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ENTERING SPACE

FEATURES

NOTES ON A NEW BOOK

UPCOMING CONFERENCE

AAS News

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President's Message

This is my final president's message, as my two-year term sadly has come to an end. So I would like to take this opportunity just to say "thanks" to some very special people.

First, I want to thank you, the members of the AAS. We are a community of individual members and corporate/institutional members who are all committed to a profession we love and believe in. I'm sure that working for Home Depot or Starbucks can be a great career – maybe with better stock options – but I'm not sure those folks look at the sky the same way that we do. We see the wonderment, the challenge, and the importance of our collective efforts to conquer the "surly bonds of Earth." Let's stay the course and keep reaching for the stars!

Next, I want to give a shout to our AAS professional staff. Jim Kirkpatrick, my Navy buddy, my colleague, and my friend: you, sir, are a *great* executive director. And Cathy Eledge, you are *priceless* as our executive assistant and production manager of *Space Times*. Thank you for your ten years of dedication and excellence in service to the AAS. Jim and Cathy, you're the best!

I want to thank all of the officers, directors, and section chairs, and Kathy Howell, our editor of *The Journal of the Astronautical Sciences*, for your volunteer service and dedication to the Society. It is only through the unselfish and unpaid work of professionals like you that the AAS can continue to "Advance All Space" as the world's premier professional society dedicated to astronautics and space.

And, speaking of volunteers, thanks to Amy Kaminski for the great job you've done as editor of *Space Times*. And thanks, too, to photo editor Mark Arend. I can't imagine how you've found the time to pull together issue after issue of interesting and timely articles and illustrations. Well done!

I want to thank Mark Craig, my successor as president, and Peggy Finarelli, our new executive vice president, for stepping forward to lead the Society into our fifty-second year. You and the new slate of officers and directors have a proud tradition to maintain, and I look forward to supporting you.

And finally, it's important that I thank my employer, Lockheed Martin, and the leadership of our Washington Operations staff, for supporting me in my own volunteer work for the Society. Serving as president has taken a not insignificant part of my time and travel resources, but I have always felt that the company not only supported but also encouraged and rewarded my efforts to be a leader in the community. It's clear that my company values the AAS and believes that we are on the right track.

So that's it, fellow members. Let's press onward and *upward* together. I'll be seeing you – *out there!*

Jon Malay

ON THE COVER

The final Titan 4 launches from Vandenberg Air Force Base in California on October 19, 2005. This launch marked the close of Titan's half-century history of space launch service to NASA, the Air Force, and the National Reconnaissance Office. In all, 368 Titan vehicles launched since the first Titan in 1959. Titans served as launch vehicles for the manned Gemini progam, the Mars Viking missions, and the Cassini Saturn mission. The final launch carried a classified satellite for the National Reconnaissance Office. (Source: Lockheed Martin Corporation/Pat Corkery)

The Launch Industry: Focused on the Customer?

These days, being a launch provider has to be about more than just selling a rocket.
by Reece Lumsden

When thinking of the space industry, we typically fixate on the hardware component of things that fly in space, be they satellites or the launch vehicles that get them there. Considering specifically the launch segment, we may think everything revolves around hardware, but what about the services element of the business? Is it plausible that the launch industry will witness real growth emerge from the creativity and innovation shown in the services companies offer rather than just from focusing on trying to sell more launch vehicles?

In this article I present the argument that launch companies and potential customers alike should place a greater emphasis on the services element of the launch business. This focus should come as a natural extension of the consolidation of multiple capabilities under fewer company banners. A large component of this change emerges from the fact that launch providers must view themselves as *solutions providers* rather than as product makers.

A Customer Focus

Before considering the provision of services and the advantages offered over the provision of goods, we need to define our terms. Whereas both goods and services offer bundles of benefits to a customer, they differ from one another in various ways. As C. Tapper explains in *The Discipline of Marketing* (2005), goods are tangible, owned, static, and nonperishable; services, however, are intangible, experiential, variable, and perishable.

Two everyday examples to help clarify the difference between the two are that a mobile phone is a good, whereas an accountant filing your tax return provides a service. A service has the advantage that it can change to accommodate a customer's needs; due to its perishable nature, it can simply evaporate if it doesn't fully meet them. A good, on the other hand, cannot change: once you've bought a certain mobile phone, there's not a lot you can do to change its core functionality. As the good has already been created, it must either be resold to another person with needs more closely aligned to what the good offers or disposed of.

Any introductory text on marketing will proclaim that the only way an organization can satisfy its goals or objectives is by creating value for customers and satisfying their wants and needs. Therefore, if a company isn't working explicitly with customers to understand their issues and further try to anticipate their concerns, they are just reacting to problems. Operating in such a fashion will not help create value and hence not increase business. A company's focus on the end result shows that the company is focused on the customer.

Where the focus presently lies for most launch companies is apparent in their advertising campaigns. Advertisements for companies who provide launch vehicles usually include a picture of a launch vehicle – a good – either sitting on the platform or just taking off. What this says to potential customers is: "Look at the launch vehicle we can provide to you." This very much draws attention to the provider, when instead, a company should really be saying: "We can help you solve your problems." An example of a solutions or services focus is the way airlines advertise, especially cut-price carriers. What they advertise is enjoyment of the experience, not which aircraft will

The Sea Launch system, shown here in its Long Beach, California, home port, is among the launch options that Boeing Launch Services markets. Catering to both government and commercial users, Boeing, which also offers the Delta family of launchers, strives to fit customer launch requirements with the appropriate launch system. (Source: The Boeing Company)

take passengers to their destinations. Hence, language is focused on things that customers care about. Most customers requiring launch vehicles are satisfying a higher need, not just getting into space.

For example, in the commercial telecommunications sector, PanAmSat's business "higher need" is not getting into space (that's just a means to an end) but providing seamless communications for customers on a global scale. As a solutions provider, a launch service provider therefore should aim to contribute toward its clients' goals. In doing so, a launch provider becomes more of a partner in a client's business rather than just a provider who has no understanding of the customer. Treating the relationship in this way makes it easier to assure repeat business because the service provider develops an insider relationship, and the customer feels the provider understands implicitly his business and is not just a provider who walks away after the deal is done.

Kistler Aerospace of Kirkland, Washington, is developing the K-1 reusable launch vehicle with the belief NASA should let the private sector provide for the needs of the International Space Station. NASA's lack of clarity regarding its plans for using commercial space products and services to support the space station has created challenges to the survival of companies like Kistler. (Source: Kistler Aerospace)

With these aspects in mind, let's focus on some of the benefits a stronger services element would give to launch companies and their customers:

1. **Provision of a "one-stop shop."** Providing an end-to-end capability to customers greatly reduces the number of interactions clients have to make and removes the need for them to hunt for multiple providers.
2. **New markets.** More opportunities open up to launch providers when there is a range of areas throughout the payload life cycle from payload integration to on-orbit testing that can be exploited.
3. **Diversification.** It is far easier to redeploy an engineer in the services industry than one who works on the manufacture of a certain spacecraft component or element.
4. **Solutions focus.** Whereas launch providers offer clients the means to reach orbit, a launch company with a services focus provides solutions to customer problems, one of which is getting into orbit.
5. **Reduced capital requirements.** A presence in the manufacturing sector requires large overhead costs and lots of specialized, potentially single-purpose capital. A services focus reduces a reliance on capital.

Despite the advantages of having a services focus, there is also a fundamental challenge to this business model. The value of a service is largely rooted in the perception created in the customer's mind. That is, customers will only see a service to be of value if they perceive it as such. Because of this fact, launch companies need to manage impressions and perceptions much more closely than with a goods focus.

Also, it is important to recognize that in a few cases, a services approach simply does not support customer needs. For one, it doesn't make sense when a customer needs or wants to utilize a particular capability at a moment's notice, making it infeasible for an external provider to respond in a timely fashion. For example, the U.S. military will purchase communications capacity from a telecommunications provider on a one-off basis instead of entering into a services contract

Example—Non-traditional Customers for the Launch Services Sector

An innovative opportunity for a launch company came about through the advertising done by Pizza Hut, when a Proton rocket bearing the restaurant's logo went into orbit in July 2000. In this instance, Pizza Hut's focus was not on which launch vehicle they would specifically use; rather, the company sought the services of a provider who could get its name into orbit. Those in the launch industry need to think more laterally to include non-traditional customers to try and tap new revenue streams.

Example—Remote Sensing

The remote sensing industry has very much been a services-driven segment. In essence, anyone can request a satellite image from one of a number of providers. The image is provided at a pre-determined price. The user does not pay for the development of the satellite, ground segment, or processing; rather, the user just pays for the image. The provider in turn seeks to increase its revenues by exploring other markets. Such a model would benefit NASA's International Space Station re-supply needs as the agency then would need only pay providers of station re-supply services to do the necessary work. NASA would have no involvement in that particular industry other than to purchase a service from a provider.

An artist's rendering of DigitalGlobe's QuickBird satellite. (Source: DigitalGlobe)

due to the unpredictability of its needs in wartime. Limitations to the reach of launch services providers also apply in cases in which a government customer has unique safety requirements that private companies have little experience addressing.

Potential Services Opportunities through NASA?

National Aeronautics and Space Administration (NASA) head Dr. Mike Griffin recently announced he was keen for the U.S. space agency to procure services from the commercial sector where sensible and appropriate. In a recent address to the Space Transportation Association, Dr. Griffin emphasized that such an approach would allow companies to develop hardware with fewer documentation and oversight requirements. Not surprisingly, this prospect has been met with enthusiasm by those in the commercial space sector, who have been trying to convince NASA for some time that the agency should engage in services contracts more often. The only problem is that there have been few areas where it made sense for NASA to enter into such contracts.

The best (and at the moment, only) area in which it makes sense for NASA to procure services from industry is the re-supply of the International Space Station. While service providers may fight over what may be a relatively small market, those intending to operate in this domain must think of new opportunities. Station re-supply provides the impetus for providers of launchers to begin thinking about being in-orbit service providers.

Companies like Kistler Aerospace have tried to help NASA see that the agency should be in the business of dictating what it needs from industry, not creating these realities itself where it doesn't make sense. Finally adopting such an approach could be very liberating for NASA, especially at a time when many feel the agency has lost sight of its true purpose. Relying more heavily on industry would free NASA to concentrate on its more important mandate of exploration. One of the big benefits to NASA in utilizing a services contract is that the agency would be free from having to pay for certain support costs. Gone would be the need to pay for the upkeep of costly launch platforms, simulators, and other infrastructure that sit unused for much of the time.

Traditionally, NASA has either developed internally or dictated to a contactor "how" to do something. Such an approach traditionally requires lots of documentation, increasing the costs to the contractor. In some cases, NASA's approach makes sense. With respect to manned vehicles, particularly in the context of the Moon/Mars initiative, NASA may need to oversee the development of any launcher developed with greater focus on the "how" rather than the "what" given that the necessary expertise in manrated vehicles does not readily exist with too many commercial providers.

If NASA is to truly embrace a services-based approach, it will require a large culture shift. It will require NASA to remove itself from defining the functionality of a space station re-supply vehicle and instead merely to define the goals it wishes to satisfy. Put another way, NASA will need to focus on "what" it wants to achieve, not "how" to achieve it if the agency is to be sincere about embracing a services approach.

Operating in such a way will be a challenge, as it requires a more strategic mindset. It also implies that the agency knows from the outset what it wants. In this case, that could seem to be relatively straightforward – to re-supply the station x times per year – but for this approach to be successful, NASA has to lay all its cards on the table.

Conclusion

The launch provider market in the past has been dominated by a focus on the type and capabilities of the launch vehicle. With a massively over-supplied market, however, competitions among launch providers for the few new opportunities for fixed price contracts is not going to create a windfall for any provider or for the launch industry as a whole. A greater solutions focus, how-

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All (Space) Politics is Local: Crafting a Public Narrative for the Vision for Space Exploration

Maintaining unlikely coalitions and reaching out to the uninvolved public are keys to sustaining support for the future of human space flight.

by Frank Sietzen, Jr.

Senators Kay Bailey Hutchison and Barbara Mikulski couldn't be more different if they had been born on separate planets. Mikulski is a proud, long-serving Eastern Shore Democrat. Hutchison is a strong western Republican conservative. But the Marylander and the Texan share one grand if unlikely passion: space exploration. Together, they have forged a working coalition in the U.S. Senate to help guide the National Aeronautics and Space Administration (NASA) and President George W. Bush's vision for space exploration through the treacherous political waters of the 109th Congress. Partisan politics has rarely interfered with space programs as the two senators, adding others of both party affiliations with their votes, have been successful thus far in getting the NASA funding for everything from continuation of the shuttle and completion of the International Space Station to a start for the Crew Exploration Vehicle and the advancement of NASA's space and Earth science programs.

Of course, coalitions come and go in public life, as issues that are considered hot-button topics one year become superseded by tomorrow's headlines and urgency. Consider how many times the average American ever thought about the lower Ninth Ward of New Orleans prior to August 2005. Yet the fact of this unique political alignment lights a pathway of sorts for all those who care about sustaining the vision for space exploration. It is all about jobs as well as national economic strength. And that reality is no less important to communities where space is something that only appears on the news as it is where NASA centers reside.

The need to link human space exploration goals to the average, non-involved public is particularly important when one considers how little impact direct spending on space has within the larger aerospace community. In one recent survey of aerospace industry employment, the total number of jobs of all combined sectors was just greater than 600,000 in the spring of 2005. Of that total, space — including missiles, satellites, and rockets — accounted for about 70,000 jobs. The vast bulk of jobs in aerospace comes not from space employment but from aviation. The sole exception is in areas clustered around the NASA installations in Texas, Alabama, and Florida. The $16-plus billion annual budget for NASA pales when compared to the $450 billion for national defense, or the $32 billion for homeland security. These numbers are unlikely to change very much in the decade ahead — and may actually shrink when much of the space shuttle workforce dwindles to support the less-complex Crew Exploration Vehicle.

So support for the vision for space exploration is unlikely to be derived just from the size of the enterprise ahead. But it is not the size but the value of the workforce that should be emphasized. The workforce harbors the kind of skilled jobs that will shape other institutional investments, such as those made by non-profits and educational centers, including vocational and community colleges as well as large universities. If the federal government is going to sustain policy stability by means of a long-term human interplanetary exploration program, it will

Senator Kay Bailey Hutchison of Texas speaks to a crowd after greeting the crew of the Return to Flight space shuttle mission. Hutchison was a part of the welcoming ceremony at Ellington Field outside of Johnson Space Center this past August. The senator, whose state includes Johnson Space Center, supports NASA initiatives. (Source: NASA)

ABOVE: *In 2002, Horace Mitchell (left), manager for scientific visualization and virtual reality in the Earth and space data computing division at NASA's Goddard Space Flight Center, explains to Maryland Senator Barbara Mikulski and former NASA Administrator Sean O'Keefe how Earth science data are used to create visual products. (Source: NASA/ Chris Gunn)*

BELOW: *Political support in Congress is critical to the success of President George W. Bush's vision for space exploration. In November 2005, technicians at Johnson Space Center began constructing a Crew Exploration Vehicle mockup, which is similar in design to the original command module. (Source: NASA/Johnson Space Center)*

make sense for colleges to teach the core subjects that will be needed by that workforce, *even if that workforce resides outside of the community at first.* We live in an age of personal mobility. Young people growing up and in schools today may not necessarily choose to live and work where they were born or grew up. In our thinking about the indirect value of human space flight to local communities where space is absent as a large employer, we should consider making the larger case for its value as a long-term, sustainable impetus for a highly skilled workforce, even a workforce that may take space-specific skills and training *and migrate those talents elsewhere.* It's not about location but about what individual strengths young people can apply, no matter where they may in the future choose to apply them.

A Bipartisan Coalition

The strength of today's unique political coalitions should also not be ignored. A case in point: Mark Udall (D-CO) along with James T. Walsh (R-NY) introduced a bill in the House of Representatives earlier this year that would require NASA to give a stronger priority to spatial technologies and use of geographic information system-related products in the civil space agency's Earth observation programs. Udall introduced his bill, the "Remote Sensing Applications Act of 2005" (H.R. 426), in early January. Walsh joined as the only House cosponsor more than six months later.

As the House recessed on August 1 for six weeks, no floor action was scheduled, meaning that the bill wasn't set for a vote by the full House of Representatives. But the bill was unexpectedly reported out of the House Science Committee. Getting through the science committee favorably without a specific hearing about the bill is highly unusual. It had helped Udall greatly that the Democrats on the science committee had worked with the Republican majority earlier to discuss their own concerns about some of Bush's space spending provisions in NASA's legislation.

While the Republicans refused to sign on to the NASA bill when it first came out of the House Space and Aeronautics Subcommittee, ranking member Bart Gordon (D-TN) kept his troops from taking pot shots or making hot speeches about the NASA budget and its unpopular cuts. This partisan restraint — unusual in today's climate on Capitol Hill — helped Sherwood Boehlert (R-NY), science committee chair, and Ken Calvert (R-CA), the space subcommittee chair, strike up a compromise that provided provisions for aeronautics in the science committee's mark-up of the 2006 NASA

authorization bill that Udall could support and beefed up remote sensing programs while not exactly including everything in Udall's remote sensing bill.

The Republicans also let the Democrats, having made their point in subcommittee, come back aboard unanimously for the final full committee passage of NASA's budget. And with only a few weeks remaining before the summer adjournment, Boehlert and others fast-tracked H.R. 426 through the full committee with a favorable reporting.

Despite some grumblings about Bush's Moon-Mars initiative, last year the civil space agency was the only non-defense and non-homeland security domestic agency to get a budget boost, almost 5.6 percent. That bipartisan coalition remains intact. And it also helped Udall that both the chair of the full science committee, Boehlert, and the chair of the space subcommittee, Calvert, were moderate (some would say even liberal) Republicans who have made environmental issues major concerns during their tenure. A more conservative leadership in the science committee may not have been so supportive, or as flexible.

Supporters of NASA and of civil space should take a lesson from last summer's coalition-building exercise. So long as space doesn't encroach upon other, more defended federal programs, these arrangements can be the norm. In a sense, it requires space flying under the political radar.

It is true that politics makes for strange bedfellows. Democrat and Republican support goes hand in hand, vote by vote. There should be no permanent enemies here, only permanent interests — in this instance, space. Ideologues need not apply.

Beware of Crafting the Wrong Public Narrative

The vision for space exploration has at its heart science and engineering accomplishments. The work that the astronaut crews are to accomplish by getting to and living on the Moon and Mars will challenge nearly every element of the U.S. industrial base. This is substantial work, to be planned and executed by a well-educated and diverse populace, and should be the front-and-center component of public support campaigns. It is what actually will be accomplished on the Moon that will sell the vision. But too often, we hear proponents urging public interest and support because we have some manifest destiny to explore outer space. That may well be true, but don't be surprised if more practical-minded people suggest that perhaps we lack the "manifest destiny" to spend tens of billions of dollars to get there. A well-intentioned but wrong public narrative could actually work against the vision.

We can't predict, of course, what may happen following the 2006 midterm elections, much less following the election of the 44th president in 2008. It is therefore increasingly necessary that a public dialog be established and maintained. This might not be as hard as some might think.

As some of you may recall, I was the spokesperson for the vision for space exploration during the final weeks of the general election campaign last fall. I did so primarily because I genuinely believed in the program that the president had set forth. Also, after reporting on aspects of space activities for United Press International since 1998, I thought it was appropriate for me to stop reporting and come forward and say plainly what I had come to believe.

What I had come to believe in was an expansive space agenda driven in large measure by placing exploration at the center of the space program but not to the exclusion of other space initiatives. As I prepared to represent the program for the campaign, I was briefed in detail by those who were closest to the president's thoughts and plans for space. The shuttle would be retired by 2010, and the International Space Station would be utilized for exploration goals and science. And then NASA would retire the shuttles with dignity once they were no longer needed.

The lunar and Mars exploration program has as its central purpose permanence and the use of lunar surface facilities to reinvigorate the American space industry as well as to unlock the secrets of the Moon's origins and geology. Along

Maryland Senator Barbara Mikulski meets with NASA astronauts. NASA's Goddard Space Flight Center resides in her state. (Source: Office of Senator Barbara Mikulski)

the way the Moon is to become, as the space station before it, a logical departure point for other science and exploration initiatives, to be set by future presidents and Congresses. Permanence and technology are the goals, not flags and footprints. And not once have I heard anyone say the new exploration agenda will become "Apollo on steroids." The architecture that has emerged does indeed look a lot like a twenty-first century reconstruction of the Apollo spacecraft and launch vehicles. But, we must hope, there the similarity ends. Apollo was a sprint to reinforce the nation's claim as a superior culture in science and engineering, a demonstration of our peaceful capability to defeat National Socialism and Communism.

We can't out-Apollo the memory of Apollo. By making the vision for space exploration look like a more modern version of the past lunar missions, we risk having thoughtful people conclude we've "been there, done that." This is not our father's human space program – it is not about limits or redoing what our past heroes have done. It is about the long term.

Making the Case for Space Once and for All

What we have embarked upon today is the beginning of a permanent process of leaving the Earth and emplacing our values on other worlds. It is a journey, one that we hope has no end.

The world has changed since Bush's historic speech of January 14, 2004, and has changed even since the election that November. On an alluvial plain along the Gulf Coast, and in the streets and subways of London, nature's embrace and terrorists' hands have again reminded us that every day we share hope and opportunity with the shadow of sacrifice and loss. During such times of uncertainty, some would say that space exploration is no longer relevant to people's lives. They would counsel to spend these funds on more prosaic needs of a shorter term.

They would be wrong.

Space activities are no more and no less relevant than they have ever been. The money we spend each year on civil space affairs is little more than a paltry down payment on the future, an affirmation of what we as a people and a society can do for future generations. And yes, it is all about jobs and national competitiveness and economic strength. For as I have heard over and over again in my travels around the nation to talk about what I've witnessed, for average Americans, it is all about them: what will they get out of it, and when? For myself, I can't imagine anything more important – or more relevant – to the future of our country. It is all about a lasting commitment, one made possible only by building and sustaining permanent facilities on the Moon and beyond. Not flags and footprints but an address that lasts.

To preserve and extend these rare political coalitions isn't it time we talked about this?

I've had the opportunity to explain space exploration before many different types of audiences. When I was the director of operations at the Louisiana Nature and Science Center in New Orleans East, I brought models of Soyuz and Apollo spacecraft to poor schools in the lower Ninth Ward to show what space capsules can achieve. Those events had special meaning for me because I was born there and grew up in nearby Slidell, Louisiana. Many of those places are gone now, but the need for a hopeful future remains. In a sense I've come full circle, telling the story of the vision most recently at science museums in New York City. Although different people in different times, their responses were much the same: when you tell people what space means to their lives and that of their children, more often than not they become excited – and supportive. If the message will not otherwise go to them, we must find ways to take it to them, for without their support, no American will ever leave Earth orbit again.

Achieving the exploration goals set by the vision requires that we do everything we can to guide our leaders, appointed as well as elected, through the difficult minefield ahead to maintain a

President Ronald Reagan's term saw triumph and tragedy for NASA, from the first space shuttle launch in 1981 to his 1984 call to develop a permanently manned space station to the 1986 Challenger disaster. Here, the president talks to the crew of STS-2 as they prepare to land in California. (Source: NASA)

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The Remote Access Medical Suit

A sophisticated medical technology could make the difference between life and death for injured space explorers.
by Tam Czarnik

2:34 pm, Nov 22; Ares Mission Day 62 —

Crew engineer Shawn Abrams, perhaps having grown a little negligent on his fourteenth extravehicular activity (EVA), steps through a seemingly solid crust on Mars's volcanic regolith, plunging three meters through the shell before striking bottom. A bad landing on an underground rock twists his left leg violently outward; Abrams's vision goes white with blinding pain, perhaps his last vision of the red planet.

Regulations call for minimum three-person EVAs; but mired in the sheer volume of data to be processed, the commander had approved two-person EVAs. Science officer Tim Bailey, who had been turned away at the time of the incident, is alone on the scene; a shout on the headset, and Abrams is gone.

Bailey attempts to contact Abrams by radio then begins a search of the area. Minutes later he finds the hole in the regolith crust, with Abrams dimly visible at the bottom; he is not moving. Bailey ties a rope to the team's rover and rappels down into the chasm; by acting quickly, he has reached Abrams only ten minutes after finding him. Abrams is unconscious with a broken femur; with his tongue blocking his airway and his left leg bleeding into his pressure suit, he will not live the ten minutes it would take Bailey to immobilize him, much less the thirty minutes to extricate him, the twenty to race back to the Habitat and the five to re-enter the airlock....

Mars's first explorers may face just such a scenario: whether on the bottom of a subsurface lava tube, at the base of a steep hillside, or under a large disturbed rock, opportunities to get seriously injured abound. Trauma doctors on Earth say the first "golden hour" after injury is when most patients will be saved and that the first "platinum half-hour" is the best chance to save someone. But astronauts on EVA cannot be touched, being sealed into a pressure suit. Simulations at the Mars Society's Mars Desert Research Station in Utah have demonstrated a ninety-minute latent phase between immobilizing a patient, transporting him to the Habitat, entering through the airlock, and removing even part of the suit to access the body and start treatment.

Even alternatives, such as the rapidly deployable, nitrogen-pressurized bivouac tent, require critical time to be spent immobilizing and extricating the patient. For an injured astronaut to survive, we should be able to initiate the ABCs of trauma care (airway, breathing, and circulation) before we can access the patient, perhaps even before we can see the patient. The challenge is to build medical care into the pressure suit itself, and so the concept for the Remote Access Medical Suit (RAMS) was born.

Maintaining an Airway

The first ABC of trauma is the airway: without an airway, the patient suffocates; if oxygen does not reach the patient, medicines will have little effect. Thus, our first challenge is to maintain

More than ninety minutes could elapse before an injured crewmember could be immobilized, transported, de-suited, and treated. Could medical care begin inside the victim's suit, before help arrives? (Source: Gernot Groemer and the Mars Society)

Technologies such as the LifeVest™ wearable defibrillator could correct a faulty heart rhythm in a patient. (Source: LIFECOR)

an airway in a patient we cannot physically touch.

An endotracheal tube, or breathing tube, is used in the emergency room for good reason: it maintains a patient's airway, ensures oxygen is delivered to the lungs, and provides an emergency route for some medicines. But to place an endotracheal tube, the rescuer needs access to the patient – an unworkable situation if victim is wearing an EVA suit.

The number one airway obstruction in the unconscious patient is the tongue, so the question becomes: how can we remotely bypass the tongue, especially if a neck fracture is suspected? Proper placement of the head and jaw can prevent tongue obstruction so the patient can breathe; this is not as effective as the endotracheal tube, but much better than nothing. If a neck fracture is suspected, the head tilt must be avoided; the neck is maintained in a straight line, and the jaw is pushed forward to get the tongue out of the back of the throat. Such head and neck alignment technology is already available for those with weak neck muscles. Attachments at the back of the helmet could facilitate jaw thrust and head tilt. A simple auditory fail-safe ("Warning: head positioning activated in 3, 2, 1…") would allow a conscious patient to disarm the intervention by, say, voice command or toggle switch if it were not needed or deployed in error.

If this method failed to clear the airway, a more drastic intervention could be considered. A needle could be deployed through the cricothyroid membrane, just below the Adam's apple, and oxygen could be pulsed under pressure through to the lungs, bypassing the blocked airway. Again, an auditory warning would allow the conscious patient to inactivate the technology if appropriate. While seemingly drastic, this intervention has saved lives when no other airway could be obtained.

Maintaining Breathing

The second ABC of trauma is breathing. An airway does little good if the patient is not breathing on his own. The problem now becomes: how do you provide a respiratory force remotely for a patient you can't even touch?

Two possibilities are positive-pressure (using force to blow air into the lungs) and negative-pressure (using force to draw air in) ventilation. While positive-pressure ventilation uses less force, it forces air into both the lungs and stomach, which can rapidly distend the stomach, causing regurgitation and worsening airway problems. Negative pressure draws air only into the lungs, enabling patients to be maintained on it for hours, days, or months, as needed.

Negative-pressure ventilation technology already exists in the cuirass ventilator, a sort of "iron lung" chest compartment which could be built into a suit's thorax relatively easily. Air outtake from the thorax "sucks" air into the lungs, and air intake into the thorax "pushes" air out of lungs. Many designs for Mars suits already presuppose a solid thoracic compartment, which facilitates easy breathing and simplifies the addition of a cuirass ventilator.

Maintaining Circulation

The final ABC of trauma is circulation: how can we provide adequate circulating blood volume, reliable venous access, and intravenous (IV) medications while the injured astronaut is still in the Mars suit?

The first intervention is to "fix the pump." If the heart is not pumping blood effectively, adequate blood volume does little good. Commercially available technology already exists to correct a faulty heart rhythm in a patient: the LifeVest™ wearable defibrillator is worn around the chest, continuously monitoring the heart and automatically defibrillating an unconscious patient if necessary. Such an apparatus could relatively easily be implemented inside the thoracic compartment and even modified to regulate an aberrant heart rhythm.

But a functioning pump does little good if it has nothing to pump: if an astronaut is bleeding out into his suit (like engineer Abrams in our example), tissues are inadequately oxygenated, and the body dies. But the legs hold two liters of circulating blood; in a trauma, this blood can be diverted to the chest and head where it's needed by squeezing it out of the legs and increasing blood flow to heart, brain, and lungs. On Earth, this can be accomplished by the Military Anti-Shock Trousers, which apply circumferential pneumatic pressure around the legs, pelvis, and abdomen. The trousers also work well for splinting leg, hip, and pelvic fractures and could easily be built into a Mars suit.

Finally, IV access must be ensured. If a suited astronaut had an IV site that was accessible from outside the suit, it would facilitate immediate fluid support, re-warming through the use of warmed IV fluid, and drug therapy. But

how do you access an IV site hidden under a pressure suit?

The answer may be the PermaCath, an IV port implanted under astronauts' skin one month before launch and impregnated with antibiotics to prevent infection. Such an indwelling catheter port is currently used for a year or more in dialysis patients and others needing long-term IV therapy. Upon external activation or command, a needle is deployed through skin into the port, providing an IV line. Fluid and trauma-critical drugs (such as atropine, dopamine, morphine and epinephrine) could be stored in a personal life-support backpack and injected through the PermaCath if needed.

The Military Anti-Shock Trousers could provide two-liter blood transfers from the legs into the chest while stabilizing leg and pelvic fractures. (Source: Tam Czarnik)

Strengths and Weaknesses of the RAMS

The major strength of the RAMS concept is its ability to provide immediate, on-site trauma care (and even, to a limited extent, advanced cardiac life support) to an injured astronaut, without the life-threatening time delay involved in locating, immobilizing, transporting, and de-suiting the patient. When survival is measured in minutes, the RAMS could well mean the difference between an astronaut being "grounded" for several weeks for recovery and a major, mission-disabling loss.

The RAMS is also extremely versatile and accessible. If an astronaut develops, say, a series of asthmatic attacks during the mission, there is no reason why the epinephrine bag could not be replaced with IV albuterol to defend against future asthma attacks on EVA. The system could be activated by the medical officer in the Habitat, an EVA teammate, or even the patient himself. If a crewmember twisted an ankle on EVA but was otherwise stable, he could activate his own IV morphine and even dial up an appropriate dose.

Weaknesses of the RAMS concept revolve chiefly around complexity and weight. In any mechanical system, more components equal more chance for failure, and the KISS principle ("Keep It Simple, Stupid!") should apply. Whereas a failure of the Military Anti-Shock Trousers would simply mean the pneumatic trousers would not inflate, a failure of the voice/toggle override command could mean an unnecessary and dangerous needle in the neck!

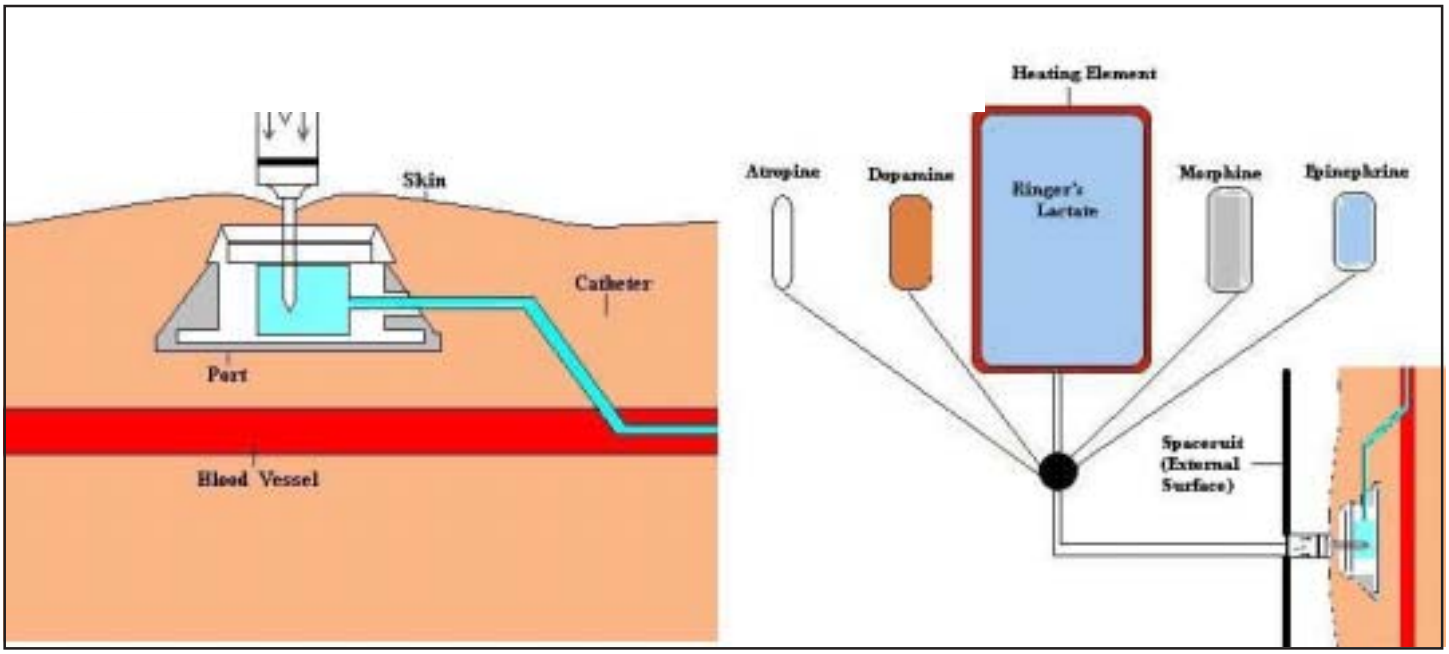
Even in Mars's low gravity, suit weight is a consideration. If the described systems add fourteen kilograms to the suit's mass, this means astronauts on EVA would need to carry an extra five kilograms. It has been suggested that the RAMS might better be incorporated into the EVA rover, with suit plug-ins for the necessary gas and fluid tubes – but which would of course limit its accessibility and increase time to care.

Finally, some astronauts might reasonably object to the elective implantation of a PermaCath, as they might object to other potential pre-flight surgeries such as elective appendectomy or extraction of unerupted molars.

Bringing It All Together: Crewman Abrams's Fate

For science officer Tim Bailey, there is little time and, fortunately, little need to think: a simple command remotely activates engineer Abrams's Remote Access Medical Suit. Immediately, Abrams's location and vital signs are shown on Bailey's retinal display, as they are on the Habitat's EVA monitoring station. The crew's medical officer takes over patient care: noting Abrams's choking respirations, he activates the jaw-elevating device and sighs with relief as chest compliance monitors indicate a clear airway into and out of Abrams's chest; no need for the neck tube today! He activates the cuirass ventilator and notes Abrams's oxygen saturation improve as 100-percent oxygen is drawn into and out of his lungs.

Noting a normal heart rhythm, the medical officer bypasses the pacing device and focuses on the blood pressure; the crewman's low pressure indicates a probable blood loss at a rate which suggests it is coming from the femur. He acti-



The PermaCath can provide for easy delivery of fluids and medications. ***LEFT:*** *The PermaCath port would be implanted under an astronaut's skin with a catheter entering a blood vessel.* ***RIGHT:*** *Trauma-critical drugs would be stored in a personal life support backpack and appended to a hypodermic needle for on-demand administration. (Source: Tam Czarnik)*

vates the Military Anti-Shock Trousers, which shift two liters of blood from Abrams's legs to his chest and head while splinting the broken femur and reducing further blood loss. He then deploys the IV into the PermaCath and orders IV fluid to replace lost blood, dopamine to bring up Abrams's blood pressure, and morphine for pain. Abrams, beginning to regain consciousness, is only too happy to let the IV needle poke him, knowing it brings pain relief and life.

Meanwhile, Bailey methodically prepares to rappel into the lava tube while a rescue team of two crewmembers is suiting up for the trip to the EVA site. By the time they reach the site ninety minutes later, Bailey has Abrams immobilized and hauled to the top of the tube; the medical officer begins to unclench his teeth while the commander vows never again to allow two-person EVAs. ■

Tam Czarnik **is a family physician cross-trained in aerospace medicine and is the medical director of the Mars Society.** **The author gratefully acknowledges the contributions of Mars Society members Gernot Groemer, Tiffany Vora, Tara Ruttley, and Dr. Richard Sylvan.**

Entertaining Proposals, Part 2

The first article in this two-part series examined the leisure activities that might occupy a crew en route to Mars. Now it's time to look at what could keep the Earth-bound public engaged in the mission.

by Tom Hill

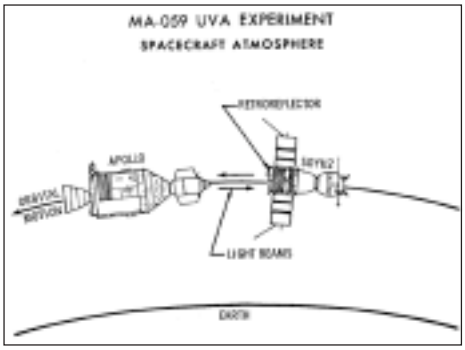
The world stood still on July 20, 1969, as Neil Armstrong took his "small step for (a) man" but then looked away quickly. It will likely do so again sometime in the near future when a human takes the first step on Mars. How can a human space effort and the media maximize their impact in support of such a goal?

When humans landed on the Moon, technology and the media environment of the time limited the Earth-bound audience to live coverage of significant events of the mission, often in poor-quality video images, and daily mission summaries on other days included as part of the evening newscasts. Today's technology allows high-quality video from on board a spacecraft, while the advent of twenty-four-hour news coverage and the creation of hundreds of television channels has divided the viewing audience in unforeseen ways and could make coverage of a future mission possible in unprecedented detail. In order to hold any audience, however, the coverage must be varied and interesting and could be combined with the power of the internet to deliver information that an audience wants and to create a media force with the potential to grow as the mission progresses.

Like on-board entertainment discussed in the first article in this two-part series (see "Entertaining Proposals" in *Space Times*, July/August 2005), the public video images released from early space missions seemed to be more of an afterthought rather than an important part of the mission package. Few could fault this approach in a test program: it was difficult to integrate video cameras with a live broadcasting capability into the mass-constrained Apollo capsules, and it was impossible to do in the Mercury and Gemini days. The astronauts as well were asked to be many things: test pilots, geologists, and philosophers to name a few, and to expect them to come up with new and exciting entertainment in the cramped quarters of a moonship was perhaps asking too much. In some cases, such as Apollo 7, the crew cancelled planned video presentations due to either cold-induced crankiness or the sheer number of other things to do. The public, in the meantime, quickly realized that they were seeing essentially the same images repeatedly – astronauts floating, eating, and drinking in space or bouncing on the Moon and views of Earth from our nearest neighbor – and were easily distracted by the latest episodes of *I Dream of Jeannie*.

In the intervening years, both the human space program and the media environment have changed appreciably. The space program, by design or by necessity, moved away from space spectaculars and settled into a more mundane se-

Space program firsts, like the first three-person spacewalk during which astronauts Pierre Thuot, Richard Hieb, and Tom Akers manually captured the Intelsat 6 communications satellite after its second-stage booster failed, capture media attention whereas more routine space events often go unnoticed. (Source: NASA)



Media coverage of human space flight has evolved from the use of basic models and diagrams as was done with Apollo-Soyuz in 1975 (upper left panel), to three-dimensional computer animations such as one shown of the Hubble Space Telescope servicing in 1999 (upper right panel), and hybrid real and computer-rendered still images such as one of the Crew Exploration Vehicle Earth Departure Stage in 2005 (lower panel). Enhanced NASA TV coverage and programming could evoke a large national interest in NASA activities. (Source: NASA)

ries of missions through flying the space shuttle many times in a year. Some missions caught media attention. Examples include the Hubble Space Telescope repair that required multiple spacewalks to make a faulty instrument able to meet its promise; the Intelsat 6 reboost where after a series of unsuccessful attempts participants in the first three-person spacewalk corralled the wayward satellite, connected it to a rocket engine, and released the combination to fly again; and John Glenn's return to space.

When Apollo worked to meet President Kennedy's challenge of "landing a man on the Moon and returning him safely to the Earth," there were only three major television networks in the United States. A small number of well-respected journalists were invited into family rooms each night to tell people "the way it is," and there were very few differences in the coverage. National Aeronautics and Space Administration (NASA) graphics and movies were used to show how an event should transpire, and few options existed for visuals in case something went differently than planned. Usually, news anchors resorted to demonstrating the problem with handheld models. Today, the variety in cable TV programming allows specialty channels undreamed of in the 1960s. While some could have predicted the development of full-time news and sports channels, it's unlikely that many would have seen the need (such as it is) for a twenty-four-hour food or travel channel. And along with the increase in the number of stations have come new screen formats, driven by increased computer power that allows a greater amount of information to be displayed on the TV screen.

Constant coverage on TV translates to an increasing need for material, which drives a lot of changes in programming. During huge news stories, such as the September 11, 2001, attacks on the United States, the programming theme is easy to choose, as the public hunger for information is focused on the one event and constant coverage can provide that information. On slower news days, however, the twenty-four-hour news format has more of an overview of news events from around the world, and stations may be searching for that polarizing event that can be turned into a high-interest item and draw the viewership such events bring. This effort leads to disproportionate coverage of events with little long-term importance, such as individual missing persons stories or celebrity murder trials.

The fundamental question is this: can a long-term human space effort punctuated with a moment like no other in the history of humankind – humanity's first steps on Mars – be translated into some sort of enduring news story?

Current Constant Space Coverage: NASA Select

In the backwaters of most cable services, usually only stumbled upon in a channel-surfing expedition, is a channel known as NASA Select. Serving as the C-SPAN of space, this channel provides a mix of old educational footage, newly-produced documentaries of current projects at the agency, archival footage of space efforts (usually to celebrate an anniversary of that effort), and live coverage of major milestones such as the Mars Exploration Rovers landings on Mars. For fill, when other programming is not available, the channel defaults to static coverage of the human space mission in progress, typically the International Space Station. The views in this latter coverage usually switch back and forth between those provided by a

camera mounted outside the station looking at Earth and that from a separate camera giving a view of mission control at Johnson Space Center. A programming guide can be found on the web at http://www.nasa.gov/multimedia/nasatv/.

NASA Select is not a commercial success, and the primary reason is that it doesn't need to be. The agency provides material at a minimal additional cost to its normal operations and considers it part of public outreach. With the signal broadcast to a publicly accessible satellite transponder, cable companies have the choice of devoting one of their channels to full-time NASA Select or part-time coverage of big events such as the Mars Exploration Rover landings, or they can ignore the signal entirely.

Still, the fact that NASA is one government agency given full-time coverage bodes well for the possibilities of expanding such coverage for a larger space TV program.

Unexploited Opportunities for Space Coverage

How could a commercial enterprise in the form of a space TV channel build up enough material to keep a varied and entertaining stream of information going and draw an audience? The answer may not be materially difficult, but will require a change in mindset for those running the new effort, in comparison to those who ran space missions of the past. There are many underrepresented portions of our space effort today, and one in particular provides more drama than most real space flights. If a portion of the "background" work that goes into a space mission were captured on tape and edited down for brevity, or even broadcast live, the public understanding of and perhaps interest in what's involved in a space effort would rise tremendously.

Some of the unexploited areas of space include:

1. *Design reviews.* As a space system is built, the contractor in charge of putting things together will meet with government representatives and describe their progress. The government will comment on designs based on its experience and recommend changes. Design reviews are typically full of contractor-private information, and a method of relaying part of the review without compromising that information would be necessary. Perhaps a short "public session" of the review could take place before the main review began.

2. *System tests.* As design of a system moves into manufacture, the equipment must be tested to verify that it will function as advertised and expected. Large-scale tests can be very boring, with test engineers toggling a group of switches for hours on end, or a tank undergoing pressure testing where there's no motion at all unless something goes very wrong. A group of systems tests could be "edited together" into an interesting piece of film, including descriptions of how the system being tested fits into the larger whole. Here, the specter of embarrassment flows into the equation. It's possible that a contractor wouldn't want its test failures filmed for general broadcast, but some sort of compromise where successes and failures are shown in the same show should be workable.

3. *Crew training.* People who fly into space are arguably the best-trained people on Earth for the jobs they do. Years of life experience as either a pilot, engineer, or scientist bring them to the career, while further training after the fact hones their skills to a fine edge. Astronaut training, especially if there's some sort of competition within it such as who gets to fly on the next mission based on personal performance, is a natural source of drama that could serve as excellent entertainment.

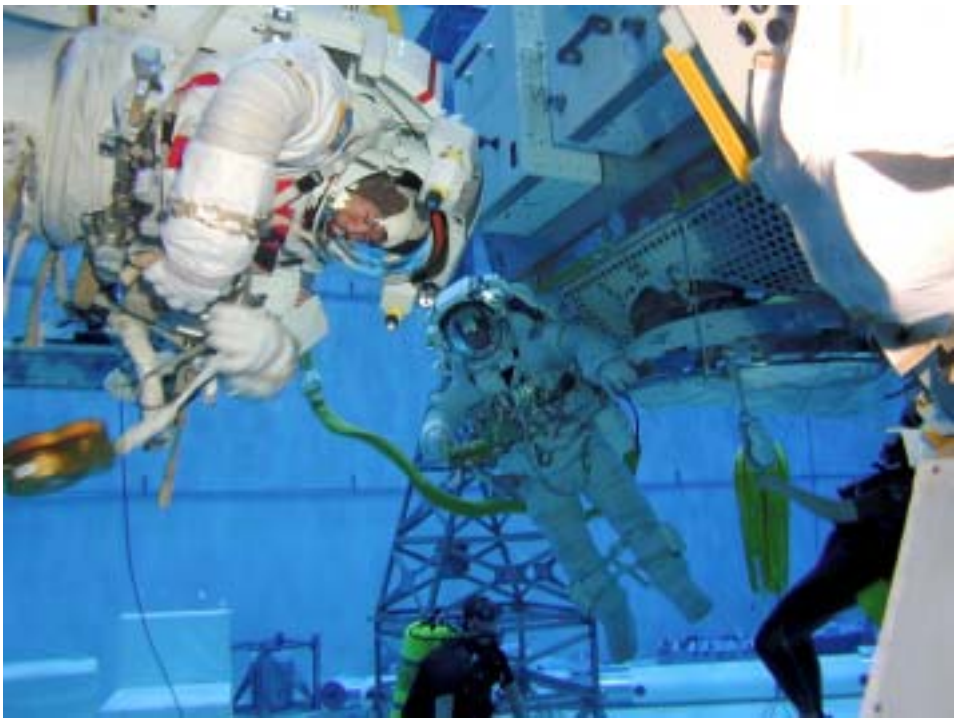
4. *Simulator rides.* The most focused form of training within the astronaut experience is a flight simulation. Here, a team of astronauts is exposed to a laundry-list of failures – all of which are possible but unlikely in the real world. During all of the failure scenarios, the test subjects must also complete a major mission event (like landing on Mars safely, for example). So, by definition, simula-

Mission training events like those performed by astronaut Charles Camarda, seen here training in Johnson Space Center's fixed-base shuttle mission simulator, could be televised and accompanied by commentary to explain what failure simulation is being evaluated. (Source: NASA)

tor rides are not dull. In a broadcast version of a simulator ride, sports-like commentary made by announcers who know or have a general idea of what the ride will entail can provide a lively experience while explanatory graphics can give background information on the simulation to help viewers understand what's going on. In this form of entertainment, internet-based technical documentation on the equipment used in the simulation could allow audiences to learn more about the simulations, increasing their viewing enjoyment. The software used for these flight simulations could be adaptable into a computer game, allowing home users to try their own skills at the tasks they watch space crews carry out.

While covering these events over the lifetime of an evolutionary space program as described in the vision for space exploration may provide enough material for a non-mainstream cable station, other media outlets will not be interested in the gritty detail that such coverage would provide. Of course, all sources of news will clamor for the visuals of the first crewed landing on Mars and the first human footfall on that planet, but between launch and the fateful day the coverage will likely be below the radar screen of a mainstream media increasingly focused on celebrity trials and government press conferences. For larger outlets, summary excerpts could be created in varying lengths and covering various lengths of time. Examples include a "Space Today" in five- and ten-minute segments and a "Space This Week" in fifteen- and thirty-minute segments. These summaries could be distilled from longer programs broadcast on a primary space network.

One way for a start-up space network to get attention would be to negotiate a first-use video release policy, similar to the agreements that networks secure when covering the Olympic Games. Here, the space network would "own" footage for a period of time, being the only one able to show video of an event until that time expired. Such an agreement, however, would be impossible for the launch, as other news stations could position their own cameras near the launch pad, and would prevent the landing and first steps from being shared with all of humanity, should the network not be accessible as a basic channel.



The physical rigors and stresses that astronauts endure while in underwater training in the Neutral Buoyancy Laboratory at the Johnson Space Center could be televised and could serve as entertainment as well as a window into future mission operations. Here astronauts Soichi Noguchi and Steve Robinson perform an underwater, simulated extravehicular activity in preparation for the STS-114 space shuttle mission. (Source: NASA)

Other Options

Detailed coverage of the technical aspects of a Mars mission will certainly make some people more attentive to the events as they unfold, but such coverage is unlikely to capture the attention of the majority of the viewing public. Keeping the crew and its mission "on the radar" of the general public will require the crew to get involved in activities which, although typically are not associated with the space program, are much more commonly covered in today's media environment. Examples covered in the previous article included movie and book reviews, although other possibilities exist. Publicity-related events have a precedent in today's space program, as the astronauts on board the International Space Station filmed an introduction to the 2001 Academy Awards celebration, including a special-effect sequence that gave the impression that Steve Martin, the host of the awards that year, was on board the station. While some believe that space efforts belittle themselves by getting involved in such pedestrian activities, realists accept the fact that, in order to stay relevant, a large-scale, publicly-funded effort must remain visible. In addition, while playing sports on the way to and on Mars will be out of the question for some time, crew members can make their alma maters known (if the past is any guide, early participants in Mars missions will have several alma maters corresponding to their many educational degrees) and provide some good lead-up material to a classic rivalry college football game happening back on Earth.

Getting from Here to There

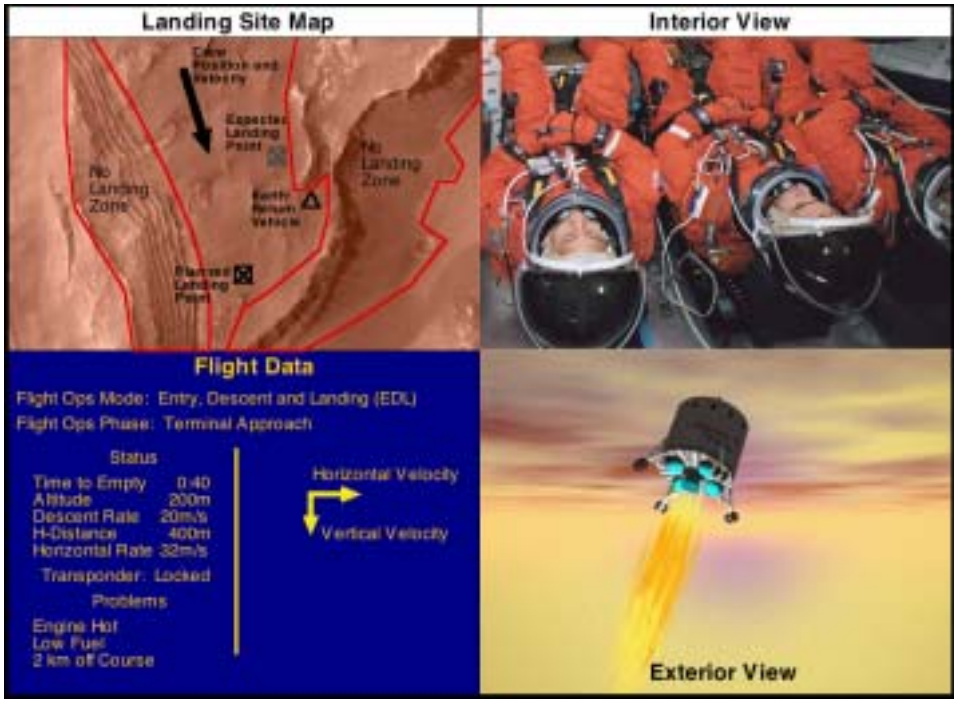
It is fairly easy to construct a strawman schedule for media program development as the Moon-Mars exploration effort moves forward. Starting today, with only NASA Select playing and development work barely started on the next generation of space vehicles, the focus may have to fall on reality TV shows to provide an entertaining story. One such program is already in the works.

In a recent press release, Ron Howard, the producer of space-themed efforts such as *Apollo 13* and *From the Earth to the Moon*, announced early work on a reality program in which people are placed in a simulated space capsule environment and given problems to solve. The working title is *Xquest*, and even though details are sparse at this time, the concept certainly holds promise.

As hardware development begins, more raw footage will be available for programming. Documentaries on the spacecraft and the people that work on them can start to come into play. Testing can provide some drama, although as mentioned before several obstacles stand in the way of this type of entertainment.

The real possibilities open up as crew selection begins. Traditionally the astronaut selection process has been a closed affair, with press releases announcing those ultimately selected being the only word coming from the process. It's likely that some portion of that mystery will remain, but once a core group is chosen, there's no real reason that their training couldn't be filmed and televised. The suspense could be held in such a situation if the best performers as judged by widely-known criteria were actually chosen to crew a mission.

After a crew and its back-up are selected for an early mission to the Moon or elsewhere, the drama for that team will drop appreciably. Final mission simulations could prove interesting, but once the crew launches, all will hope for a smooth mission. A smooth mission means very low viewership for a constant monitoring of the crew's activities. Exceptions will happen, of course. The first widely-covered landing on the Moon, with the potential of having a pre-positioned camera on the surface that can allow the public to watch the new explorers land in their craft, will be a huge media event, as will the first steps on the surface, but subsequent steps and missions won't draw the ratings.



Proper use of television screen real estate can turn a crew simulation into an exciting event for viewers. In this sample, the display is divided into four quadrants. The upper left shows where the crew's lander is relative to its planned landing site and the hazards that the crew must avoid (Source: NASA/Jet Propulsion Laboratory/Malin Space Science Systems). The upper right shows the crew members in their seats controlling the descent (Source: NASA/Johnson Space Center). The lower left image shows technical data about the simulation (Source: Tom Hill), while the lower right shows an exterior view of the lander in flight (Source: Tom Hill, rendered with Mars Direct toolkit software).

Headline shows on the space TV network at this time could again focus on crew selections for the next mission, with some teams holding together while others lose members. In the meantime, spacecraft design, development, and testing will continue for the next round of mission hardware to take people further into space, starting the cycle over.

In *Chariots for Apollo* (Avon Books, 1985), Pellegrino and Stoff's story of building moonships, the last chapter is devoted to the loss of public interest in the Moon program. As Lynn Radcliffe, an engineer who worked on the lunar module at Grumman Corporation on Long Island, New York, is quoted: "We had the people in the palms of our hands, looking at the tube witnessing the most amazing achievement in the history of man, and we lost them." While the causes for such a shift are varied and debated, public engagement remains an important part of every space effort. A comprehensive public interest program will engage disparate age groups and meet them where they live and work and seek entertainment. Such a program will be difficult to ignore and should cement space exploration's place as a part of our society. ■

Tom Hill **is an aerospace engineer by day and a space activist by night. His book,** ***Space: What Now?*** **(Publish America, 2005), explores topics such as leisure time in space. He can be reached at tom@spacewhatnow.com.**

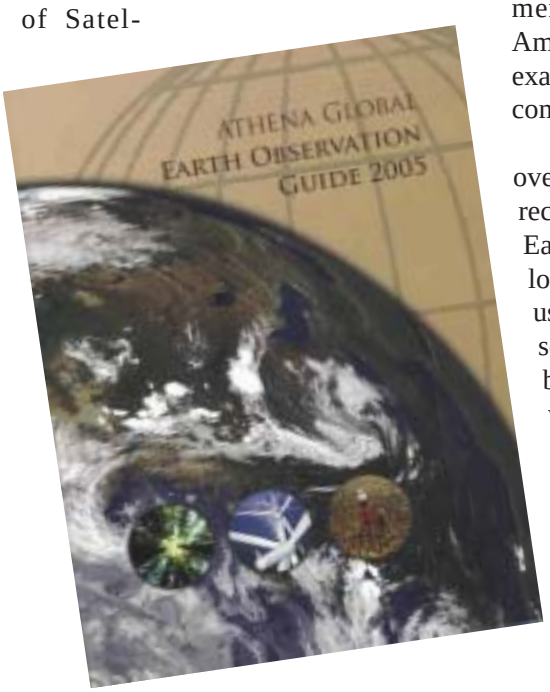
Athena Global Earth Observation Guide 2005

Reviewed by Mark Williamson

Athena Global Earth Observation Guide 2005: A Decision Maker's Guide to the Use of Satellites for the Environment, Resources, Disasters, and Security by Andrew Eddy et al. Montreal: Athena Global, 2005. 255 pages. ISBN: 0-9737-1060-8. $1200 USD +$40 shipping for international orders (paperback).

To point out that we live in a "global world" these days is somewhat clichéd and tautologous, but it is a fact. News of impending hurricanes or devastating tsunami travels around the world in the blink of an eye or, more accurately, in the click of a satellite switch. While communications satellites bring news of events from natural disasters to terrorist atrocities, Earth observation satellites bring images of everything from breached levees in Louisiana to calving glaciers in Antarctica.

The *Athena Global Earth Observation Guide 2005* is subtitled "A Decision Maker's Guide to the Use of Satellites for the Environment, Resources, Disasters, and Security" and, as such, fits well into our need for global information. Recognizing the importance of space-based resources, the *Guide* is aimed at those who are, or should be, using them: politicians and their policy advisors, senior public servants, directors of international organizations (including non-governmental organizations), and other decision makers.



This multi-author work provides a comprehensive review of available satellite technologies and how they are used around the world. It is well-designed and clearly presented (with many color images) and succeeds in providing a top-level, global feel at every turn of the page. Two-page, Earth-view spreads, such as the "Earth at Night" spread showing the global extent of artificial lighting, introduce each section and other images. The design of the book has somehow done away with any hint of parochialism, which often taints other ostensibly global documents. There is no concentration on American or European technology, for example, and no self-indulgent use of one company's imagery.

The book begins with a global overview of available satellites, sensors, receiving stations, and related trends in Earth observation. This overview is followed by three "theme papers" on the use of satellites for the environment, resources, and disasters and security. The bulk of the book is a geographical survey of how individual countries are using space technology to address the issues and problems they face. It is divided into eight regions and covers forty-three countries. Each section presents a "fast facts" box on the region and an overview of the three themes as they relate to that region, then provides details of individual nations. The design makes the information easily accessible and should prove attractive to the target market, whose members typically lack the time to wade through masses of text in search of information. Regional "one step further" boxes provide web links to further relevant information, and the book concludes with a short glossary and list of acronyms.

So is the book an embodiment of perfection, then? No, of course not: any attempt at a global review in 250 pages is bound to gloss over detail and leave the interested reader wanting more. In addition, it is always possible to find mistakes in areas one knows well: for example, the United Kingdom-based Surrey Satellite Technology Limited is given at least two other, incorrect names in the book. The editors might consider for any future edition compiling an index to avoid this type of error. Also, a diagram on one page mislabels a frequency spectrum in hertz, rather than gigahertz, but these are mere quibbles in the context of the whole volume.

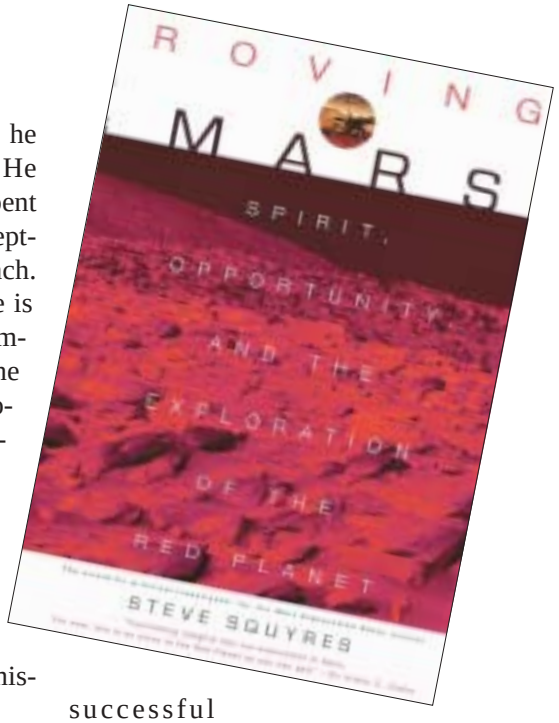
A review on a global level, as a book of this type deserves, reveals that broad-scale research and innovative design can come together to produce a guide to Earth observation that is second to none. Although its high price will rule it out for most individual purchasers, it deserves a place on the bookshelves of all target institutions. ■

Mark Williamson **is an independent space technology consultant and author.**

Discounts are available for academics and bulk orders. Email patricia.marshall@athenaglobal.com or visit http://www.athenaglobal.com/en/AGEOguide.html.

Roving Mars: Spirit, Opportunity, and the Exploration of the Red Planet

Reviewed by Anthony Young



Roving Mars: Spirit, Opportunity, and the Exploration of the Red Planet by Steve Squyres. New York: Hyperion, 2005. 422 pages. ISBN: 1-4013-0149-5. $25.95 (hardback).

For more than a year and a half, the world has been witness to some of the most stunning images ever taken of the planet Mars. Those images were not beamed back from an orbiting space probe but from two sophisticated and, it turns out, very rugged robotic rovers on the surface of the red planet: Spirit and Opportunity. These marvels of engineering have surpassed all expectations, even those of the creators: the engineers, scientists, and mission planners at the Jet Propulsion Laboratory in Pasadena, California.

Steve Squyres is the principal investigator and scientist for the Mars Exploration Rover mission. His book, *Roving Mars*, documents the dramatic story of how the project was conceived, proposed, rejected, re-proposed, approved, funded, and finally begun against an impossibly short deadline and repeated threats of cancellation due to cost overruns and engineering dead-ends. Pure engineering of this nature can be pretty boring in the telling, but Squyres has written the book in such a riveting style that it truly is a page turner. So how does he do it? Squyres places the emphasis on the men and women who have been involved with this amazing mission from day one and how each experienced the gamut of human emotion in an effort not only to get these robotic rovers to the surface of Mars but also to keep them running against all odds.

Squyres's book is very much a personal story. He begins the book with his fascination in looking at the Viking pictures of Mars at Cornell University, where he was an undergraduate and where he would later become a professor. He joined Ames Research Center and spent five years working there before accepting an offer to return to Cornell to teach. The story picks up the pace when he is invited to attend a planetary science symposium in Moscow in 1987. There the seed was planted in his mind to put together a proposal to submit to the National Aeronautics and Space Administration (NASA) for a new mission to Mars. The reader then experiences the repeated anticipation and disappointment as Squyres writes several proposals in an attempt to get approval and funding for a planetary mission to Mars.

After years of effort, one of Squyres's proposals survived the NASA approval gauntlet, and he was faced with putting together a team to actually engineer, build, launch, and land on Mars not one but two robotic rovers. He relates the frustrating development problems, incessant battle with vehicle weight, unnerving program reviews, schedule pressures, near-death experiences over bloated program costs, eleventh-hour completion and delivery of the two rovers to Cape Canaveral Air Force Station in Florida, and the almost anti-climactic launches of Spirit on June 23, 2003, and Opportunity just a few weeks later on July 7. The reader will experience the nerve-racking entry, descent, and landing and the jubilation at successful deployment of each rover on Mars. Squyres then slows the pace of the book as the rovers begin their methodical exploration of Mars and beam back images. Squyres spends sufficient space discussing the scientific and geologic findings the rovers are sending back to Earth.

The book is thoroughly illustrated with many color photographs of proposed rover concepts, the rovers being tested and built, personnel involved with the program, and some of the best images from the surface of Mars to date. It is worthy of every *Space Times* reader's bookshelf. ■

***Anthony Young* has published nine books covering transportation history.**

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29th Annual AAS Guidance and Control Conference

February 4-8, 2006, Beaver Run Resort, Breckenridge, Colorado

American Astronautical Society
Rocky Mountain Section

It is our distinct pleasure to invite you to attend the 29th annual AAS Guidance and Control Conference. The conference will be held at the Beaver Run Resort in Breckenridge, Colorado, February 4-8, 2006. We have worked hard to put together another exciting and educational program, and new for this conference will be two opening sessions on the 4th which are for U.S. citizens only: **"Special Initiatives"** and **"Autonomous Proximity Operations and Servicing."** On Sunday the 5th we will continue with our normal international sessions. In addition to the traditional conference sessions of **"G&C Advances"** and **"Recent Experiences,"** we will include **"Control Techniques for Deployables and Large Structures," "GPS and Satellite Navigation,"** and **"Space Exploration Initiatives."** Details on the session topics and papers can be found at our web site http://www.aas-rocky-mountain-section.org (updates are available periodically).

As usual, our **"Technical Exhibits"** session will provide attendees the unique opportunity for one-on-one interaction with industry, national laboratory, and academia representatives, and will provide exposure to state-of-the-art guidance and control technology. This is accomplished in a setting unique to our conference and is traditionally attended by all participants. For those unfamiliar with this special session, **we encourage you to bring your family**, enjoy our sumptuous buffet, and socialize with friends and colleagues old and new!

The traditional evening banquet will once again present a nationally known speaker who is sure to entertain not only us engineers but our family members as well. Multiple family events are planned. One special activity for school-age children will be a talk from former NASA astronaut Bill Gregory.

Come join us in the Colorado Rockies for four days of learning from world leaders in Guidance and Control. The exciting atmosphere, state-of-the-art technical innovation, and lessons learned will make it an exceptional experience. The conference format blends world-class technical presentations with ample time for recreation, family and group activities, and social gatherings in an authentic mountain community. The conference offers special discounts on lodging, ski tickets, ski lessons, and rental equipment, so be prepared for an experience that will keep you coming back year after year.

Hope to see you in February!

Steve Jolly, Conference Chairperson
Lockheed Martin Space Systems
Phone: 303-971-6758 Email: steven.d.jolly@lmco.com

Deb Wright, Conference Coordinator
Lockheed Martin Space Systems
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Complete details on the conference content and registration, Beaver Run Resort reservations, and the town of Breckenridge can be found at http://www.aas-rocky-mountain-section.org.

The Launch Industry: Focused on the Customer?

Continued from page 6

ever, may open new revenue streams based not on fixed-price but open-ended contracts, such as for consulting services. The challenge for launch providers, therefore, is to change their focus from being product providers to solutions providers.

Such a focus will require a greater understanding of customers' wants and needs, to the point where future problems can be anticipated and hence opportunities to add value can be created.

NASA has started down the path of utilizing services from industry, realizing it may offer great benefits, but this direction will require a culture shift to ensure the agency fully understands what it wishes to achieve and does not revert to defining "how" a service provider will deliver.

A services focus has operated successfully for some time in the space industry, remote sensing being a primary example. Therefore, there should be no reason why this model cannot be expanded to encompass other industry segments where appropriate. ■

Reece Lumsden **is an associate of Athena Global (www.athenaglobal.com), a management consultancy focused on the utilization of space services to solve cross-disciplinary problems. He is also the founder of Tek-talk (www.tek-talk.com), a free online service providing interviews with scientists and engineers from around the world to students currently studying science and engineering.**

The AAS is proud to present our recently elected officers and directors

Introducing the Officers:

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Jonathan T. Malay, Director, Civil Space Programs, Lockheed Martin Corporation Washington Operations

Clayton Mowry, President and Chairman of the Board of the Washington, DC-based Arianespace, Inc.

Kathy J. Nado, Account Manager, Science and Information Services, Computer Sciences Corporation

Richard M. Obermann, Democratic Professional Staff member on the House Committee on Science

All (Space) Politics is Local

Continued from page 10

purposeful space agenda that preserves the objectives of science and engineering excellence and avoids, under growing budget pressure, the temptation to reduce our sights and settle instead for a replay of the glories of the past. For it is true about space affairs as is true about many other facets of federal spending, where public support is essential to keep the political winds flowing favorably: all politics is local – local needs, local hopes, and local strength writ large on a national scale.

The exploration of space will continue whether Americans sustain these programs or not. Though we have often led the world into space, it is far from assured that we will continue to do so. We are not the only space power as this new century begins. Both traditional allies as well as historical adversaries understand only too well the value of space technology — and of being "first" in space. It is the promise of exploration, and all that it may uncover and discover about the universe, that we must preserve, fight for, and keep in mind always as we work to keep this public and political coalition working. Space is all about benefits, even those we can't yet imagine. We really do not know what we don't know. And isn't that exciting?

Neil Armstrong was right, you know: out there in the cold and darkness of space, there are indeed places to go beyond belief. ■

***Frank Sietzen, Jr.*, writes and lectures about space exploration, geographic information systems, and technical communication. The views expressed in this article are his own.**

UPCOMING EVENTS

AAS Events Schedule

January 22-26, 2006
***AAS/AIAA Space Flight Mechanics Winter Meeting**
Westin Innsbruck Golf Resort
Tampa, Florida
www.space-flight.org

February 4-8, 2006
29th AAS Guidance and Control Conference
See page 22 for details!
Beaver Run Resort
Breckenridge, Colorado
www.aas-rocky-mountain-section.org

March 14-15, 2006
44th Robert H. Goddard Memorial Symposium
"Eighty Years After Robert Goddard's First Rocket Flight: Engineers, Scientists, and the Vision"
Greenbelt Mariott Hotel
See page 14 for details!
Greenbelt, Maryland
www.astronautical.org

June 8–10, 2006
***Student CanSat Competition**
Washington, D.C., area
www.cansatcompetition.com

August 21–24, 2006
***AIAA/AAS Astrodynamics Specialist Conference and Exhibit**
Keystone Resort & Conference Center
Keystone, Colorado
www.aiaa.org

November 14–15, 2006
AAS National Conference and 53rd Annual Meeting
Pasadena Hilton
Pasadena, California
www.astronautical.org

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