
SPACE POLICY

33 – The Impact of New Capabilities

SUMMARY

As fleets of reusable heavy lift vehicles become available, space policy will need to fundamentally change to take full advantage of this new capability. Given the likely ability to transport large cargo and crew, time is running out for countries to fund their companies to develop competing surface systems such as specialty has, surface transport vehicles, life support, agriculture, etc.

NEW CAPABILITIES FUNDAMENTALLY IMPACT POLICY

The Significance of New Capabilities

We are getting very close to having access to fleets of partially or even fully reusable heavy and super heavy lift vehicles. Namely, SpaceX's Starship is already reusing its first stage and is achieving pinpoint landings with its upper stage. As of this writing, Blue Origin has launched its New Glenn heavy lift rocket and successfully landed it downrange on its ship and will likely reuse that stage within a year. Vehicles of these sizes open the possibility of lunar and Martian development on a scale significantly larger than anything that NASA has been planning. The savings of partial and fully reusable commercial launch systems shouldn't be underestimated. We are talking about cost to LEO dropping by something like an order of magnitude and eventually more than that. Continuing with much more costly legacy approaches will soon make no sense.

The systems that NASA is operating and developing were conceived prior to the emergence of these emerging reusable capabilities. Put another way, NASA's current operations and plans won't make sense as these new capabilities become operational. This fundamental fact needs to be acknowledged, and our nationals space policies need to fundamentally change as a result. The sooner that those changes are made, the less of NASA's budget will be wasted and the further ahead we will be.

We need to start transitioning away from old policies based upon old and limited capabilities. This transition won't be easy due to two factors: entrenched powers lobbying for the continuation of the old approaches and the "bird in the hand" phenomenon. By the latter, I mean that it is

reasonable to say, "Let's keep moving forward with the old approach that we can be confident will work even though we know that it is very expensive. We can wait until the new capability is fully proven before making the transition". The problem with this is that we can lose billions of dollars and several years waiting for proven capabilities. Those billions of dollars could have been directed at developing the payloads (i.e. surface systems).

There is a tempting approach that I hope no one will advocate for. It may be tempting to say that we need the very expensive government rocket approach as a backup to the reusable fleets just in case the latter runs into a problem. Sorry, that isn't being prudent, it is downright stupid. The consequence of that approach is that so much money will be tied up funding the expensive, slow approach such that there will not be enough money to take full advantage of the hugely better systems. We need to cut our losses -- it is just a question of when.

The Tipping Point Criteria

At what point do we let go of what we have to have the budgetary space to take full advantage of the reusable fleets? That is a policy judgement call. But if we wait too long then we will have wasted a significant amount of money and time. But if we transition too early then we might be risking having an approach that doesn't work.

The correct way of thinking about this question is by thinking in terms of future probabilities and contingency strategies. What is the probability that the reusable fleet will become operational at significantly lower cost than the legacy systems? And, if there are difficulties in the remaining developments, are there smart approaches where we can still accomplish the missions?

The Starship first stage, with its 33 engines, has been caught by SpaceX's launch tower three times now. Two of the recovered boosters have already been reflown. For all practical purposes, the first stage should already be reusable. Reusing the second stage is much harder due to re-entry temperatures. And yet, the upper stage has conducted three pinpoint ocean landings, and the last flight (test flight 11) avoided unexpected burn throughs seen previously. It's still somewhat away from full reusability but is showing promise. It is true that Starship hasn't yet made it to orbit but that is not because it can't but because they chose to cut the engines 8% early during current testing flights as a safety precaution.

The bigger uncertainty is whether we can be confident that Starship can successfully deliver propellant to and refuel at a depot in LEO. Without that, it cannot replace the necessary functions of the legacy systems for either lunar or Martian transport systems. I interviewed the leading published research engineer on the question of LEO depot probabilities who indicated that all the components of propellant docking, connecting, transfer, and long-term storage (zero boil off) has either been demonstrated in orbit or equivalently in the lab. No single step poses a particular concern. His prediction was that it was most likely to be demonstrated successfully even on the first attempt. Still, it remains a reasonable concern.

Therefore, the Tipping Point Criteria reasonably should be specified as when a Starship docks and transfers propellant and when the depot demonstrates zero boil-off. SpaceX estimates that this will be accomplished by the end of 2026. Our space policy needs to remain flexible enough to allow fundamental changes rather than locking into a policy that quickly makes no sense.

FULLY UTILIZING THE REUSABLE FLEETS

The single most important policy that needs to be established is that the United States should take full advantage of the reusable fleets when they become available. By "full advantage", this means that NASA's budget should be spent in such a way as to get maximum value. So, for example, if each year, a total of two billion dollars is being spent on two "commercial" LEO stations, is it unlikely that the benefits of that amount of money will be equal or more to the value of that money having been spent on missions to the Moon and Mars using the reusable fleets? In my book, it doesn't come close -- the American public will be far more interested in missions to the Moon and Mars than continuing the ISS research in LEO for another 20+ years.

If it becomes the policy to make maximal use of the reusable fleet, then there needs that program needs to be outlined. For example, we know what the plan is for Artemis 2 through 9. Likewise, after the Tipping Point Criteria is met, NASA should be tasked with identifying a program for how that capability can be maximally used. How would surface assets be developed? What categories of missions should be conducted and when? How would the US collaborate with the space agencies of other nations in a coordinated program of lunar and Martian exploration? When can international bases be established? How could NASA collaborate in private partnerships?

COMMERCIAL SURFACE SYSTEMS

Time is Running Out

The reusable heavy lift systems (Starship and New Glenn) are rapidly being developed with lunar cargo capability like in the 2027 to 2029 timeframe. That's a few short years from now. Will we have the payloads to deliver to the lunar surface? Or will we put off using the capacity of those fleets because we haven't gotten around to developing the necessary surface systems?

So, it is here proposed that a space policy that recognizes the emerging capability of these reusable fleets also establishes programs to award companies for the completion of the surface systems necessary. But this shouldn't be a vague approach of giving small grants to small companies to come up with ideas. NASA does a lot of this and yet isn't completing the development of systems. Time is running out and we no longer have the luxury to turn development programs into commercial space stimulation programs where we are even developing but never coming to conclusions. Like during the Apollo Program we need to have a clear concept of what we are developing and to adequately fund companies to complete that work.

Related to that policy should be to collaborate with other nations to encourage them to fund their own companies to develop competing surface systems or also to choose a specialty hab for their companies to develop. In this way, we can recruit the space budgets of other nations towards a common goal.