

NASA and the Commercial Space Industry

**Remarks on the Occasion
of the
X-Prize Cup Summit**

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19 October 2006

Thank you for inviting me to speak to you at this X-Prize Cup Summit. I want to congratulate Peter Diamandis and the other organizers of this event for bringing together this eclectic group. An insightful, and often all too apt, observation goes: “There are three types of people in the world. People who make things happen, people who watch things happen, and people who wonder what happened.” The group assembled here clearly fits into the first category, and so for my part, I’d like to spend some time with you this morning wondering what happened... More seriously, I believe this observation needs a fourth category, ahead of the three given above; first there must be the people who think about what ought to happen. These are the visionaries, and none of us would be here at this event today without them. So, I want to spend some time with you thinking about what needs to happen next.

All of you here will be familiar with our new Commercial Orbital Transportation Services (COTS) demonstrations, being conducted under the framework of NASA Space Act Agreements. These landmark agreements are, truly, NASA’s most significant investment to date in attempting to spur the development of the commercial space industry. But let me say this at the outset: NASA can do even better in partnering with the commercial and entrepreneurial space sector in carrying out our nation’s Vision for Space Exploration. However, let me be equally blunt about the other side of the coin: “partnership” with NASA is not a synonym for “helping NASA spend its money”. Just as with our international partnerships, I expect commercial and venture capital partners to have “skin in the game”, contributing resources toward a common goal that is greater than that which could be easily afforded by NASA alone, while figuring out how to make a profit from it!

Thus, it is important for the future that NASA's investments productively leverage the engine of the American economy, a GDP valued at over \$13 trillion per year, to help us carry out our mission of space exploration. As the President's Science Advisor Jack Marburger stated earlier this year, "questions about the Vision boil down to whether we want to incorporate the Solar System in our economic sphere, or not." I think that I can guess how most of you who are here today would answer that question. And, indeed, I have said in other venues that for me also, this is one of the core principles justifying human exploration and expansion into space.

But the kind of things we need to do have been done before. We know how it should go. Many of you have in the past heard me allude briefly to the story of how the U.S. Post Office Department, with the help of the War Department, helped spur our nation's aviation industry when it started the air mail service routes in 1918. I very strongly believe that we can, *and should*, draw certain lessons from this event; that it can be a historical paradigm for how NASA might fill a similar role in spurring our emerging commercial space industry in concert with the goals of the Vision for Space Exploration. However, a review of this history shows that it was not an easy proposition then, and it is likely to be just as difficult to pursue in the present era. But, as President John Kennedy said at Rice University in 1962, we do these things, "not because they are easy, but because they are hard." So let us look again at what was once done, and then let us think about what might yet be done.

The idea of an air mail service in the United States was initially proposed by the Post Office Department in 1912. However, Congress refused to grant them the \$50,000 appropriation needed to start. Undaunted and persistent, the Post Office Department kept requesting funds from the Congress for an air mail service. Finally, in 1916, some funding was received, but when the Post Office Department invited bids for air mail routes in Massachusetts and Alaska, no company took them up on their offer, because no airplanes then in existence could meet the stringent requirements. Revising its plans, the Post Office Department and the Army finally demonstrated the first air mail route between Long Island, New York and Washington, D.C. in May 1918. It was a momentous occasion, and President Woodrow Wilson greeted the pilot upon landing. Today, if you walk along the Potomac River not far from the Jefferson Memorial, you will find several plaques commemorating those first air mail flights.

Using initially the then-plentiful Curtis Jenny trainers, surplus from the Great War, transcontinental air mail routes were quickly established. By the mid-

1920s, the Post Office Department's fleet was flying 2.5 million miles annually, delivering 14 million letters. This air mail service was popular because delivery times were much faster than could be accomplished using trains. However, there were also many fatalities during this barnstorming era. Cross-country flights in all kinds of weather and lighting conditions presented new and unsolved problems. The reason why pilots wore goggles and scarves in those open-air cockpits was hardly to look dashing. The goggles prevented bugs from striking the pilot's eyes at 100 miles per hour, and the scarf was to cover the pilot's mouth from the bugs that might fly in and to wipe away oil sputtering from the plane's engine. Those of us who flew here to Las Cruces today should not take for granted our current level of aviation safety and comfort. Today, you have about the same chance of being killed by a lightning strike – about 100 Americans per year die this way – as in an air transport accident. But back then, aviation accidents and deaths were all too common.

In 1925, the Contract Air Mail Act (or Kelly Act) authorized the Postmaster General to contract for airmail services, and in the process spawned our nation's nascent airline industry, as the airlines delivered both paying passengers and cargo. Charles Lindbergh was one of those early pilots, flying the route between Chicago and St. Louis in his de Havilland DH-4. His experiences flying the mail in these early years – including the bailouts and emergency landings – are recounted with both great literary grace and a pilot's sense of immediacy in *We*, his autobiographical summary of those years. Lindbergh's early experiences flying the mail gave him the experience he would need for his famous first non-stop flight from New York to Paris in 1927, winning the \$25,000 Orteig Prize for himself and his backers.

But the story doesn't end there. In 1933, President Roosevelt's Postmaster General found unethical behavior in the awarding of these air mail contracts, and the President summarily canceled all such contracts and ordered the Army Air Corps to step in and take over the air mail service for a brief time. A young man by the name of James Webb, who was a lawyer and also a Marine Corps aviator himself, and who would later become NASA's greatest Administrator, was closely involved in bringing order out of that chaos to re-start the commercial air mail service. This phase of Webb's life is chronicled in his biography, *Powering Apollo*, by W. Henry Lambright.

So what are the lessons to be gleaned? First, the U.S. government acted through the Post Office Department as a major purchaser of potential air transport services, as opposed to being a technology developer. The aviation industry used

the government's investment to develop their commercial operations further, and along the way, incorporated numerous technical innovations that proceeded from the Ford tri-motor, to the Boeing 247, and eventually to the Douglas DC-3, generally considered to be the first practical commercial transport aircraft. These investments in soliciting actual air mail service, rather than in technology development itself, spurred innovation in retractable landing gear, radio navigation aids, aluminum monocoque structural design for low weight, low drag airframes, air-cooled radial engines, vacuum gyroscopes, and a slew of other technologies, while also delivering the mail, which was of course the intended primary goal. Technology development was the byproduct of this investment; it occurred as a natural result of competitive entrepreneurs attempting to out-do each other in servicing a known government market.

But second, we should remember that even as the Post Office Department was stimulating the development of aviation by purchasing commercial service, another arm of the U.S. government was doing its part from a different perspective. Aviation technology development was extensively aided and abetted by the activities of the National Advisory Committee for Aviation, or NACA, the predecessor of today's NASA. Through its three research centers – first Langley, then later the Lewis and Ames laboratories – the NACA sponsored much of the groundbreaking technology development and proof-of-concept work, providing a base of feasible technical alternatives upon which industry could draw with each new airplane design. In my opinion, this private-public synergy achieved results both far better, and much faster, than either approach alone could have done.

So, what about space? We now have more than 50 years of investment, through both NASA and the DoD, in space technology and systems development. But what we have not had is a stable, predictable government market for space services sufficient to stimulate the development of a commercial space industry analogous to that which was seen in the growth of aviation. My hope is that with the seed money we are putting into the COTS program, we can demonstrate the possibility of commercial cargo and crew transportation to the International Space Station, and that subsequently NASA will be able to meet its ISS logistics needs by purchasing these demonstrated services. If we can do this, we will be able to change the paradigm for transportation services to be more in line with the air mail service of the 1920s, meeting the logistics needs of the ISS, some 7,000 to 10,000 kilograms per year, after the Space Shuttle is retired in 2010. In the process, we may be able to spur innovation for low-cost access to space. This is a carefully-considered investment with known risks that we can all see and appreciate, but with a potentially huge upside that makes it well worth the risks.

I'll risk repeating myself to ensure that everyone fully understands how serious NASA takes the COTS demonstrations: if these commercial service capabilities are successfully demonstrated and cost-effective, NASA will welcome and use them. That is our default strategy for ISS re-supply. Most of you will probably agree that meeting or beating the government's cost to provide space transportation services shouldn't be too difficult for private industry to do. I hope you are right. I want these demonstrations to succeed; however, my wanting it won't make it so. If these capabilities are not successfully demonstrated, then NASA's fall-back position is to rely on the *Orion* Crew Exploration Vehicle or international partner cargo and crew service capabilities for ISS logistics support.

Now, there is another lesson to be derived from the airmail experience. For the space transportation services we seek, certain human rating and visiting vehicle requirements applicable to the ISS must be respected. To that end, we're interested in hearing from potential commercial providers, like SpaceX and Rocketplane Kistler, as well as Lockheed Martin's *Orion* team, concerning what requirements are necessary and value-added, and which ones may not be. The definition of human-rating is not simply how much paper and process we can afford to buy. That is the wrong metric. For this reason, we are reviewing the visiting vehicle and human rating requirements, not only for the COTS demonstration but also for the Crew Exploration Vehicle, to ensure that we're writing our engineering specifications to achieve the goal of technical excellence, and are not simply following a handbook. Good engineers do not simply quote requirements from handbooks; we understand the underlying technical necessity behind such requirements.

Similarly, we must avoid relying solely on precedent, upon the mentality of "that's the way we did it on Shuttle...", or ISS, or Apollo, or Skylab, or whatever, as a substitute for good judgment. If we don't periodically question our technical requirements, if we focus on process to the exclusion of outcome, if we substitute methodology for intent, then we will replicate the experience of the Post Office Department in its initial request for bids on air mail service: commercial industry will never be able to meet NASA's stated needs. Thus, we must focus upon, and be experts in, systems engineering as we work through various technical issues for our future crew and cargo systems. We must be prepared to question our assumptions when necessary.

Yet another lesson gained from the air mail service was how it helped train a new generation of pilots like Wiley Post and Charles Lindbergh, engineers like

Glenn Curtiss and Donald Douglas, and lawyers like future NASA Administrator Jim Webb. This barnstorming era engendered a certain sense of “air-mindedness” among the American people in much the same way that space tourism is rekindling an interest in space travel for the American public, over and above that which NASA accomplishes today. Of course, the physics and engineering are more difficult for personal space travel than for air travel, with even greater levels of cost and risk, but we must recognize that this change is occurring. There are now emerging certain rudimentary commercial capabilities for members of the public to have their own personal “space experience”, with varying degrees of weightlessness and views of the Earth and space. I fervently hope that the emergence of such capabilities will help make America more “space minded”.

Now, I must be clear that the development of space tourism is *not* a part of NASA’s charter. NASA was founded during the Cold War, soon after the launch of *Sputnik*, when the United States was in a race with the Soviets. NASA and the early civil space program were instruments of American preeminence in the world, at a time when an important component of such was seen to be preeminence in space. NASA achieved the goals that were set for it by the nation’s policymakers in that era, and did so with remarkable brilliance, so much so that even today we remain in awe of what the Apollo generation did. Now, some have since posited that NASA somehow failed the American public by not opening up the experience of space travel to the broader population. This is patent nonsense; the agency could not fail at something it was never asked to do. Such a mandate was simply never in NASA’s charter; if it were, I would question the wisdom of such a role for a government entity. However, as we go forward with the Vision for Space Exploration, it emphatically *is* our duty to encourage and leverage nascent commercial space capabilities. Not only is it the right thing to do in a country whose economic system is rooted in free market concepts, but it will also be a necessity if we are to achieve the goals set out for the U.S. civil space program.

A little over a year ago, I unveiled to the Congress and the public NASA’s architecture for returning to the Moon. It is a conservative plan, designed to accomplish the stated mission with minimum cost, maximum cost confidence, and as much use of existing systems as we could reasonably achieve. But having combed through the design trades, associated costs, and projected budget for the agency, it is apparent that NASA will need to leverage commercial and international partners to the maximum if we are to sustain this long journey, with footholds first on the International Space Station, then on the Moon, and from there onward to Mars. It is out of necessity for, not charity toward, commercial space endeavors that we at NASA must change our way of doing business. While I think

that the \$500 million we're investing in the COTS demonstrations is a sizable first step, there's more gold to be mined in other fields of commercial endeavor as well.

To that end, we are taking a hard look at our government-operated microgravity research aircraft at Johnson Space Center, and at what NASA requirements commercial providers can meet. We've purchased some commercial research flights from Zero-G Corporation in the past, and going forward, we are looking to meet the full set of our requirements through the purchase of private sector services at a lower cost. You recently saw a NASA Request for Information on micro-gravity flight services, and you can expect to see more from NASA in the coming months.

Commercial aircraft can make parabolic flights for 20-30 seconds of weightlessness at a time. I hope that future suborbital flights will soon be taking paying passengers to the edge of space for approximately four minutes of weightlessness, as well as a great view of the Earth from the edge of space. Using the air mail paradigm, NASA will purchase seats for these suborbital flights for certain experiments, and possibly astronaut candidate proficiency, if and when they become available. Just as NASA pilots fly T-38s and micro-gravity aircraft flights to maintain proficiency, we should consider how we might use these future suborbital flight opportunities. I have asked NASA Associate Administrator Rex Geveden to look into this capability under NASA's Innovative Partnership Program. Rex also oversees management of NASA's Centennial Challenge prize program, authorized by the Congress last December. Several NASA prize challenges, like the lunar lander, will be featured here at the X-Prize Cup over the next several days. The spirit and heritage of these prizes harks back to Charles Lindbergh's successful bid for the Orteig Prize in 1927; I hope these new prizes spark similar accomplishments.

In another vein, the NASA Authorization Act of 2005 also designates the U.S. segment of the International Space Station a national laboratory. NASA is actively seeking commercial partners who would like to use the ISS for their own experiments. After the loss of Space Shuttle *Columbia*, NASA was forced to curtail a great deal of ISS research, and with our focus on the use of the Space Shuttle system for ISS assembly over the next few years, I believe that commercial cargo and crew services will prove invaluable for increasing access to space and to the ISS for these commercial experiments.

Also in connection with the ISS, we need to be open to novel concepts which can enhance the utility of this multi-billion dollar facility. As one example,

former astronaut and present-day entrepreneur Franklin Chang-Diaz, creator and proponent of the VASIMIR electric propulsion concept, has opened discussions with NASA in connection with the possible use of the VASIMIR engine for ISS orbit maintenance. We don't know, yet, whether this particular approach makes sense or not, but if it does, there might be a classic "win-win" strategy here; we gain experience with a potentially useful space propulsion concept, and we reduce the amount of propellant delivery needed for ISS reboost, leaving room in the logistics manifest for more productive cargo. This is the kind of private-public synergy that can serve us well.

While we are on the theme of innovative approaches to commercial space endeavors, I want to congratulate Pete Worden and his team at Ames for working with Bigelow Aerospace to secure a piggyback ride for their Genebox experiment on Bigelow's Genesis inflatable space habitat demonstration. I believe that this is one of many innovative, short turnaround ideas that we'll be seeing from Pete over the next several years. He is turning Ames Research Center in Silicon Valley into a "Mecca" for space entrepreneurs, where among other things we are hosting the Red Planet venture capital fund, similar in some ways to the CIA's In-Q-Tel operation, to leverage innovators and investors who have not typically done business with NASA.

It should be no surprise to anyone here that in my first few weeks as NASA Administrator, I met with Burt Rutan, Elon Musk, Bob Bigelow, and other space entrepreneurs to hear their ideas, or that I want a healthy, pragmatic dialogue between NASA and the commercial and entrepreneurial space community. Several people on my senior management team, including Shana Dale, Rex Geveden, Scott Pace, Pete Worden, Bill Claybaugh, Chris Shank, and numerous others are intimately familiar with the concerns of the commercial space community, and we are also realists. We are mindful of the pitfalls (and frankly, pratfalls) of all too many endeavors between space companies and NASA.

Recalling again the lessons of the air mail service in 1933, we know that we must avoid any real or perceived favoritism before entering into any joint endeavors. There must be a healthy competition of ideas and resources. Before making commitments, we must carefully consider and ensure that joint endeavors are properly aligned with NASA's mission, are of sufficiently high priority, and can be done within the resources provided to NASA. Now, I specifically want to emphasize that the phrase "carefully considered" is *not* a euphemism for hiding behind bureaucratic process or legalistic red tape. If you see this happening, we want to hear about it. Having worked in industry, I appreciate the need to meet a

payroll, and I know well how the timing of government decisions affects your “skin in the game.” For this reason, clear dialogue is necessary between NASA and the parties involved when exploring possible joint endeavors. We must not over-promise or over-commit. It is one thing to begin an endeavor, but it is an even greater accomplishment to complete it! Too many exciting endeavors at NASA have failed to meet this standard in recent years. We must re-establish NASA’s reputation for finishing what we start.

As I stated earlier, there are people who make things happen, people who watch things happen, and people who wonder what happened. I’ll share with you another of my favorite aphorisms: managers do things right, but leaders do the right things. So, we need to make things happen, but we also need to make sure that we’re trying to make the *right things* happen. The lessons learned from our nation’s first steps in creating a commercial air mail service are useful to us today. So, let me leave you with a final thought from a certain air mail pilot, one Charles Lindbergh: “It is the greatest shot of adrenaline to be doing what you have wanted to do so badly. You almost feel like you could fly without the plane.” The group assembled here today knows that feeling. So, let’s make things happen, so that we can enjoy it more often!

Thank you.