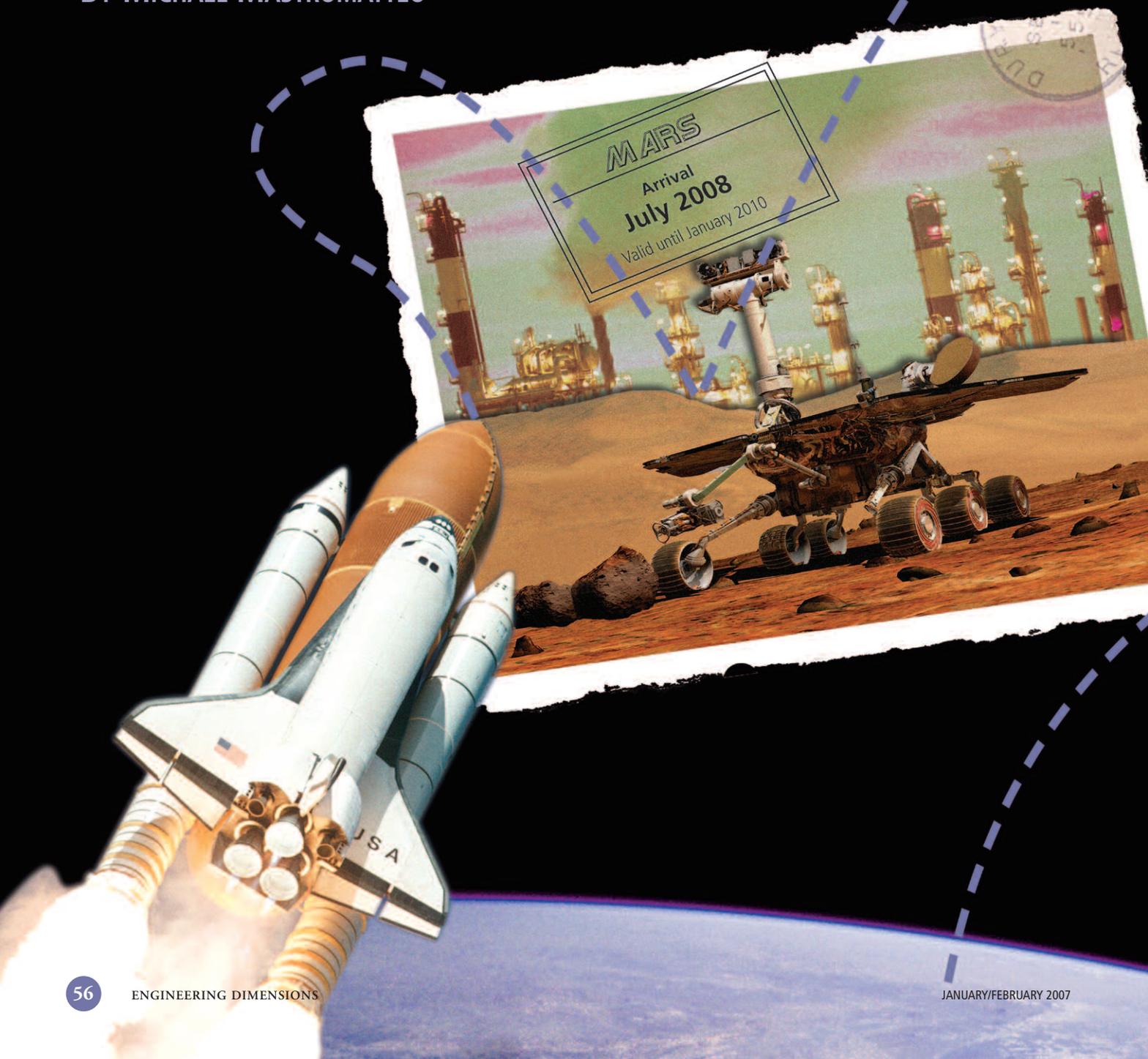


Whose rules?

How much risk is too much when commerce meets new technology and uncharted territory? Will engineers, committed to the public interest, and space entrepreneurs, committed to the bottom line, be at odds in the "New Space"?

By MICHAEL MASTROMATTEO





The accomplishments of Canadian engineers and engineering in space exploration could present interesting questions for the profession as the “New Space” era unfolds.

New Space is the term coined to describe the movement of additional players into the space “market.” As government-run space agencies grapple with budgets, changing political priorities and wavering public support of the value and risk of space exploration, a greater number of private entrepreneurs are looking to get into the game.

As well, with the National Aeronautics and Space Administration’s (NASA) intention to return astronauts to the moon by 2024, and the fervent talk in some quarters of establishing space architecture for humans to travel to Mars and beyond, the need to bring a regulatory/legal/safety ethos to other worlds will be tested.

Michael Griffin, PhD, PE, NASA administrator and a professional engineer, has identified “space colonization” as the ultimate goal of current space programs. To that end, he speculates that scientific exploration is only part of the impetus for advancing the space frontier.

“The goal isn’t just scientific exploration,” Griffin said in a recent address. “It’s also about extending the range of human habitat out from Earth into the solar system as we go forward in time. In the long run, a single-planet species will not survive. If we humans want to survive for hundreds of thousands or millions of years, we must ultimately populate other planets. Now, today, the technology is such that this is barely conceivable. We’re in the infancy of it. I’m talking about that one day, I don’t know when that day is, but there will be more human beings who live off the Earth than on it. We may well have people living on the moon. We may have people living on the moons of Jupiter and other planets. We may have people making habitats on asteroids. I know that humans will colonize the solar system and one day go beyond.”

Stuff of fiction?

Although, as Griffin admits, the technology to establish a human presence beyond Earth and the moon is still in its infancy,

there is every reason to believe robotic landings on Mars and other planets will open the door to an eventual human presence deeper into the solar system.

Noteworthy in this context is the theme of next spring’s International Association for the Advancement of Space Safety conference in Chicago. The “Space Safety in a Global World” conference, scheduled for May 14 to 16 is described as “an invitation to reflect and exchange information on a number of topics in space safety that are of national and international interest.”

Conference organizers suggest the formerly exclusive “club” of nations with space launch capabilities will soon be crowded with ambitious new players.

“Commercial spaceports are being planned and built, while some of the old ones are changing hands from military to private and commercial management,” conference invitees have been told. “In the manned spaceflight arena, a commercial market may start finally to emerge with space tourism and (government) demand for private cargo transportation services to orbit. Besides the national ambitions in space, the international cooperation, both civil and commercial, is also gaining momentum.”

Ram Jakhu, an associate professor at McGill University’s Institute of Air and Space Law, specializes in international space law and government regulation of space activities, and plans to attend next spring’s space safety conference. He recently discussed the future of space exploration at the Canadian Space Summit November 17 to 18 in Ottawa.

Jakhu later told *Engineering Dimensions* he believes the push by commercial interests for a piece of the space action could present a regulatory gap issue. “As governments run out of money and public interest in expensive space exploration is fading, the private sector realizes correctly that money can be made by way of space utilization,” Jakhu said. “However, the private sector might push for a no-law, less-regulatory environment so that it could exploit space without any significant restrictions.”

Jakhu says such a scenario could leave an important role to play for engineering

and other regulators, especially in helping determine safety standards and optimal use of such resources as satellite transmission frequencies, “sustainable exploration,” and development of natural resources on the moon and other bodies in space.

Some of the incentive for a more defined engineering presence in future space activity stems from the engineering profession’s imperative to protect the public and serve the greater social good. While today’s performance and safety regulation now fall to the national governments operating such organizations as the Canadian Space Agency (CSA) and NASA, and the private companies that design, produce and market space mission products, there will undoubt-

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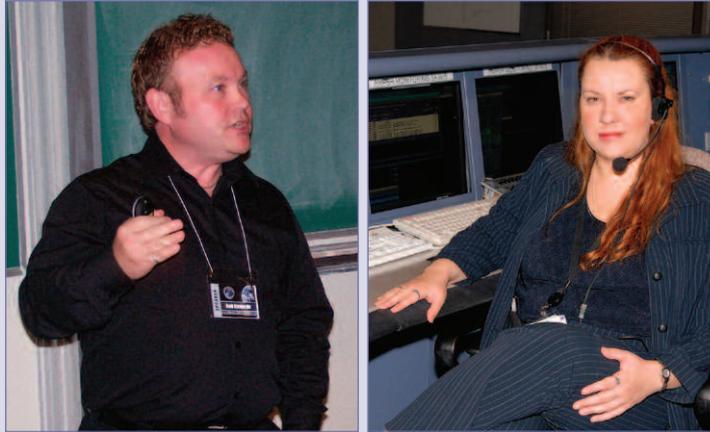
Rick Tumlinson, co-founder,
Space Frontier Foundation

edly be grounds for an additional regulatory presence in the coming decades.

This could be due to what many observers believe will be an expanding playing field for space-related activities. The commercial allure of space—ranging from the launch of telecommunications satellites to the fledgling space tourism industry—all but beg a need for regulatory oversight to protect the safety of participants and what is termed the “non-involved public.”

Space authorities

Currently, the rules and regulations designed to protect crew members and equipment on space missions fall to flight controllers working for NASA and other national space agencies involved in each



Danielle Cormier, right, a flight controller with the Canadian Space Agency, says an engineering mindset already informs today’s space mission rules and procedures. At left, Robert Richards, of Optech Incorporated, discusses the expanding space frontier at the Canadian Space Summit in Ottawa.

mission. Danielle Cormier, a flight control specialist with the CSA, told *Engineering Dimensions* it is generally up to a partnership of space authorities to establish and approve flight rules and operating procedures.

“Flight rules are written by flight controllers, most of whom are engineers, but with a few other disciplines, such as physics, mathematics and computer science added in,” Cormier said. “The rules are written using engineering data provided by the hardware owner and/or vendor. For flight rules, this data is found mostly in hazard reports. Other kinds of relevant engineering data are covered in other kinds of operational products, such as procedures, console briefs, console drawings and other sources.”

As space missions take on a more international flavour, however, there is some concern about establishing a common currency of safety and performance systems.

Virendra Jha, P.Eng., CSA vice president, science, technology and programs, says NASA generally has primary responsibility for the safety of crew members participating in space missions, including those involving international partners. “The CSA, however, has to demonstrate safety of the space hardware it contributes to the NASA program,” Jha said. “The CSA has to ensure and demonstrate that the CSA hardware, for example, the Canadarm 2, will not pose any safety risk to crew members either accidentally, or due to a design failure.”

Jha says the CSA has its own performance standards, which vary depending on the nature of each mission. Naturally, he says, “the most strict standards are used for missions involving human space flights.”

The CSA vice president also speculates on the need for regulatory oversight in the increasing commercialization of space activity.

“There is concern that increased commercialization may lead to some regulatory gap and some safety issues could be compromised,” Jha said. “We think the government should look at the existing policies concerning private investment in human space flights, assess the gaps, and put the necessary regulatory framework in place.”

Despite their aversion to over-regulation, the proponents of a more open skies policy for future space travel still accept some role for governments and regulators in setting a proper framework for the next generation of space adventure.

Rick Tumlinson, co-founder of the US-based Space Frontier Foundation, suggests governments and regulators should work to create a level playing field among all the interests, government and otherwise, that are competing to maintain or establish a presence in space.

Says Tumlinson: “The US and other spacefaring nations should set up a few standard rules for operating commercially in space, much like those that govern the seas. A few basic standards are all that is needed, as we do not want to over-regulate what is an embryonic field at best.

One can guess what would have happened to the Internet, television, radio and even commercial flying here on Earth if, at the very earliest stages, overly zealous bureaucrats had stepped in and created a wall of red tape.”

Tumlinson says some basic standards are essential, however, even if only to ensure and finance private sector space endeavours. Basic licensing for commercial activities, certification of space ships and their operators, and safety requirements and building codes will help to establish a clean and safe record for all involved, and help the industry avoid disasters.

Competition as progress

These views are influenced in part by a belief that commercial competition is just the ingredient to advance the space frontier in an era of lethargic government bureaucracies hamstrung with budgetary and other considerations.

Existing but outdated treaties covering the exploitation of space and the moon call for these resources to be developed for the good of all humanity. And while this international approach continues to hold sway, some private sector groups have begun lobbying for a more private property approach to tomorrow's space adventures.

Robert Richards, director of the space division at Optech Incorporated, a Brampton-based company developing advanced laser systems for space exploration, is a new space advocate who also recognizes the need for proper regulatory oversight.

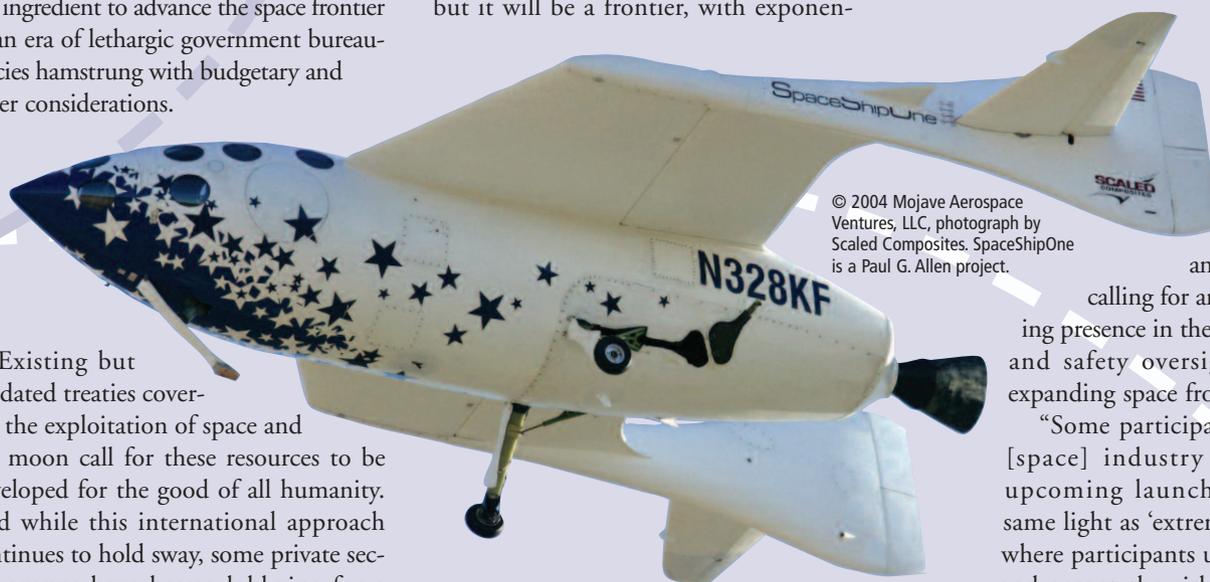
“As space transitions in the coming decade from a government-dominated realm of large overhead and risk-adverse projects to an entrepreneurial realm of commerce and personal spaceflight, engineers in the commercial space industry will have an increasing responsibility to design traditional margins of safety into

spacecraft and space facilities,” he told *Engineering Dimensions*. He added that in the US in 2004, more commercial spaceships flew into space than did government spaceships—a development fostered in part by the success of the SpaceShipOne project. SpaceShipOne was the first recipient of the \$10-million (US) X Prize as the first non-governmental organization to launch a reusable piloted spacecraft into space twice within two weeks.

“SpaceShipOne has spawned a new league of entrepreneurial commercial space companies, and the first private space hotels are being built and tested right now,” Richards added. “In the new space-dominated world only a few years off, privateers will be offering services to off-world adventurers, tourists, explorers and settlers. It won't be the wild west, but it will be a frontier, with exponen-

“Performance in the service of the greater public and proper safety culture are the basis of all engineering activities,” Carswell said. “I am confident that as the size and scope of the space community expand, these attributes will carry forward. Engineers have always played an important role with respect to the establishment of a proper regulatory and safety environment. I see this continuing as the space frontier moves outward and the spectrum of engineering requirements and responsibilities expand. As the complexity of space-related requirements increases, it will be mandatory to have the technical input from experienced engineers on regulatory and safety issues.”

Similarly, Daniel Faber, president of the Canadian Space Society, and a soon-to-be-licensed professional engineer, is



© 2004 Mojave Aerospace Ventures, LLC, photograph by Scaled Composites. SpaceShipOne is a Paul G. Allen project.

tial growth of technology and economics analogous to the ones that drove the fledgling private aviation efforts of the early 1900s to the mass market, low-cost and incredibly safe commercial aviation industry we have today.”

Richards' views are supported by engineers with more than a passing interest in space exploration.

Allen Carswell, P.Eng., chairman of Optech Inc., and a professor emeritus of York University's faculty of science and engineering, takes the view that as a discipline so central to the success of space exploration, engineers will continue to exert a safety ethic in the “new space” era.

another voice calling for an engineering presence in the regulation and safety oversight of an expanding space frontier.

“Some participants in the [space] industry view the upcoming launches in the same light as ‘extreme sports,’ where participants understand and accept the risks they are taking,” he told *Engineering Dimensions*. “However, the details of the machines that will carry people into space will be largely beyond the understanding of the participants, leaving the companies and the engineers in their employ with a duty of care and a responsibility to communicate the risks associated with the new technology. If the industry does not develop an acceptable combination of safety, communication, liability waiver and insurance, it will meet with regulation over which it has far less control. The public litmus test will come with the first crash, and those that follow.”