

# Keynote Address

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[Edited version of the author's extemporaneous speech. Corrections for grammar and syntax and minor alterations to the organization and content of the text were made while preserving the intent of the original remarks.]

Thanks, Steve [NASA Historian Steve Dick], for that nice introduction. By the way, Steve is right; I do greatly enjoy coming down to the History Office from time to time to pick up their latest releases, most of which I've managed to read at one time or another. It says something about me that NASA history documents are one of my sources of entertainment. I'm not quite sure what it says, but it says something.

I also want to thank Steve for setting up this conference, which I think is a very positive addition to our industry. It allows us to step back for a moment and view NASA and its contribution to society from a more strategic perspective. I believe that such a perspective, and the guidance it can provide in regard to our contribution to society, is our most pressing need as we embark on our next half-century. It is too easy to become mired in the day-to-day tactics of budget defense or program execution, too easy to lose sight of the larger goal. A look back at history can provide the context to look forward at what we are doing, and why. When I consider NASA and the nation's space program in this way, I am drawn again and again to the overriding need for constancy of purpose in our enterprise, if we are to obtain anything useful from it.

Of course, our purpose must be the right purpose! Prior to the loss of *Columbia*, NASA had a steady purpose for several decades. But I believed then, and believe now, that our space program was guided by the *wrong* purpose. We were doing the wrong things. We were limiting our horizon for human space exploration to low-Earth orbit, with nothing but indefinite promises of future programs without timing, funding or programmatic content.

In the aftermath of *Columbia*, the Columbia Accident Investigation Board, and especially Chairman Hal Gehman and Prof. John Logsdon, who is here with us today, recognized and called attention to this lapse. They recognized the need for an over-arching strategic purpose for what we do, a guiding vision for the nation's civil space program. Responding to this need, President Bush put forth the Vision for Space Exploration, now the nation's civil space policy.

The goals of that policy were supported, indeed expanded, in two subsequent NASA authorization acts, the first by a Republican Congress in 2005, and the second by a Democratic Congress just this month. This strong bipartisan – actually non-partisan – support for NASA and our nation’s space program is very satisfying. From a policy perspective, in terms of having a clear statement of national purpose, I think that NASA has not been better positioned in decades. We have rational, cogent, well-balanced priorities for aeronautics, scientific discovery and expansion of the human range of action and exploration, taking appropriately into account the layout and geography of the solar system. The policy also respects the nation’s overall funding priorities, setting goals consistent with the amount of money that can be reasonably be made available for civil space programs.

So we have a good policy. I’d like to see us maintain it. We at NASA cannot produce results acceptable to anyone – ourselves, the tax-paying public, our congressional and executive branch overseers, our international partners – if we churn our portfolio on a regular basis, determining anew after every congressional or presidential or senatorial election cycle what NASA’s purpose is to be. If NASA is to be successful, the agency must enjoy the stability associated with planning on decadal timescales. I hope that we can achieve that goal and maintain it in the future.

Turning to another subject, I am often asked (and especially so as my tenure comes to its probable end) what my major goals and accomplishments have been. I must leave any assessment of accomplishments, major or minor, to others. I hold firmly to the belief, endemic among credible technical professionals, that one cannot self-assess. That is why independent peer review is such an important part of the work of engineers, mathematicians and scientists. You who are historians will have to judge my work.

But I can state what my goals were. When I was offered this job, we at NASA simply did not have technical and managerial credibility with the White House, the Congress or the public. Now, in my opinion some of that was unfair. There is always an over-reaction to traumatic events, and none is more traumatic than losing a space shuttle and seven lives in full public view. But without regard to the mixture of substance versus perception, it is simply a fact that, three-and-a-half years ago, NASA lacked the full measure of technical and managerial creditability that the nation expects of us and that we expect of ourselves.

So to restore that was my first priority, because nothing good can happen without it. After that, as I have stated publicly many times, I wanted to complete the safe return of the space shuttle to flight. That was a policy decision made by the President and supported by the Congress, and it was stalling. It fell to me to oversee it. It was not in good place when I joined the agency, and we needed very rapidly to get it on track if it was to be done at all.

To fly the shuttle safely, we needed to re-develop a management team, procedures and methods for doing so. We then needed to do the same thing to retire it, to bring the program to an orderly and disciplined close. Anyone can stop flying the shuttle; to do in

it in a disciplined and orderly manner is what NASA and the nation needed, and still needs. We are working hard on that task every day.

The purpose of returning the space shuttle to flight, as stated by the President and, again, supported by the Congress, was to use it to finish the International Space Station (ISS). At this point the ISS represents a multi-decade international commitment, as well as a commitment to our nation and ourselves. It is a commitment large enough in scale and scope that it was judged to be worth the risk of flying the shuttle almost 20 more times to finish the job. Doing that job well, efficiently and safely was my next highest priority after returning to flight.

If we are ever going to do anything in space beyond ISS – and I began this speech by saying how important I thought that was – then it falls to us in this time to craft a credible human spaceflight architecture that can support operations in low Earth orbit (LEO), as well as to take us back to the moon and lay the groundwork for eventual voyages to Mars. To go to Mars we will certainly need much more than is being developed today, but what we develop today should be designed with an eye toward Mars. In my view, we must create systems that enable a logical path to the establishment of a permanent base on the moon, to a Mars mission, to voyages to the near-Earth asteroids, and to the servicing of large telescopes and other instruments at the Lagrange points, as well as other purposes we might not presently envision. We should work today with an eye toward becoming a permanently spacefaring nation, a permanently spacefaring society, to do things that build on what has been accomplished before.

In planning our next spaceflight architecture, I wanted to plan also for the incorporation of commercially supplied goods and services to the maximum extent possible. Again in my view, it is long past time to incorporate into our spaceflight activities the same policy framework that underpinned the development of aeronautics in the United States throughout most of the 20th century. There was extensive government sponsorship of aeronautics, and there was private development of aeronautics, and they fed each other quite synergistically. Looking back, it seems to me that few things were more central to the rise of the United States as a world power than the lead we forged in the development of aeronautics. It allowed us to project power and influence, commerce and culture, throughout the world in a fashion never seen before our time. The analogies to spaceflight are not, of course, exact. Spaceflight is not aeronautics. But I believe that there are analogies, and that we have not taken proper advantage of them as a matter of government policy. I wanted to do whatever I could to stimulate the commercial development of space as Administrator.

We must understand the proper relationship between governmental and commercial space endeavors. I see important roles for both. But with the history of space development coming about as it did, as a response to cold-war tensions, I think we had what I sometimes call an ‘excess of government.’ But actually, that’s the wrong term. We certainly do not have an excess of government activity in space, but we do have an insufficiency of private enterprise.

I believe that a key role of government in the development of space is to define, occupy and extend the frontier of human action and scientific discovery. That is an inherently governmental role; industry cannot make a profit doing it. It's not a productive area for free enterprise, yet. And yet, societies which do not define, occupy, and extend the frontier of human action and scientific discovery will inevitably wither and die. So in my opinion it is a public responsibility, one in which we share the risk as a society.

Now government activity is often inefficient, while properly regulated capitalism is one of the best mechanisms we have found to allocate the resources of a society efficiently. So, I think an important role of commercial enterprise in the development of the space frontier is to help meet government policy goals efficiently. Government's role should be to help bring about the development of space commerce by providing a stable market for service, and stable requirements to be met by industry. If industry can meet those requirements, it will almost certainly do so more efficiently than can government. But industry cannot work in an environment where the market lacks stability over the development and sales life cycles of the products and the services they wish to furnish. It cannot be done. So we need a stable policy environment on the part of government in order to enable the kind of space commerce that I believe we would all like to see.

Similarly, international cooperation in spaceflight offers many advantages to the United States as well as to our partners. As a world power, there are things we must do that don't make other people happy, and yet we must do them. Leadership in great enterprises is a hallmark of a great nation, but leaders need allies and partners. We cannot function in the world if every hand is turned against us, or even if others are indifferent to us. So it behooves us to look proactively for things we can do with others to bind us together in common cause. And it is my observation that every society in the world, when it reaches the stage of technical maturity where it can begin to do something in space, does so. It is an arena which everyone seems to find uplifting, exciting and appealing.

We live in a time, possibly the last time, when only the United States has the technical and financial wherewithal to provide the leadership of great activities in space. I wanted to capitalize on that fact, and to take advantage of the hard-won partnerships which have been developed in the course of the space station program, where we were really learning how to do these large-scale enterprises in a manner that worked for everybody. I wanted to take that partnership forward to the moon, and to add new members to it. I wanted to keep faith with our partners on ISS today, and return with them to the moon, establish a research base there, and eventually go on to the near-Earth asteroids and to Mars. Bringing together that collaboration was a major priority for me.

I wanted to do all this while maintaining the scientific excellence of our space science program today. I'm often asked why I've put so much emphasis into human space flight in my tenure as Administrator. And the answer is always been easy – I love everything we do, but when I showed up at the agency our science program wasn't broken and our human space flight program was. I frankly didn't have enough hours in the day to do all that needed to be done, and I think most of our management team here could say the same. So, I spend my time and that of our management team where it is most needed.

Now, our science program will always have important issues, and we need to work hard to keep it the best in the world. But it wasn't broken, and so I felt that I would do well if we could simply avoid creating collateral damage to our science program while trying to fix things that were damaged.

Finally, I wanted to restore the standing of NASA's aeronautic research program.

If these were the goals, then what have been the main difficulties in reaching them? The biggest of these arises from what I call "democracy in action." I think most of you know that I have spent a good deal of my career in the DoD space program, and there is a saying that I picked up from some of my military acquaintances. When frustrated by "the system," they will point out that we are here to protect democracy, not to practice it. That analogy is not completely applicable to a civilian organization such as NASA, but it conveys an important thought in a clever manner.

Winston Churchill noted that democracy was the worst form of government, except for all the others. I will add that in a democratic society there is an inherent tension between the undemocratic autocracy of expertise, and the plain fact that the universe doesn't care about the niceties of the democratic process. Technical problems do not yield to majority opinion, or produce results on schedules compatible with electoral cycles. Nature punishes technical mistakes, whether they are made democratically, or not. It is important to be right.

It is very difficult to manage a large, visible government program efficiently, because far too many people claim the right to a voice in decisions in which they may admittedly have a stake, but for which they lack the expertise necessary to make a useful contribution. When industry is more efficient than government, it is not because it employs better people, but because decisions can be made, actions can be taken, results can be assessed, and corrections can be made, all without engaging anyone not needed for the task. There is personal authority, responsibility and accountability in the system, all driven by the need to produce a profitable result in a competitive environment. When everyone has a voice, these things are diffused or lacking entirely.

These issues are compounded by any lack of clarity in regard to policy. What should the goals of the civil space program be? To expand the human range of action? To explore, to 'go boldly where no one has gone before'? To do more science? To do more technology development? Or are the goals less noble, such as maintaining full employment at major centers? Or is the goal just 'don't make waves,' to avoid controversial things like retiring the space shuttle? Or is the goal even more ignoble – just see to it that whatever you are doing doesn't fail, doesn't make a mess?

Actually, all of these things, at one level or another, for one stakeholder or another, are agency goals. None of them are entirely compatible, some are completely inconsistent with others, and in any case there is never enough money to accomplish them all. There is no single authority in government to prioritize them. The Administrator isn't allowed

to do it – he can recommend, but he cannot act alone. Each of the various stakeholders expects his goal to be the one on top. It's a difficult environment in which to work.

It is always interesting to me that when a crisis looms – a war, the space race, a financial collapse – we nearly always decide to invest resources and authority in what we believe and hope will prove to be expert leadership. We judge the performance of these leaders on outcome, not process. President Lincoln replaced a lot of generals before he found his man, but he didn't deploy White House staff to the field, and he didn't give up on the idea that it took a general to run the army.

We somehow need to balance the tension between the autocracy of expertise and the need for transparent, democratic processes in government. It is very difficult. I think it is useful at times to remind ourselves that we live in a representative democracy, not a direct democracy, not a plebiscite. In a representative democracy such as the framers of our Constitution established, the people do not decide issues directly. The people decide who will decide. Now, through their delegated authority, it is NASA people who decide issues concerning the execution of civil space programs. I think you obtain the best results, the best compromise in the tension of which I spoke, when the leaders of the enterprise possess both demonstrated character and clear expertise.

Expertise without moral character is without value, and good intentions are no substitute for knowing how things work. We need both in the leadership of NASA. If we look at NASA and don't clearly see those traits at all levels, then we still have work to do. If there is not a general understanding that the people who are running the space agency know what they are doing, we get a lot of interference in the doing of it. We get more than enough of it even when the agency's leadership *is* generally thought to be competent and objective!

Concern over risk is a perennial theme at NASA and among our stakeholders, and can be a major impediment to achieving the goals we set. How much risk should be taken in the name of exploration? My view is that it should be considerably more than we're willing to accept today. It is interesting to note that when Captain Cook set sail on his first voyage to the South Seas, where all he did was discover Australia and New Zealand, he started out with 94 sailors. He was praised upon his return, three years later, for losing only 38 of them to the various hazards of the time; disease, accidents and hostile action. That praise is easier to understand when one realizes that the first world girdling voyage by Ferdinand Magellan started out with five ships, and almost 300 sailors, yet only one ship and 18 sailors made it back to port. Magellan was not among them. By those standards, Cook did really well.

The current odds of surviving a Mt. Everest climb are just about 1 in 60. This is comparable to, but not as good as, our best estimate for the loss-of-crew risk is for the space shuttle. And yet I would venture to guess that the average citizen believes that flying in space is more dangerous than climbing Mt. Everest. I haven't seen any public calls to limit the climbing of Mt. Everest, and yet I see many people who are concerned about the risk of space flight. Why the difference?

Now in all candor, spaceflight is dangerous, and we work hard every day to make it safer. But a sense of perspective is necessary. I've often noted that there is a thousand years in time separating the first open ocean voyages by westerners, the Viking expeditions, from the pleasure cruises that depart Port Canaveral, a few miles from where our space shuttle crews lift off. When the Vikings first set sail from Scandinavia, I doubt that anybody envisioned pleasure cruises as a future possibility.

While I doubt that those Viking expeditions were anywhere close to being as safe as flying on the space shuttle, we nevertheless have a long way to go in mastering space flight. A very, very long way. It is a risky enterprise, and likely to remain so for centuries to come. It is not something for which everyone has a taste, nor should they. We fly volunteers. But we cannot, we simply cannot, define, occupy, and extend the human frontier while at the same time claiming that we can do it safely – not without badly misusing the word “safe.”

Not terribly long ago I came across an aphorism concerning the settlement of the west: the pioneers were the ones with the arrows in the front.

So extending the frontier has never been a safe activity, and I think we are disingenuous if we claim that it will be. We should make it as safe as we can. We should try not to make the same mistake twice. I often say that our goal should at least be to make a new mistake. But when we are doing something which has not been done before, which we barely know how to do at all, which is just barely within the range of technical possibility, we should not be surprised when we sometimes fail. As tragic as it is, and as much as we want to prevent it, as much as we want to fix it so that the accident never happens again, we shouldn't be surprised.

I cannot leave the subject of risk, failure and accidents without noting that there never has been any such thing as a smart failure. Every failure that we encounter looks stupid in hindsight. It is. It reflects something we didn't know, and would like to have known, and by the time that the investigation is complete, feel that we ought to have known. So when we deal with failure by looking for the guilty parties, my usual suggestion is to start with a mirror. As Shakespeare put it, “The fault, dear Brutus, is not in our stars, but in ourselves...”

Speaking of failure reminds me that it comes in many flavors. There are failures bigger even than the loss of a space shuttle, and lessons to be learned from those as well. I'm fond of the comment by Santayana that those who are ignorant of history are doomed to repeat it. Regarding our own history, I have often said that the Saturn-Apollo transportation system seems to me to be unique in the history of successful transportation systems, in that we spent 80 percent of the budget of the Apollo program developing it, less than 20 percent of the budget using it, and then threw it away.

That seems to me to have been irrational. And yet the decision to terminate Apollo and all that went with it was made during the Nixon administration with very little, if any,

public debate. I certainly don't recall much discussion; if there was, it was lost in that surrounding the Vietnam War. But looking back, there is a lesson to be learned, and I think the lesson is that it is important to conserve the gains we make. To save what we've built, to adapt it, to reuse it, to take what works, and shed what doesn't. But we must try very hard not to lose what we've built, because it comes at very high cost. We must not again throw away capabilities crafted at the great expense in terms of money, time and human skill.

I will close by commenting on another of the questions I am often asked when I represent NASA to those outside the agency, and that is the question of our impact on society. Looking back across 50 years, I can identify any number of specific, easily defined contributions stemming from our nation's investment in space, and NASA. But above these, I think, is a more important contribution. NASA is *the* entity which captures what Americans believe are the quintessential American qualities. Boldness, and the will to use it to press beyond today's limits. Leadership in great ventures. Those things are better and more visibly combined at NASA than in any other enterprise in our society.

And so I'll leave you with that. I think that if we can hold true to our desire to continue to make that kind of impact, we will have done well. Thanks for listening.