career, to organize her priorities, and to always know when to say no. "These are skills that all good project managers need," she says.

FLY SAFE, BUT FLY

by kenneth j. szalai

Risk management process is a front-burner topic in all aircraft and spacecraft communities. A former colleague of mine noted that a zero mishap rate in experimental flight research can only be assured by padlocking the hangar doors. However, achievement of the objectives of a flight program still requires accomplishment of the mission—flying.

I LEARNED A LESSON ABOUT MANAGING RISK FROM A great project manager—Calvin R. Jarvis. The Phase I program adapted the Apollo Guidance System to the F-8 airplane, and in 1972 it flew without any mechanical pilot controls, becoming the first aircraft to fly with a digital computer in full control.

I got to work for Cal Jarvis on the F-8 Digital Fly-by-Wire (DFBW) project. The Phase I program adapted the Apollo Guidance System to an airplane, In 1972 it flew without any mechanical back-up system, becoming the first digital fly-by-wire aircraft. Its safety depended on its full-time, full-authority primary DFBW control system.

Cal managed both high-risk pioneering programs with great success. He was a master Project Manager, always keeping cost, schedule and technical performance in balance, but never trading them for safety.

The Crisis

I was chief engineer and software manager of the second phase of the program, where three digital computers were configured as the first fault-tolerant airplane DFBW system. The Draper Laboratory developed the flight software. IBM supplied the flight computers.

The F-8 Digital Fly-by-Wire (DFBW) in flight.

The F-8 DFBW aircraft had flown about a dozen flights, and was making good progress. A systems engineer called and told me that the preflight self-test had failed while preparing for the next day's flight.

Early in the program we had encountered a few self-test problems in the control surface tests, which had very small tolerances, so I assumed it was a tolerance problem.

While troubleshooting the self-test failure on the airplane, however, I froze and my heart sank as I realized

the problem was far worse than some self-test tolerance setting. I discovered that a half-dozen instructions in the computer's flight software did not match the program listing! I could tell the paper listing was correct — so the flight computer had contaminated instructions.

This was impossible, unbelievable. There was no immediate explanation. One thing was certain, the

The F-8 Digital Fly-by-Wire (DFBW) in flight.

airplane and the program had to be grounded until we could figure out what had happened.

I called Cal Jarvis immediately and told him about the problem. He asked quietly, "Does this mean the flight tomorrow is off?" "Cal," I said, "This is a catastrophe! I have no idea what is wrong. This is a spear through the heart of the program."

"How about flying Tuesday or Wednesday next week?" Cal asked. "You just don't understand," I said. "This is a monumental disaster." Cal wasn't listening to my doomsday remarks. He asked me to document the problem and work with Draper and IBM to find out what happened.

Problem Found, but the Crisis Remains

The Draper Laboratory and IBM identified the cause of the problem the next day. An error in the "Assembler" software was found that could produce a contaminated computer load tape while correctly producing the software listing.

We verified that the paper listing was correct. This was to be a key finding. We also established that prior flight tapes had not been contaminated. We informed the Space Shuttle program about this problem since they were using the same computer and Assembler software.

I told Cal that IBM was fixing the Assembler flaw and we were developing a new check process that would verify future tapes to be correct. We would then reassemble the flight code, generate a new load tape, load the computers and carry out the preflight tests. I estimated it would take a couple of weeks.

Risk Management

Cal noted that the F-8 schedule was critical, with upcoming flight tests of some Space Shuttle software. On Thursday he asked, "Is next week out of the question for a flight?" By this time my patience was wearing thin. I was only thinking of safety, my primary focus. Cal was concerned about safety, too, but he was also thinking about flying safely.

He asked me how many memory locations had been contaminated. I said that the handful of instructions in the self-test program was the only thing we'd found so far, but that there were about 25,000 instructions and data words that we hadn't checked yet.

Cal then asked the key question, "If we could prove that these were the only contaminated memory locations, and we corrected them, would we be able to fly next week?" That was a good question—could we fix the problem expeditiously? I looked at the pictures on his wall, of the other experimental aircraft he had worked on, which all flew successfully. I decided to think about his challenge.

Risk Elimination

I subdued my emotional response, and started to focus on the technical issues. We didn't have a means to automatically check the computer memory against the accurate printed listing. The listing took up 250 big pages.

I laughed to myself and thought, "How long would it take to manually check a computer memory dump against the listing?

Let's see, there are 25,000 memory locations. If we had five teams of engineers, and they could read aloud and verify one memory location every 10 seconds, five teams could verify 30 memory locations a minute. That would take about 14 hours.

I proposed this to Cal, and he smiled and said, "How about flying next Wednesday?" I said we could do it. We got a few more than five teams together, alternated the reader and verifier every couple of pages or so, and

added breaks. We finished by Friday afternoon, and did not find any other errors. I guess sometimes pioneering work needs solutions rather than elegance.

We had a process for patching the software on site, and so we manufactured and verified a corrected load tape. The self-test was run and passed several times. I signed the software release document as the Software Manager (with more humility this time) and developed the technical briefing for management.

I presented the technical findings and explained the carefully controlled manual checking process. Cal offered another explanation for flight readiness. "We all agree that the intended software load, as represented by the listing, was qualified before the contamination, and we had many successful flights. Therefore correcting the six incorrect computer words to their original value means the patched software load is also qualified."

After some hard questions—like "Why didn't you anticipate this?"—senior management approved the flight. We flew on Wednesday, as Cal had asked.

We also worked with Draper Lab and IBM to develop a 100% closed loop check process of the load tape and listing against the original machine code produced in the mainframe.

Years Later

This event happened more than 25 years ago. The F-8 DFBW completed a long and safe flight research program.

I learned from Cal Jarvis that the role of the Project Manager is to complete the project successfully. Cal Jarvis never lost sight of that, but he never cut any corners or sacrificed safety for schedule. I realized Cal Jarvis's success on the F-8 DFBW was not just good luck.

Cal Jarvis went on to manage several more projects, including the joint US-Russian Tu-144 supersonic flight research project, and eventually ran the entire Dryden Flight Projects organization for several years.

The bottom line is that it is possible to conduct high-risk missions safely, but it takes intense effort and an open, communicating organization. Today, you can visit Dryden and see the F-8 DFBW, the X-29, and several other experimental aircraft on display. This is a testimony to the ability to fly high-risk programs safely.

It had been instilled in me that the objective of an important endeavor, like experimental flight research and test, is to fly safely. Padlocking the hangar doors will eliminate flying accidents, but will not advance the cause of flying. •

Lessons

- Effective managers keep their cool when unexpected situations arise. This enables them to calmly see the big picture while zeroing in on the specific problem.
- Project success requires a keen focus on results, even if the processes and solutions employed to get them are not so elegant.

Question

To what extent is the project leader's attitude towards a setback reflected in the attitude of the team?

KENNETH J. SZALAI served as Director of the NASA Dryden Flight Research Center from 1990–1998, retiring from NASA after 34 years of service. He is currently an aerospace and management consultant in the United States and in Europe.

Digital Fly-by-Wire, or DFBW, is a digital electronic flight control technology. A digital computer receives pilot maneuver commands and rate, altitude, and acceleration information from sensors. The computer uses this information to direct the hydraulic actuators to move the aircraft control surfaces in such a way that the aircraft maneuvers according to the pilot's commands. All this information is electronic, and is carried by wires, hence "fly-by-wire". The cables, pulleys, and other mechanical devices formerly used to connect the pilot stick controls to the surfaces or hydraulics are removed in a pure fly-by-wire system.

The digital computer software also provides powerful artificial stabilization of the vehicle so that the aircraft designer is no longer bound by traditional design constraints. DFBW enabled the first moon landing. The NASA Dryden F-8 DFBW program was the first to achieve digital fly-by-wire control for an aircraft, in May 1972. Now virtually all military aircraft and modern airliners use DFBW control.

FOR SAFETY'S SAKE

BY JOAN PALLIX

BACK IN THE MID-1980S AN ISRAELI FIGHTER PILOT COLLIDED WITH ANOTHER VEHICLE DURING A TRAINING MISSION. THE WING WAS TORN FROM HIS F-15 DOWN TO THE WING ROOT. HIS TRAINER ORDERED HIM TO EJECT, BUT THIS HIGHLY SKILLED PILOT REFUSED AND PROCEEDED TO STABILIZE THE AIRCRAFT BY USING HIS REMAINING CONTROLS IN A HIGHLY UNCONVENTIONAL MANNER. HE MANAGED TO DO THE IMPOSSIBLE BY SAFELY LANDING A SINGLE-WINGED PLANE.

That's very, very hard to do. In a simulation after the incident, it was found that only one in ten of the pilot's peers could have successfully completed that same maneuver. Ideally, of course, we want to develop technology that enables all pilots to have the same capability to land safely.

These mishaps aren't just happening to military aircraft, either. In the past 20 years, there have been a number of commercial aircraft mishaps resulting from loss of primary control systems. For example, there was a serious incident in Sioux City, Iowa with a DC10 carrying a full load of passengers. An engine component failed and exited the engine compartment, penetrating the fuselage and severing the hydraulics required to manipulate the aircraft control surfaces. Under normal circumstances this would result in an uncontrolled crash. As luck would have it, one of the passengers on the plane was a pilot who had just completed 100 hours of engine-only flight training, which involves flying without surface controls. He recognized that there was a problem on the plane and made his way to the cockpit to offer his help. Amazingly, this experienced passenger and pilot worked together to crash-land the plane, saving more than half of the lives of the passengers. All would have been lost if not for the unique experience of this unexpected passenger.

PUSHING FORWARD

Recognizing these stories as representative of a national technological need, my group at the NASA Ames Research Center, Resilient Systems and Operations, began funding technology development to enable seriously damaged aircraft to autonomously

SO WHY DEVELOP CONTROL TECHNOLOGIES IN THE FIRST PLACE?

"We had all these organizations—the NASA Integrated Action Team, the Shuttle Independent Assessment Team, and the U.S. Air Force—looking at accidents like the Arian Shuttle and the Challenger and asking why," explains Joan Pallix, of the NASA Ames Research Center. "One of the things they found is that we don't have any systems that understand when there is something wrong with them and can autonomously diagnose their problems."

Pallix says that this technology will become essential for ensuring the safety of vehicles like airplanes and spacecraft. "Until now we've had no way to test vehicle's complex systems to make sure that what we've built is right," she says. "Usually a problem has to do with a failure in the structure of the vehicle, or the propulsion system, or the control system. That's why we are focusing on intelligent flight control."

There are hundreds of things that can go wrong inside a vehicle, but Pallix and her team are developing flight software that will eliminate the most common sources of failure. What's unique about it? "The 'neural net' is a system that actually learns," she says. "It notices when the pilot tries to do something and the plane doesn't react. Then it reuses the surfaces to make it happen."

regain control. We had started to develop and flight test an intelligent flight control system, or "neural net controller," designed to adapt to the loss of various control surfaces and devices on commercial planes and spacecraft. We believed it would be revolutionary in changing the level of safety on these vehicles.

Our conviction wasn't enough proof for NASA Headquarters and Congress; good ideas abound, but budget is limited. They needed to see a clear future in our project and a definite plan to infuse the technology into future aircraft or they'd cut our funding. The Federal Aviation Administration (FAA) is responsible for safety regulations in the national airspace and helps government agencies to make this type of funding decision. Historically we've had trouble getting the FAA on board. They wouldn't back a project just because it was supposed to make things safer. They'd need to see research on how the system works with a human being in the cockpit—and that takes time.

Still, FAA support was important for the project, I made it my mission to write the requirements in a way that put it on track for success. I didn't simply tell the people on the program that FAA buy-in was important, I went a step further. I wrote it into the actual requirements that we get FAA agreement. By placing that on the project's "critical path," I knew that the issue would get attention.

Though the FAA typically deals with the certification of finished products, I knew that having their support up front would give us a much better chance of survival with Headquarters and Congress. At first, my efforts were ignored. They weren't interested in spending time on a speculative project at such an early stage of development.

They didn't want to talk to us about a system until some company said, "We're going to put it in our vehicle." No company was going to put it in their vehicle unless they knew that it was certifiable and cost effective. Congress wouldn't and shouldn't fund a system that no one was committed to putting in their aircraft. It was something of a Catch-22 as far as funding goes.

A LITTLE HELP FROM OUR FRIENDS

I realized that I couldn't do it alone, so I made a new plan: I started networking. I used my contacts to get someone's attention at the FAA. We do a lot of work with pilots and researchers inside our NASA organization stationed at Dryden who, in turn, have a lot of direct contact with the folks at the FAA—so we enlisted their help.

We know the Dryden people well since they fly all the software we develop. I was able to convince one of the guys there to help me push it through. I explained to him that our program wouldn't have credibility unless we found an advocate at the FAA, someone who would say, "Hey, I'm interested in this; it could be the wave of the future," and convince their bosses to let them go and have a look.

He understood how important the project was, and he worked hard to reach an agreement with the FAA. They were reluctant to commit to a standard certification process for a project that wasn't even finished—but they finally agreed to what they a called "mock certification" process for our system.

This was a major success! We had gotten the go-ahead to work on our experimental project, and we could test it with our provisional certification. This was exactly the "green light" we needed to ensure continued funding for our work on the neutral net. •

Lessons

- Sometimes the success of a project is determined by how much you believe in it and how much you are willing to push. New development projects are never handed out readymade; you have to be willing to shape it and keep it moving whether you have initial support or not.
- It is important to know the politics involved in the approval of your project. You need to not only know what you're selling, but who you're selling to.

Question

Is it the role of the project manager, or the project sponsor to scan the project's external environment and maintain constant communication with the project's stakeholders?

JOAN PALLIX earned her Ph.D. degree in chemical physics from Yale University in 1987. With a diverse background in quantum dynamics, chemistry, laser spectroscopy, materials science and solid-state diagnostics, diagnostic instrumentation, measurement systems, and optics, she has published numerous papers in those areas. Over the last ten years, she has held various supervisory and managerial positions for scientific research and engineering projects at NASA. Pallix currently manages the Resilient Systems and Operations project at NASA Ames Research Center.

THE CAMERA NEVER LIES

BY W. SCOTT CAMERON

THROUGHOUT MY LIFE, PEOPLE HAVE ALWAYS STRESSED TO ME THE IMPORTANCE OF EFFECTIVE COMMUNICATION WITH OTHERS. ONE OF THE FIRST TIMES I REMEMBER HEARING IT WAS IN THE SIXTH GRADE. MY ENGLISH TEACHER WOULD HARP ON ME ABOUT HOW HIS SPEECH CLASS WAS GOING TO BE SO IMPORTANT TO ME IN THE FUTURE. BUT BEING ONLY 12 AT THE TIME, THE IMPACT OF THIS SAGE ADVICE FELL ON DEAF EARS. I HEARD THIS SAME ADVICE AGAIN IN A COLLEGE SPEECH COURSE. THE COURSE DIDN'T HELP ME GET OVER BEING NERVOUS ABOUT SPEAKING IN FRONT OF PEOPLE, BUT IT DID REITERATE THE IMPORTANCE OF VERBAL COMMUNICATION.

So, when I entered the workforce I already knew communication skills would be considered an important asset; but I was an engineer, and the stereotype of engineers at that time was that they didn't have well-developed writing and speaking skills. Because of this, the success bar for an engineer's presentation skills was set fairly low, and I evaluated my own skills. What I came up with, in my "unbiased opinion," was that I communicated much more effectively than the typical engineer, and only minor improvements were needed to be seen as having better communication skills than my peers. Needless to say, I felt pretty good about myself.

During an annual performance evaluation, after working for about five years, my boss suggested I attend a communications training course instead of the standard technical or project management (PM) courses

I had attended in the past. Most of my previous training recommendations were based on increasing my knowledge of the nuts and bolts of PM and engineering (i.e. making schedules, scope development, cost control, team dynamics, etc.) so I was somewhat taken aback by this suggestion.

Apparently, the feedback I had received—from not only my hierarchy but also from my peers—indicated that I could benefit from a communications course. I thought I had good presentation skills, and it had always appeared others liked my presentations and meetings. But I decided to take the feedback as an opportunity to improve and made the decision to attend a two-day communications course.

"THE FEEDBACK I HAD RECEIVED—FROM NOT ONLY MY HIERARCHY BUT ALSO FROM MY PEERS—INDICATED THAT I COULD BENEFIT FROM A COMMUNICATIONS COURSE."

The course I chose was different from any other training I'd experienced. Its sole purpose was to improve your verbal communication/presentation skills by addressing three separate situations encountered in the workplace. One situation was a one-on-one meeting with another person, another was a two-minute question and answer session, and the last was a five-minute prepared presentation with a question and answer period at the end. The presentations were videotaped and critiqued during the first day of the course. They were taped again at the end of the second day so you could evaluate your progress and hopefully see a positive difference.

I was shocked at what I saw on the first tape. Yes, that was me talking in each of the situations, only now I was seeing myself as others saw me. They say the camera never lies, but this was not the way I had envisioned myself. My eye contact was terrible, I swayed back and forth, there were too many hesitations, my body was stiff, I didn't have a command of the material or the stage… the list could go on. To make matters worse, in a class of fifteen other students, I compared my style to theirs and realized I was not even in the top 50% for communication skills. Each taped presentation pointed out the different flaws in my communication, and I got to see the impact it had on my audience first-hand.

I completed the course, and I am happy to say it has had a positive and lasting effect on my verbal communication skills, how I view the presentations of others, and how I provide feedback for them. Because of lessons I learned from this course, my boss and my peers commented on the marked improvement they saw in my communication skills in a variety of settings.

To this day I call upon these communication skills constantly, since as a Project Manager I am often the focal point of many one-on-one, project team, and review meetings. I've learned it is important to be able to step back and see yourself the way others see you. It helps you gain credibility, and if you are not credible, then your effectiveness as a project manager can be greatly diminished.

When I coach and mentor project managers, I find myself focusing on their "soft communication skills" as potentially huge growth opportunities for them, but also as ways to differentiate themselves from other Project Managers. I try to pass along that taking a communication training course and seeing yourself as others see you can improve your overall effectiveness.

After all, effective communication is a must for project managers and it's our job to set the success bar higher for the future of project management. It still amazes me how my sixth-grade English teacher had it right all those years ago, but I just didn't listen. •

W. SCOTT CAMERON is the Capital Systems Manager for the Food & Beverage Global Business Unit of Proctor & Gamble. He is also a regular contributor to *ASK Magazine*.

MENTORING:

TEACHING WHAT IT MEANS TO BE A LEADER

BY TERRY LITTLE

RECENTLY I CHAIRED A PANEL INTERVIEWING CANDIDATES TO FILL AN S.E.S. POSITION WITHIN THE MISSILE DEFENSE AGENCY. WE INTERVIEWED SEVEN CANDIDATES: SIX FROM THE DEPARTMENT OF DEFENSE AND ONE WHO HAD RETIRED FROM PRIVATE INDUSTRY. FIVE OF THE CANDIDATES, ALL GS-15S, WERE UNACCEPTABLE FOR THE POSITION. THE SIMPLE REASON WAS THAT THEY DIDN'T COMPREHEND WHAT IT MEANT TO BE A LEADER. AND THE SAD TRUTH IS THAT NO ONE EVER TOLD THEM. THEY NEEDED MENTORING, BUT NEVER GOT IT.

LET ME COUNT THE WAYS...

No one that I know in a senior position got there without some mentoring along the way. Usually they've had informal mentoring, and usually it started early in the career with more than a single mentor. But there are many different ways to get the benefit of mentoring. It can be done in a way that is formal, informal or in a way I like to call "informal-informal."

It's been my experience that formal mentoring programs almost never work, and there are varying reasons for this. One is that such formal programs demand a pervasive management commitment across an organization that almost never exists. Many senior people give mentoring lip service but are unwilling to spend the time that it takes to do it. Notice I said unwilling rather than unable. Many so-called leaders fail to recognize that mentoring is as important as anything they do and more important than most of what they do.

The second reason formal programs fail is that they tend to be cumbersome and unwieldy. Everyone clamors to become part of a formal mentor program; they view it as some sort of right or important square to fill. This leads, in turn, to a bureaucratic selection process where paper matters more than real accomplishment. The truth is that many people can derive no benefit from mentoring, because they think they already have all the answers, because they have limited potential, or because they view mentoring as just a way to get a better job with higher pay. Mentoring needs to be selective.

STEPPING UP

My strong preference is for informal mentoring; I want to pick whom I mentor. For instance, in my current job I have selected seven people within the Agency. How did I select them? I used my own observations, and the opinions of others whom I respect, to identify GS-15s

with high potential to become SESs. Only one of those people actually works for me and there are two that I frankly don't like very much. That's OK because not all high potential people work for me or are to my liking.

And why did I choose GS-15s instead of GS-12s or GS-13s who might be in their more formative years? The answer is two-fold. Number one, mentoring takes a lot of time and effort, and I have limited time and energy. I would rather do a reasonable job mentoring a few than a pitiful job mentoring many. Number two, mentoring is everyone's responsibility and not just the responsibility of those in senior positions. Put another way, every GS-13 has an affirmative responsibility to mentor those below him or her in the pecking order. The same is true for every grade level. Part of my role in a senior position is to communicate my expectation to those below me that they have a mentoring responsibility for which I hold them accountable.

AN INFORMAL GATHERING

So how do I do my informal mentoring? I meet with each person I mentor regularly—nominally once a quarter. I also meet with everyone I mentor as a group once each six months. In between, I send articles or suggested readings, as well as some words of counsel that come to me. To me and to them it's critical that these things be predictable and personal—something they can count on and that means something to them as diverse individuals.

WE DISCUSSED THE IMPORTANCE OF MAINTAINING UNBRIDLED PASSION ABOUT THEIR WORK, BUT AVOIDING COUNTERPRODUCTIVE DISPLAYS OF EMOTION.

When we recently met as a group, we discussed the importance of maintaining unbridled passion about our work, while avoiding counterproductive displays of emotion. We tried to come to grips with how to maintain our dignity and grace in the face of adversity. We also addressed the importance of focusing on the job-after-next as a guide star for deciding what to do now. In the cases of the individual meetings, I typically answer any questions and give direct feedback on areas where each person may need improvement. For instance, I told one individual recently that his manner of dress (casual, with a short sleeve shirt, no tie and relatively disheveled hair) impacted his ability to influence people and left a bad first impression. He argued that his manner of dress shouldn't matter. I countered that whether it should or shouldn't matter is irrelevant. It does and he should do something about it if he wants to lead. I told another person that she did too much talking when she should be listening. I gave her several examples. Both people thanked me for the feedback and related that no one had ever given them such constructive feedback in their entire careers. Perhaps it was easier for me to do this since neither of the persons worked for me, but I think it's a pretty sad commentary that neither of these two had ever had the benefit of the most basic mentoring tool: timely, constructive feedback.

WHAT KIND OF ROLE MODEL ARE YOU?

Finally, my favorite mentoring is what I call "informal-informal" mentoring. I like it because it's unconscious and natural for the mentor (especially valuable for a lazy one like me) and because those getting the mentoring don't even know that it is happening. Its working is simple. As we progress up the career chain, our behaviors become more and more visible to an increasingly larger number of people. We are not conscious of it, but others take their cues from those higher up the bureaucratic pyramid than they are. They observe our behaviors and make judgments about it. Is it something worth emulating? If so, how can I adapt that behavior to my unique personality? Is it something to avoid? If so, how do I sensitize myself so that I don't do it unconsciously? Much of what we turn out to be as individuals is a derivative of what we have learned from observing others—not from what others have told us, what we have read and so forth. When others seek to emulate us, we have mentoring at its finest. Each person may have his or her own style that precludes direct "copycatting." But when one sees basic leadership principles working effectively in real life, it can have a profound effect.

I believe that mentoring is so important and so neglected that I intend this article to be the first in a series I will write on the subject. For the readers, my hope is that these will contain an idea or two that may provoke you to become better mentors. •

TERRY LITTLE is the Director of the Kinetic Energy Boost Office at the Missile Defense Agency. One of the most seasoned program managers in DoD, he is also a regular contributor to *ASK Magazine*.

TESTING POSITIVE

by Ron Zellar

As a line manager overseeing the software development team for the Mercury Laser Altimeter (MLA) on the satellite MESSENGER (**ME**rcury **S**urface, **S**pace **EN**vironment, **GE**ochemistry and **R**anging), which is scheduled for launch in July, I was charged with the responsibility of making sure the software delivery was complete and on time. Because the spacecraft is going to Mercury, its launch date is constrained by planetary alignment. And since the launch was constrained, everything that came before it had to go according to plan.

Near the end of the 2002, and after months on Goddard's MLA project, I became concerned that the software test effort had not made as much progress as was needed.

The development effort was nearing completion, but the testing effort seemed to be struggling. We had created a loose schedule when the team was formed, but now it wasn't serving our needs. It was difficult to tell how much work was left in the test effort, and instrument integration was just a few months away. By early 2003, it was clear that action had to be taken to clearly quantify the magnitude of the remaining work.

Another manager and I made some inquiries about why the test effort was struggling. We found that the test procedure environment wasn't as easy to use as we'd hoped, and that delays in production of the flight software were translating into delays for the test effort.

I asked the software Test Lead to come up with a detailed schedule that showed delivery of all the test procedures by June 30th. I asked that it include all the

empty staff positions required to pull it off. That way, we could see exactly how much work was left to do and how many people were needed to do it.

I knew the prevailing opinion of adding newcomers late in a project was that it didn't work. Putting more people on a job supposedly causes greater delays, since it distracts the already established team from making progress. Still, we needed more manpower to get the job done. And after looking at the Test Lead's schedule, I realized just how big our problem was. Realistically, in order to develop the test procedures required to test all of the functionality in the flight software, our test team would have to double or even triple in size.

The Mercury Laser Altimeter (MLA) software and development team from left to right: Anne Koslosky, Brett Mathews, Samira Ghazi-Tehrani, Dan Berry, Maureen Armbruster, Dave McComas, Lisa Hoge, and Ron Zellar.

The recovery plan

We decided that we needed to add five or six full-time people to the project. Although we needed the help desperately, we still knew the importance of getting the right people. We needed people who had a proven track record of success, and a background in software script languages. A history with software testing would have been a bonus.

The other branches in our division really came through for us. They realized that this mission was an important one for Goddard, and that on-time completion was critical to its success. They took people off their current projects part-time and delayed the schedules on those projects. In the end we managed to get eight part-timers, who were essentially the equivalent of five or six full-time people.

As people were identified to us, we approached them individually. Some were concerned about moving to the project so late in the game, and we wanted to ease their transition. We negotiated a "contract" with them. "If you can help us out," we told them, "then we will make a commitment to you that we will not involve you past June 30th." This was the key for getting people to agree to work with us.

By late January and early February, new people began joining the team. In March the full team was in place, and we scheduled a training session so the existing team members had an opportunity to share their knowledge about how the system worked. We were trying to promote a unified team atmosphere. It gave the senior team the opportunity to say, "Here, let me take you under my wing," instead of saying, "You're an outsider. Stay away."

The best-laid plans…

The first thing we did as a newly organized team was to plan a new schedule. We planned it in a lot of detail, essentially week-by-week, using an earned value system. This allowed us to keep on top of whether we were making our plan or falling short of it. It also allowed us to keep everyone informed about our progress.

Things were going well for a few weeks, but then we started to fall behind schedule again in late April. This time, we saw the slip right away. We met with the entire team to address the issue. I asked them, "What can we do to recover? What can we do to get our results to match our plan?" The meeting resulted in many recommendations and some greater insight into the team's challenges.

For example, one recommendation was to acquire another test bed. I talked to the Project Manager and was able to get time on a second test bed and have it moved

The Mercury Laser Altimeter (MLA) CPU board that operates the MLA software.

into the software development area. This way the team wouldn't be constrained by limited resources. It went a long way toward keeping the team's momentum going.

I also reminded the team members that comp time was available, and they made regular use of it. During this time, though it was difficult to do, I always tried never to refuse a request for leave. We all tried to create an atmosphere in which it was clear that we needed to get a lot of work done in a short amount of time, but in which the team as a whole would fill in the gaps when necessary.

It was suggested that weekend work might be a good idea for those team members who could do it. A lot of people had children and other commitments, so I had to be respectful of those who couldn't come in. It was definitely a "request" rather than a "demand," and I left it to the team leads to talk with their staff.

For those people who showed up on weekends, I tried to always show my appreciation for their time and efforts. I made sure that I was there on those extra days as well. I usually found one or both of the team leads there along with a few other staff members. I would call ahead and ask what their lunch request was. Then I'd stop on my way in to pick up sandwiches for anyone in the lab. I made sure that everyone's supervisor knew they had worked on a weekend. My manager would even make a special trip to an individual's office just to thank them for working extra hours.

The attitude seemed to spread. The Test Lead brought in candy for everyone and music to listen to as we worked. People were making a real effort to stay positive. In response to that, others were more willing to work additional hours without even being asked. The workplace became a more "fun" place to be, but at the same time there was an acknowledgement of my high expectations leading to a more aggressive schedule. People were giving their all, and for the most part they were giving it with a smile. This demonstrated a real dedication to success—the dedication to succeed as a team and not as individuals—and created an atmosphere that was mutually supportive.

Against the odds

By late June we had actually made up for lost time. The test procedures were substantially ready. There were a few exceptions, but these were well-noted and understood. We began our formal acceptance testing of the flight software. Some of the staff members even decided to help us as best they could after their committed deadline of June 30th had passed.

In the end there were a number of factors that contributed to our success: a sense of commitment, more attention to schedule, Branch Managers willing to reassign their best people, and Division Managers that championed our work. We did it despite the common belief that it doesn't work to add extra people in the middle of a development cycle. The Product and Test Leads continually exceeded my expectations and visibly grew in their leadership capacity. As a testament to their group effort, many members of the development and test teams received awards and recognition from our division for their outstanding efforts. Most feel, however, their greatest reward will be the day MLA returns its first science data from Mercury. •

Lessons

- Fostering a positive atmosphere and an attitude of team spirit may make all the difference in the success of your project. People will be more willing to step up when they feel like appreciated members of the team.
- High levels of team energy and enthusiasm are sustained by both high expectations and an environment where each member can effectively work at the peak of their capabilities.

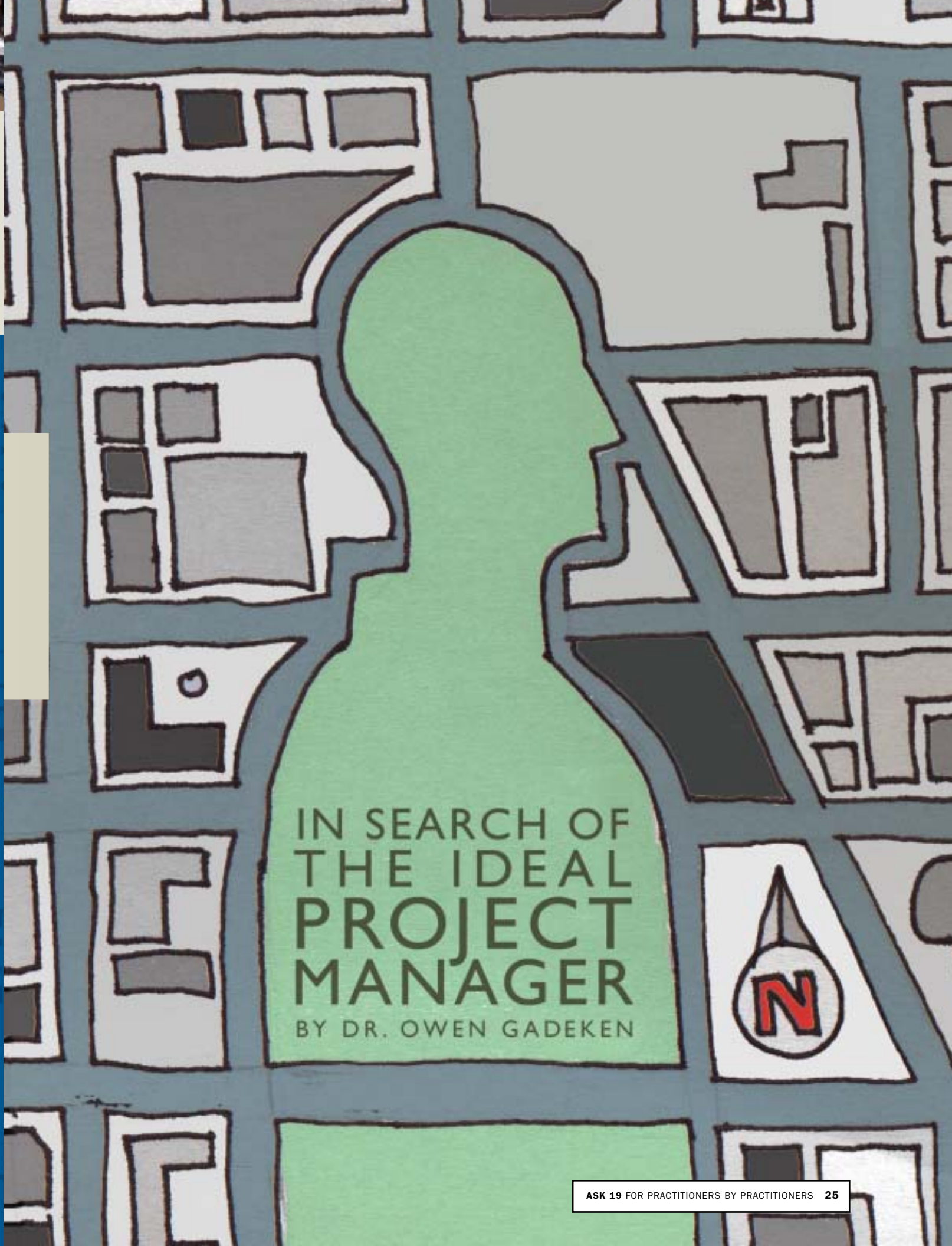
Question

When adding people to your project team, how do you know you are getting the right people?

RON ZELLAR graduated from Virginia Polytechnic Institute in 1991 with a B.S. degree in Physics and a concentration in Astronomy. "When I got out of school, I was working with scientists," he says. "I learned software as an aside, as a means of supporting them." His "aside" soon turned into his career.

He made the jump to flight software, becoming a contractor for the Naval Research Laboratory where he worked on a project called the Interim Control Module (ICM) for the International Space Station. After leaving the Naval Research Laboratory, he landed his first management position as an Associate Branch Head at Goddard Space Flight Center. There he serves in a branch that develops and maintains flight software for Goddard's missions. He oversees and reviews the implementation of computer-based subsystems, instruments, and sensor suites that enable the operation of Goddard's scientific space-bourn systems. One of his first assignments was to oversee the development of the MLA software, an instrument on the MESSENGER Spacecraft set to orbit Mercury in 2011.

His motto: "Build cool stuff. Launch it into space."



IN SEARCH OF THE IDEAL PROJECT MANAGER

BY DR. OWEN GADEKEN

Needing money for college, I was able to get an Air Force ROTC scholarship and used it to get my undergraduate degree in chemistry. The Air Force also allowed me to go on to graduate school and delay my entry to active duty. I earned my masters and was well on the way to my doctorate when I was finally called up to serve. I was elated when I got a laboratory assignment to work on new warheads for air-to-surface missiles.

My euphoria was short-lived. Immediately after I arrived, the Air Force decided to contract out most of their warhead research. I was reassigned as an R&D project manager with responsibility for part of this research. As a consolation, I was sent off to a three-week Air Force training program on R&D project management, but I still felt inadequate for the task. I wasn't sure why at the time, but looking back I think the training concentrated too much on the "programmatics" of cost, schedule, and performance, and not enough on how to really manage a project.

Still wanting to learn, I decided to switch to a more practical strategy. There were lots of project managers in my new organization, many who had been at it for years. I decided to pick a few and pay closer attention to what they were doing.

The first and most obvious candidate was my officemate Ed. He had worked in the lab for years and was way above the rest of us technically. At first glance he appeared shy, but he was quite personable when you got to know him. What stood out about Ed was his work ethic; he was so interested in his work that he had set up a small laboratory at home in his garage. Tinkering on his own, he had actually developed a new formula for incendiary material. He passed this on to his contractor, and it later became the basis for a successful fielded system. I was puzzled that Ed hadn't been promoted to a higher level in the organization.

The puzzle didn't last long however. As I watched more carefully, I discovered that Ed was weak as a communicator. He was a poor writer and had an outright phobia for giving briefings. Once when he was scheduled to give a project briefing to upper management, he called in sick, and his branch chief had to give the briefing for him on short notice.

I decided to switch my attention to Jim, who was the real star performer in our division. He was young, energetic, and articulate. He never seemed to miss an opportunity to talk about his project. This was important since our laboratory projects were always short of funding, and the more visible your project was the more likely it was to be funded.

My decision to watch Jim was reinforced when he was moved from the laboratory up to our product division to manage a new major weapons program. Jim's enthusiasm was contagious. He was a natural magnet who drew people and funding to his project. Still, he wasn't perfect. Sometimes he got carried away with his enthusiasm, and it affected his judgment. I watched one high-level briefing where his "can do" attitude led him to make several technical projections, which he later was unable to deliver. He was forgiven but this flaw eventually caught up to him, and he was transferred to a dead-end position in our test organization.

Finding the ideal project manager was proving more difficult than I anticipated. I bumped around the laboratory and future plans division for a few years and then made a career change to training. I joined the faculty of the Defense Systems Management College (DSMC), the center of project management training in the Department of Defense (DoD). Our main mission was teaching future DoD project managers, but the faculty was also encouraged to do research and writing.

The best data came from having managers recount critical incidents that occurred on their projects.

I decided to channel my interest in the ideal project manager into a research project. While my "people watching" strategy hadn't exactly borne fruit during my early project management career, I concluded that the approach was still sound. Surprisingly, this method of "success modeling" was widely endorsed by esteemed publications from *The Handbook of Leadership* to the best seller *Think and Grow Rich*. There were also high-priced consulting firms using it to create competency models and professional development programs for a variety of career fields, which did not yet include project management. So I obtained some funding and started a research project myself.

There was no better place to study project manager characteristics than DSMC, the "Mecca" for DoD project managers. We had former project managers as faculty, future project managers as students, and current project managers as guest speakers. This latter category interested me the most. I took a lot of survey and interview data from practicing project managers, but the best data came from having these project managers recount critical incidents

that had occurred on their projects. This is very similar to the "learning through stories" approach used by NASA.

Our flagship course at DSMC was the 20-week program management course and we prided ourselves on bringing top-level project managers in as guest speakers. I checked the list of guest speakers for the current course and noticed that we had scheduled two high ranking Air Force project managers one week apart. Each was a brigadier general managing the largest project in his product division. I would make it a point to watch both speakers and look for the similarities.

The first project manager had a reputation as a tough, hard-nosed manager and he lived up to that reputation in person. He was a "pusher." He pushed hard on himself, his people, his contractors and on anyone who got in his way. He was very confident and articulate. As he talked to our students, I had a momentary flashback to the movie *Patton*. Here was the project management equivalent to George C. Scott as General Patton making his famous speech to the troops. The analogy was almost perfect.

A week later the second guest speaker came in, also a brigadier general but from a different Air Force product division. He was much more "low key" than his counterpart. While he spoke softly, he still commanded our attention. What was most remarkable about this project manager was his constant reference and deference to his people. He attributed his success in project management to pulling together an excellent team and giving them lots of leeway and support to do their jobs. I again flashed back to the *Patton* movie, and here was the equivalent of Karl Malden as General Omar Bradley. Again, the analogy was almost perfect.

Both project managers had come and gone as guest speakers, and I took stock of what I learned. I had expected to find some clearly evident characteristics common to both. But this was not to be. In fact, I had a hard time identifying any similarities between the two of them at all. The appearance of two completely opposite, yet successful, project management styles left me in a state of "cognitive dissonance."

Not wanting to give up completely, I reflected for a moment. If the two project managers had no clear similarities on the surface, what about less obvious similarities? I thought about this for a moment. Clearly, both were successful. They were one-star generals managing two of the largest programs in the Air Force. They achieved program outcomes and delivered systems to the warfighter. They got RESULTS. (Both continued to advance in their careers and later retired as three-star generals.)

While their styles were quite different, both project managers were true to themselves. What you saw was what you got. They weren't playing the role of project manager. They were being themselves. They had personal CREDIBILITY.

As it turned out, wading through lists of competencies from my formal research project provided no more significant insight than I got from watching these two experienced project managers. Every project manager I interviewed or surveyed in my research was different, but they were able to get results with a style based on their personal credibility.

So what about the differences? That I have come to realize is the nature of project management and life in general. Projects are different, project managers are different, project teams are different, and the environment for each project is different and constantly changing. This leads to my final conclusion that there is no ideal project manager nor should there be. I think that is what attracted me to project management in the first place and what will keep me engaged in a lifetime of research and reflection in this field. •

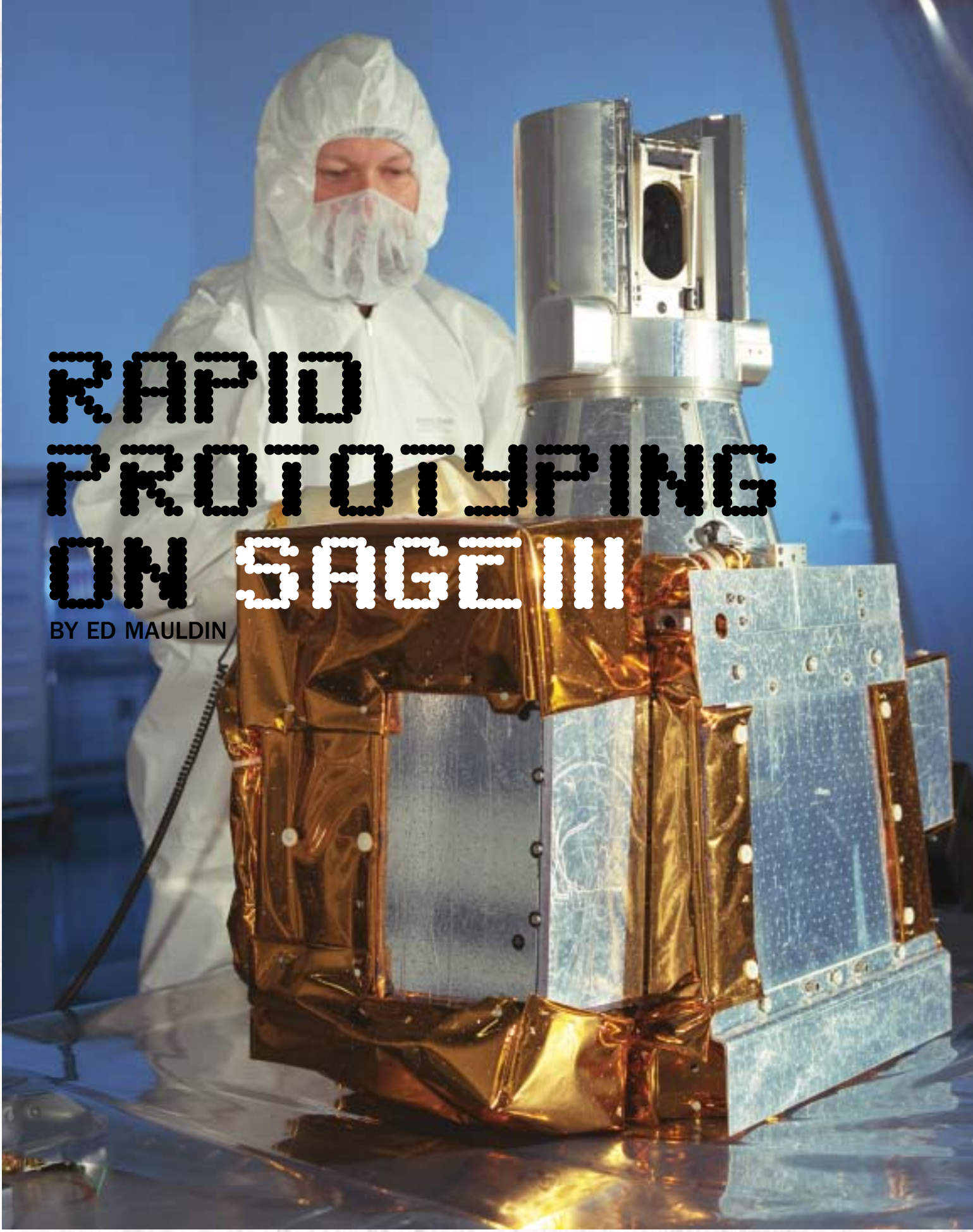
Lessons

- Technical expertise and experience aren't the only ingredients necessary to succeed in project management.
- You can learn a lot by carefully watching and listening to experienced project managers, but you may need to reflect on it to find the real meaning.
- Personal credibility and achieving results are key to project management success, but there are many paths to get there.

DR. OWEN GADEKEN is a Professor of Engineering Management at the Defense Acquisition University where he has taught the Department of Defense Program and project managers for over twenty years. He is a retired Colonel from the Air Force Reserve and a Senior Reservist at the Air Force Office of Scientific Research. In addition to serving on the *ASK* Review Board, Dr. Gadeken has published both his stories and practices in various issues of *ASK Magazine*.

RAPID PROTOTYPING ON SAGE III

BY ED MAULDIN



The integrated team works on the SAGE III instrument.

WHAT IS PROTOTYPING?

PROTOTYPING IS PROBABLY THE OLDEST METHOD OF DESIGN. IT IS TYPICALLY DEFINED AS THE USE OF A PHYSICAL MODEL OF A DESIGN, AS DIFFERENTIATED FROM AN ANALYTICAL OR GRAPHIC MODEL. IT IS USED TO TEST PHYSICALLY THE ESSENTIAL ASPECTS OF A DESIGN BEFORE CLOSING THE DESIGN PROCESS (E.G., COMPLETION AND RELEASE OF DRAWINGS, BEGINNING RELIABILITY TESTING, ETC.). PROTOTYPES MAY VARY FROM STATIC "MOCKUPS" OF TAPE, CARDBOARD, AND STYROFOAM, WHICH OPTIMIZE PHYSICAL INTERFACES WITH OPERATORS OR OTHER SYSTEMS, TO ACTUAL FUNCTIONING MACHINES OR ELECTRONIC DEVICES. THEY MAY BE FULL OR SUB-SCALE, DEPENDING ON THE PARTICULAR ELEMENT BEING EVALUATED. IN ALL CASES, PROTOTYPES ARE CHARACTERIZED BY LOW INVESTMENT IN TOOLING AND EASE OF CHANGE.

SOMETHING NEW ON THE HORIZON

The SAGE III instrument was a spectrometer designed to point at the sun during sunrise/sunset and at the moon during moonrise/moonset in order to unravel the vertical distribution of ozone and aerosols in the stratosphere.

At the time when we were working on this project, which was in 1992, the Clinton-Gore administration had just taken office, and the Soviet Union had just broken up. Russian Prime Minister Victor Chernomyrdin and Vice President Al Gore formed a commission to draw the two former enemies closer together. They were looking for potential joint ventures between the two countries. The SAGE-III was in a marketing campaign looking for a ride on a NASA spacecraft when we were told

SAGE III above earth's atmosphere.

A physical model can enhance communication between designers of different backgrounds and native languages, and between designers, builders, and users, who may not share common terminology. Involving all these stakeholders early in the project can build on their collective knowledge, minimizing errors, and enhancing the ability to react to problems later.

that we had been selected to be one of the eight initial ventures in the Gore-Chernomyrdin Commission (GCC).

This raised the visibility of our project at the Langley Research Center to the highest level. We would report directly to the Vice President twice a year, and our Center director wanted zero chance of failure on this program. And while these were certainly benefits to our project, our new focus and Russian partners were going to change it considerably. Once the project became part of the GCC, we had to make major adjustments. We were going to have to adapt our instrument to the infrastructure of a Russian Meteor spacecraft and Russian Flight Control Center. We decided to use rapid prototyping to integrate the changes.

FACING UP TO INTERFACES

In many cases, aspects of Russian spacecraft control panels were opposite of those in American spacecraft. For example, the Russian electronics were positive-grounded and ours negative-grounded. Interfaces that get very little attention between American instruments and American spacecraft became major issues in the Russian spacecraft. There's nothing as frustrating as knowing your triple-redundant system needs to attach three wires to their dual-redundant two.

We spent an entire year designing and testing special bolts for attaching our instrument to the spacecraft. We built and tested prototypes for each difference in our systems. In each case, problems were discovered during prototype testing, and the solutions that were applied to the flight hardware as we struggled to make the prototype work resulted in our saving a considerable amount of money and time.

Along with the Russians, we built interface simulators that were exact copies of the flight interface designs, and these simulators went through a rigorous test program. Many of the original designs didn't work, and they had to be redesigned, rebuilt, and retested.

DESIGNING A NEW GENERATION

SAGE III was a fourth generation instrument, and many of the subsystems were radical departures from those of previous generations. The "new" designs turned into a huge problem for us. We were very concerned about certain systems, so we purchased parts early in the life of the project to make sure they would meet our needs. Some didn't. In one particular instance we had a part delivered five times incorrectly, and we didn't have the time or budget to go for a sixth delivery. We relied on prototyping to test a series of hardware and software repairs for the system.

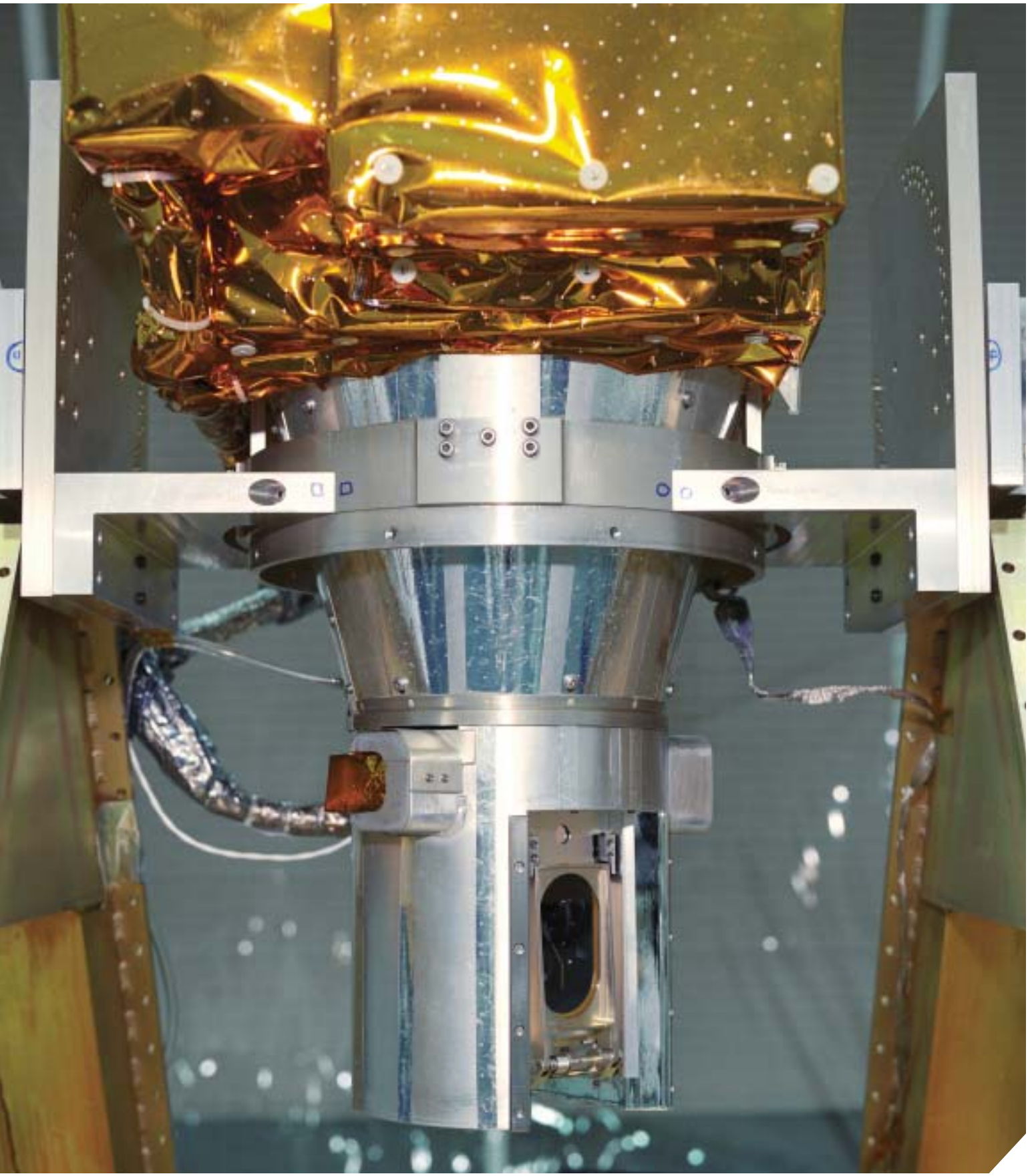
The older designs were huge problems in some cases as well. Parts no longer existed. Processes no longer existed. People that knew how to assemble the instrument or manufacture the instrument had retired. One of our biggest challenges had to do with an older design for a flex-cable on the flight instrument. The problem had been solved four separate times—each time a new generation of the instrument was built. Even though we had the flight drawings, all of the manufacturing procedures, and everything in front of us, we could not reproduce that flex-cable. We had to essentially start from scratch each time because the processes were different and the people were different.

We used rapid prototyping to solve the issues with the flex-cable. This taught us a valuable lesson: very early in the system design process, you should identify the older subsystem designs that will be hard to reproduce and submit these to rapid prototyping.

The sooner one finds errors of design, the less costly the impact to the project. The real-world problems of ultimate acceptability can be tested and verified quickly by prototyping, before an extensive commitment of resources.

Designing by feedback may require several cycles of incremental design and implementation. Often, in order to do it quickly and correctly, one must be willing to do it wrong first.

Russian spacecraft 3M in orbit with the SAGE III instrument on board.



SAGE III instrument.

"INTERFACES THAT GET VERY LITTLE ATTENTION BETWEEN AMERICAN INSTRUMENTS AND AMERICAN SPACECRAFT BECAME MAJOR ISSUES IN THE RUSSIAN SPACECRAFT. THERE'S NOTHING AS FRUSTRATING AS KNOWING YOUR TRIPLE-REDUNDANT SYSTEM NEEDS TO ATTACH THREE WIRES TO THEIR DUAL-REDUNDANT TWO."

TAPPING RESOURCES

You can use prototyping simply for troubleshooting, but I think there is an even better reason to employ this practice. By prototyping, you're actually getting to use some of the most talented people on your team, which are your machinists and your technicians. A machinist can be a wonderful help in a design. When you sit down with your machinist with a sketch of a prototype and say, "This is what I want to do," he can say, "Well, we really should use this material instead of that material."

The same goes with your technicians. They can say, "You know, you really should have a port here for an alignment….You know, you need a hole here…. You need a removable bracket here." You don't get that if you go straight to flight hardware. You're not using these people's minds; you're only using their hands. When you take a flight drawing to a machinist, he gets no say. If you have a piece of aluminum with a hole in it bigger than the aluminum itself, he will deliver you an envelope full of metal shavings. That has happened to me in the past.

MODEL CITIZENS

On this project, and really on all my projects, prototyping was standard procedure. SAGE-III launched successfully on December 10, 2001. Less than a month later, NASA lost communication with the spacecraft when the main transmitter went out and the Russian GPS receiver didn't work.

This is when all our joint repairs with the Russians really paid off. Because of our intensive work together during the prototyping phase, we had developed into a high-performance, unified, international team. This close situation led each side to have an excellent understanding of the other side's half of the interface. And in turn, this understanding led to quick, joint solutions to extremely difficult problems. In the end, together we were able to overcome the transmitter failure. This got SAGE III operating and sending its invaluable stratospheric data back to earth. And this data is the key to understanding ozone destruction in the stratosphere. •

ED MAULDIN retired in 2003 after 42 years of service at NASA Headquarters and NASA centers Ames and Langley, where he served as Project Manager, Optical Engineer, and Systems Engineer. Mauldin remains actively involved with APPL, and is currently teaching project management and risk management courses to NASA employees.

ASK talks with

DENNIS McCARTHY

WORLD-RENOWNED ASTROPHYSICIST STEPHEN HAWKING CALLED THE COSMIC BACKGROUND EXPLORER (COBE) "THE DISCOVERY OF THE CENTURY, IF NOT OF ALL TIME." DEPUTY PROJECT MANAGER DENNIS MCCARTHY, TOGETHER WITH NOW-DECEASED PROJECT MANAGER ROGER MATTSON AND THEIR TEAM, DESIGNED AND BUILT COBE AS AN IN-HOUSE PROGRAM AT GODDARD SPACE FLIGHT CENTER. THE SATELLITE WAS BUILT TO GATHER EVIDENCE OF THE BIG BANG, A THEORY WHICH STATES THAT THE UNIVERSE WAS CREATED DURING A GIANT EXPLOSION, LEAVING BEHIND RADIATION AND SMALL TEMPERATURE DIFFERENCES THAT CONTRIBUTED TO THE FORMATION OF THE STARS, GALAXIES, AND PLANETS. COBE WAS LAUNCHED IN 1989 FROM VANDENBURG AIR FORCE BASE IN LOMPOC, CALIFORNIA, AND COLLECTED FOUR YEARS WORTH OF DATA CONFIRMING THE SCIENTIFIC PREDICTIONS ABOUT THE THEORY OF THE PRIMORDIAL EXPLOSION.

Dennis McCarthy was the Deputy Project Manager for the COsmic Background Explorer (COBE) at Goddard from 1983-1989. He stayed at Goddard in 1990 as the Associate Director for the Space Sciences Directorate, moving in 1991 to Headquarters to be the Program Manager for the Hubble Space Telescope (HST). He followed the project back to Goddard in 1992, where he was the Deputy Project Manager for the HST Servicing Mission, and later Deputy Associate Director of Flight Projects. After his various positions on HST, McCarthy was Program Director for the Far Ultraviolet Spectroscopic Explorer (FUSE), Johns Hopkins University's first Principal Investigator (PI) program. Since 2000, McCarthy has been the Vice President and Director of Engineering Services at Swales Aerospace, where he is responsible for all engineering discipline support to NASA, universities, and industry.

Altogether you spent close to 30 years of your career at Goddard. Developing a satellite like COBE, which has made enormous scientific contributions, must've been a huge accomplishment for both you and the center.
It was. We were involved in Nobel-type science. COBE was an in-house program where they were developing the best they could develop. That has its upside and its downside.

The upside can obviously be seen in the success of COBE. Can you talk about the downside in this type of project?
Let me explain it this way: there's an analogy I use when I give talks about these programs. I think of them as essentially having three "pieces"—a spacecraft, the instruments, and the ground system. When all three are new designs, it just iterates, and iterates. Now combine that with the fact that it's an in-house program, and it's difficult to stick to a schedule. The reason is that in-house programs are always looking for the "ideal" design.

In my experience, it's an in-house mantra: develop the best, because our projects are one-of-a-kind, and we only do them once. It has to be the best we can possibly do, and our hardware has to have all brand new designs. When you get into this kind of thing, you can hardly ever complete the project. Then the management team gets criticized, because it can't get done.

This is different from your experiences on other programs?
It was much different when I went to Johns Hopkins University to manage the Far Ultraviolet Spectroscopic Explorer (FUSE) in the late '90s. The spacecraft and the ground station were bought off-the-shelf. Both were

Artist rendering of the COsmic Background Explorer (COBE).

"In my experience, it's an in-house mantra: develop the best, because our projects are one-of-a-kind, and we only do them once. It has to be the best we can possibly do."

fixed-price contracts. The only thing that was iterated was the instrument. When you only iterate one "piece" and the other two are fixed, you can get it done much quicker and at cost.

Since COBE was in-house, how did you keep the team from continuing to search for that "ideal" design?

When we redesigned COBE for a Delta ELV after the Shuttle Challenger accident, we froze the spacecraft design. We selected the ground system and said, "We're going to go with what we've got; no more changes." It made a difference.

If we hadn't done that, it could've gone on much longer. An in-house program is sometimes like a sandbox where everyone gets to keep playing and experimenting. Many in-house people have the attitude of "We want to build the best. It'll be done when it's done." Those same people expected me to let them play, and then to periodically go to Headquarters to get more money to fund it. That's wasn't my job, but that's their philosophy.

Is this a problem particular to your project and center, or do you think that project managers always have to fight for control of their respective projects?

It happens in other places as well. I sat on a review board for Mars Pathfinder and Project Manager Tony Spear. He had formed a Skunk Works on his project, and I'm thinking, "This looks familiar." He was trying to control the Jet Propulsion Laboratory (JPL).

I met with him privately before the review. I said, "Tony, what can I do to help you? I'm not just here to look under rocks and find things you're not doing, because you don't have the time or money." It was a surprise to him, because no one had ever asked him what he needed in a situation like that. He told me he needed control of the people that work in a matrix organization at JPL.

And did you take action?

Yes. I got up in front of the Deputy Administrator and all of the Associate Administrators and said that I believed that Mars Pathfinder would work. I went out on a limb, but I supported it as an engineer. Then I said that there's one thing he needs, and that is control of the people in the matrix organization at JPL. I said, "I strongly suggest

COBE's image of the infrared sky.

and recommend that he co-sign their performance." And the Associates agreed with me.

Would it have been possible for you to have tried a technique like co-signing on COBE?
No, no. The in-house people would never give up control of their people on the project. Some of them thought we were just the source of funds for their sandboxes. When that's the case, it's a terrible environment in which to try to build flight programs on schedule. That's the way it was for me until the Shuttle accident in 1986. Then we had priority at the Project Office, and we were given the requirement to get it done on time. We eventually got the center to do it our way, but it annoyed a lot of people. A lot of people still wanted to do it the old way.

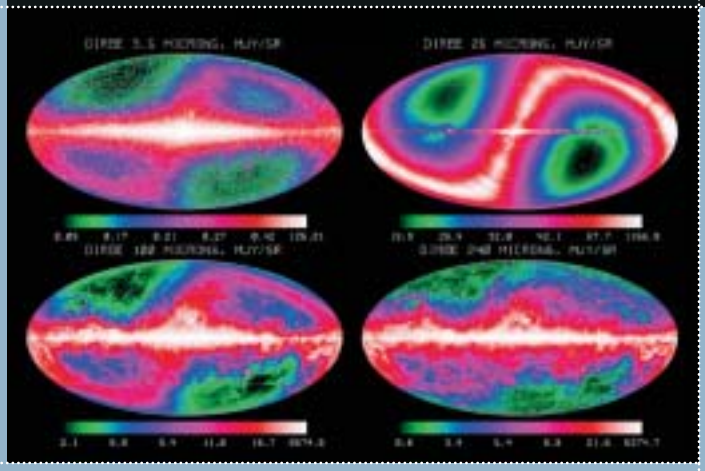
How did you get around that?
In our case, it took a crisis like the Challenger explosion to get more control. When the accident happened, we couldn't find a way to launch COBE. I was working hard to find another rocket, evaluating every launch vehicle in the world from the Chinese to the European Arianne. NASA Headquarters was naturally embarrassed, because here was this premier science satellite that we were going to build and launch from a rocket in another country.

So they found a way to launch it domestically?
The Associate Administrator looked around and found one Delta-1 rocket left, and it was old—the last one ever built. They said we could use it.

And it was possible for COBE to launch on a smaller rocket?
Well, the satellite originally weighed close to 12,000 pounds. However, if it wasn't launched on the Shuttle, it wouldn't need the 5,000-pound propulsion system. It also wouldn't need the 3,000-pound structure that held it across the Shuttle's cargo bay. So I figured we could fold everything up like the MARS Rover and launch it at about 5,000 pounds from a Delta.

NASA looked at the figures and agreed to launch it from the Delta?
They decided to do it. Noel Hinners, Goddard's Center Director, got behind us. He said, "This program will be the centerpiece of Goddard for the next 3 years. It will have all the priority needed." That's what got us really moving.

"For those of us who used to work there in the 1960s—it made us remember a time when we used to just do things. Back then we didn't have so many processes, procedures, and reviews. We just built things."



Annual average maps created from information retrieved from the Diffuse Infrared Background Experiment (DIRBE), one of COBE's three instruments.

For those of us who used to work there in the 1960s, it made us remember a time when we used to just do things. Back then we didn't have so many processes, procedures, and reviews. We just built things. We were always saddened in the '80s that the younger people had no idea you could do things like that.

So, this was a great model for the younger professionals to see that when the system focuses on a specific goal and clears the barriers away, that you can get it done. In our case, our barriers were cleared by an unfortunate crisis. Without the attention the project got from losing the Challenger, and without some pushing on the system on my part to find another way to launch,

COBE's view of the Milky Way Galaxy in infrared light.

it would've died. COBE would have faded into the woodwork, and everyone would've forgotten about us.

Was it always you and the Project Manager against the system, or did your team back you?

They did, and it really didn't take long. But it started out with control. When we formed the Skunk Works, we said, "We're in complete control of this project; we'll decide when you get it done." We met with everyone each week in the war room. We just took over.

Then, after a year and a half of a 3-year Skunk Works, the workers tend to take over. I worked half that time trying to move just an inch forward every day. After a while, they look up, and we've moved five feet. And the workers want to finish the job; they get a look in their eye. My goal then was to get out of their way—to give them what they needed and let them go.

How did you get the workers who wanted to "develop new technology" to shift their focus to meeting time and money constraints?

We just showed them that we were in control of the project. We said, "We're not asking any more questions. We are going to get this done." It didn't take long for the workers to throw the switch. Once it clicks that this is not going to be the run of the mill sandbox—where we're just going to develop new designs—they want to get it done. It's psychological.

What exactly was the Skunk Works strategy that set all this in motion?

We co-located everyone in one building, all of the engineers, and we put offices in. The core team was about 3-dozen people. They were working for us for the next two and a half years, which was hard since their matrix home was somewhere else. But we said, "We'll send them back when we're done."

We had a big "war" room and met there each week so there could be frequent and direct communication. We put every schedule on the wall, with the name of a different team member on each one. That schedule was their responsibility. I told them, "That's not my schedule up there, that's yours."

If you empower people, then they feel responsible. My philosophy was to delegate and empower people. To me, that's the job of the project manager: empowering and removing obstacles.

This must've been an amazing opportunity for some of the people you empowered.

They still talk about it. There is a street sign at Goddard that says COBE Road. It was a huge project spanning seven years. The fact that they did it after the Shuttle accident, it was the first NASA science mission, and they did it in Skunk Works…it's really satisfying. They kept to a schedule, they got empowered and took responsibility, and they ultimately made the project a success. •

Managing Projects in a Dynamic Environment: Results-Focused Leadership

This summer, the Knowledge Sharing Initiative will be celebrating its fifth birthday

FOR ALMOST TWENTY YEARS, THE MAIN THRUST OF MY research has been to gain an understanding of the elements that make for successful project management. Since I wanted to develop a "theory of practice," most of my research was based on first-hand data. I started by identifying the most competent project managers, interviewing them, observing them in action, and listening carefully to their stories.

This has indeed been a long and arduous voyage, since it was not always smooth sailing. Several times I reached the painful conclusion that in order to make any progress, I would first have to unlearn long-held concepts. In the end came the satisfaction, as I was able to formulate a set of principles that could deal head-on with the current dynamic environment of project management.

Readers of *ASK* will recall that I shared three of these unlearning experiences in my columns in *ASK* 12, 13 and 16. I also discussed several milestones in my research, as well as some of my findings in *ASK* 1, 4, 7 and 18. In this column, I present a brief summary of my findings which have been reduced to five major principles.*

ASK is one of the primary products of the Knowledge Sharing Initiative (KSI) of the NASA Academy of Program and Project Leadership (APPL). KSI broke ground following the first Forum of Master Project Managers that was held in July 1999 in Leesburg, VA. The keynote speaker in that Forum was the NASA Administrator, Mr. Daniel Goldin.

Therefore, this summer KSI will be celebrating its fifth birthday. I join in this celebration by presenting my current understanding of the five principles of project management in a dynamic environment, linked to 30 stories which were published in previous issues of *ASK*. Each principle is supported by three sub-principles and each of these, in turn, is linked to two stories from *ASK*, in which the sub-principle is demonstrated. By reviewing the principles and the stories together, I believe the reader will gain a deeper appreciation of the principles, as well as their application to project management in a dynamic environment.

The following two-colored figures should help the reader gain a better understanding of the principles. The first, "Results-Focused Leadership—Essence of the Principles," that graphically and most succinctly describes each of the principles, should help the reader see them as a single entity. The second, "Results-Focused Leadership—The Human Metaphor," shows how we, as human beings, resort to many different yet complementary resources in our lives. It should help the reader to better understand the unique nature of each of the five principles, as well as their mutual interdependence.

The colors were selected to reflect some of the unique characteristics of the principles.

Green (vegetation and growth) *for planning: suggests the growing, learning-based and evolving nature of project planning and control in a dynamic environment.*

Yellow (sunshine and optimism) *for attitude: suggests the spirited nature of the required "will to win" leadership.*

Brown (earth) *for results-oriented implementation: suggests the down-to-earth, practical, results-based focus.*

Red (heart) *for people and organization: suggests the softer aspects of people and teams, in particular, feelings, emotions, and warm and trusting relationships.*

Gray (drab, fog) *for communication: suggests the endless, ongoing, non-heroic and tedious efforts required for project communication. (It also represents the nebulous ambiguity resulting from continuous irrelevant and unclear information—a problem that frequent, intensive, and rich communication may help resolve.)*

** My 1996 book,* Simultaneous Management, *fully addresses principles 1, 4 and 5, and only partially principles 2 and 3. The book I co-authored with Ed Hoffman in 2000,* Project Management Success Stories, *goes further by addressing fully the third principle, but still addressed the second principle only partially. A later reexamination of the data presented in both books showed that ALL five principles are fully substantiated by the data. Reexamining the findings was triggered primarily by my work with NASA's project managers in 1999-2000 (in the early stages of the KSI). A more recent research composed of four case studies (two from NASA and two from the USAF), also support all five principles. These four case studies will be published soon in a book co-authored by A. Laufer, T. Post and E. Hoffman.*

FIGURE 1
Results-Focused Leadership: Essence of the Principles

FIGURE 2
Results-Focused Leadership: The Human Metaphor

THE FIVE PRINCIPLES OF MANAGING PROJECTS IN A DYNAMIC ENVIRONMENT

Consider these five principles as a single entity composed of five complementary and interconnected sets of activities, each balancing the other.

• Implementation of any one principle and its impact on project success depends on the implementation of all the others. To compensate for inability to fully adhere to a principle, be prepared to modify the implementation of the others as well as adjust project expectations.

• Embrace and apply these principles as general guidelines that must be tailored to each unique context of the project (e.g., stability of objectives, speed, task's complexity, organizational culture, top management support, team members' experience and skills).**

***Project context affects the manner in which a principle is implemented as well as the extent to which a principle must or can be implemented. For example, when organizational culture does not foster trust-based teamwork, you must rely more on formal work processes rather than informal ones. Or, when project environment is stable and task novelty low, there is less need to adopt an evolving, learning-based, planning process, and it is more appropriate to employ the traditional planning process that freezes project objectives and scope early on.*

PLANNING & CONTROL

1. Plan and Control to Accommodate Change
   1.1. Adopt a learning-based planning mind-set: start by defining project objectives that are dictated by customer's needs, however, don't finalize them before you quickly explore the means and the solutions.
   Lessons from the Great Masters, ASK *3; The One Thing You Need to Know,* ASK *6*
   1.2. Start planning early and employ an evolving planning and control process: continuously and throughout project life collect feedback on changes in the environment and in planning assumptions, and on project performance.
   Check Your Ego At the Door, Please, ASK *4; Implementation Reviews,* ASK *12*
   1.3. Use an appropriate amount of redundancy to contain the impact of uncertainty and enhance the stability of the plan: add reserves; loosen the connections between uncertain tasks; prepare contingency plans for extremely uncertain and crucial tasks.
   A Good Man is Hard to Find, ASK *15; Checkmate to Uncertainty,* ASK *17*

IMPLEMENTATION

2. Create a Results-Oriented Focus
   2.1. Create and maintain a focus; decide what NOT to do.
   How to Say No, ASK *1; Enough Is Enough,* ASK *14*
   2.2. Right from the beginning and throughout, focus on results—both long-term and short-term. In particular, prepare tangible intermediate products (e.g., prototypes) that provide you rich and quick feedback and that the customer can easily understand and assess.
   Dropping in on Mars, ASK *13; Proof of Concept,* ASK *13*
   2.3. Develop a pragmatic mode of operation: invest in planning yet be ready to respond swiftly to frequent, unanticipated events; identify areas where the search for optimal solutions is worthwhile, but for the rest of the project, be ready to embrace "good enough" solutions; for repetitive activities or critical areas (i.e., safety), employ formal/standard work processes, otherwise, employ those that are informal or ad hoc.
   Simplify and Succeed, ASK *9; Thanksgiving Hocus Pocus,* ASK *10*

ATTITUDE

3. Develop a Will to Win
   3.1. Develop a sense of a mission and "own" the project. (When needed, engage in politics and work hard to sell your project).
   Know Thyself—But Don't Forget to Learn About the Customer Too, ASK *5; Stumping for the Project,* ASK *12*
   3.2. When necessary, challenge the status quo and be willing to take calculated risks.
   Listening to the Voice Inside, ASK *2; What GOES Around, Comes Around,* ASK *16*
   3.3. Persevere; keep trying until you get it right. Yet, know when it is time to change course or retreat.
   Marbles for the Imagination, ASK 16; The Don Quixote Complex, ASK 5

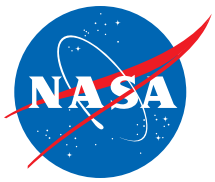
PEOPLE & ORGANIZATION

4. Collaborate through Interdependence and Trust
   4.1. Take recruiting very seriously and spend as much energy as possible on getting the right people.
   The Idyllic Workplace, ASK *7; Start-Up,* ASK *11*
   4.2. Develop trust-based teamwork and make sure that team members feel dependent upon each other and share the conviction that they are mutually responsible for project results.
   Chaos is the Fraternal Twin of Creativity, ASK *3; Earthly Considerations on Mars,* ASK *12*
   4.3. Throughout project life, assess team functioning, ensure its alignment on project objectives, and renew its energy.
   Keeping the Deal, ASK *7; The Journey Back,* ASK *16*

COMMUNICATION

5. Pull and Push Information Intensively
   5.1. Frequently and vigorously pull and push (ask for and provide) information within and across functions and teams, including all project stakeholders.
   Open Newsletters, ASK *6; What Has He Done For Me Lately?,* ASK *9*
   5.2. Employ multiple communication mediums; in particular, extensive frequent face-to-face communication and modern information technology.
   The Join-Up Meeting, ASK *7; Say What You Mean,* ASK *16*
   5.3. Adopt a moving about mode of communication. (Moving about helps you affect project performance by better understanding what is going on and by influencing people's behavior in a timely, natural, and subtle way.)
   A Gentle Touch, ASK *9; Walking a Fine Line,* ASK *17*

ASK



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