NASA's fucked - Here's my vision

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How'd This Happen?

In researching NASA I have come to the obvious conclusion that it is a horribly bureaucratic and political organizaiton. I haven't seen anyone ardently dispute this point. As I am writing this post I see the Moon rising over the horizon. NASA has failed. We haven't colonized it yet.

"NASA hasn't made any good rockets since the 60's" - Geohot on a stream.

How do a few kilograms of Mars rocks cost $10B? How does the SLS cost >$40B before its first flight?

There are two core explanations:

1. Cost-Plus contracting
2. Politics

Cost-Plus contracting gained a lot of popularity during the Second World War. The government needed to build a lot of stuff quickly and cost-plus was the best way to do it.

This is the Cost-Plus process: Your company gives an estimated price for a contract. If you need more money, oh well, we're at war, you can have it. No one would dare overspend money if your coworker's son would die. [Update Dec 7 2024]

No one dies if SLS is delayed 5 years. So, the contractors can delay and get more money. Incentives are not aligned.

The other explanation is politics.

The Senate Launch System (SLS) and Artemis Program are prime examples of NASA's inefficiencies.

They were born out of the constellation program. Ozan Bellik's blog posts have a lot of good info on this.

The Constellation Program's plan to land on the moon involved two launches that docked in Low Earth Orbit. (1) An Ares 5 launches a lander and a TLI stage. (2) An Ares 1 launches an Orion capsule into orbit which docks to the prior launch's payload.

When Constellation was rightly cancelled by the Obama Administration in favour of Commerical Space (lots of info about this in Lori Garver's book) the Senators complained about all the government-funded jobs that would disappear from their districts with the end of the Shuttle hardware. So, the Senators came up with the Senate Launch System (SLS).

The SLS is an underoptimized rocket for its task: Landing on the Moon. A single-launch lunar landing is absolutely possible with it's 95-Ton LEO Capacity. However, the mass of Orion and its low-deltaV service module prevent this. Under the Constellation Program, the Altair lander would conduct the Lunar Orbit insertion burn. The Orion CSM is not designed to get into Lunar Orbit on its own.

The Constellation Architecture is not inherently flawed. But it takes NASA in the wrong direction, as I will explain later. In contrast, the Artemis Architecture takes a couple of parts of Constellation and a few parts of Commerical Space and joins them together in an underoptimized Lunar Program.

At least we get Reusable Lunar Landers out of Artemis.

My predictions for Artemis are the following:

1. The SLS will be cancelled when there is a suitable replacement.
2. These replacement(s) will be derived from the reusable landers.
3. The later Artemis missions will become more commercialized.

Artemis is far from the only example of NASA's deep inefficiencies.

I want to be clear. NASA is a net positive for the world. But it is horribly inefficient. Government agencies often are.

There are many examples of NASA impeding progress in space. Lori Garver's book Escaping Gravity has many examples of this. As Deputy Administrator of NASA, she was in a position to see this.

Who was against the commercialization of NASA? Who stands to lose if NASA becomes more efficient? The contractors and senators.

These are the people who spoke out against the COTS, CRS, and Commercial Crew contracts. It is debatable whether they truly believed the commercial companies would fail or if they were just trying to keep their funding [See Update Dec 13 2023]. The true answer obviously lies somewhere

in the middle. However, with the last decade of progress in commercial space, it is clear that the commercial companies were the right choice.

It is a testament to the senators and contractors power that they could overcome a directive from the President of the United States. President Obama was in favour of the Commercialization of NASA.

With the recent OIG report on the cost overruns of the Mars Sample Return program (MSR), I saw a post from a former JPL employee that is very relevant to this discussion. Backup image in case the original is deleted.

It shows how SpaceX pursued Red Dragon as a Mars Lander. This would be a more efficient platform for conducting science on the surface of Mars. There was intense pressure to not give funding to this program. From the post, it is not entirely clear where this pressure came from or the exact motive. But it is clear that the pressure was enough for SpaceX to cancel Red Dragon and shift over to Starship.

JPL currently conducts all the flagship missions to Mars. They are very good at getting small payloads to the surface of Mars. But they are not good at decreasing the cost - MSR is $10B! Red Dragon could have decreased the cost per ton to the surface of Mars by more than an order of magnitude.

Who stands to lose from this? JPL and contractors.

This shows the common theme with NASA projects: entrenched interests that are not aligned with the goals of NASA.

If NASA could proportion funds to maximize science and exploration without regard to outside interests, it would be a much more efficient organization.

One of the factors that prevent this is how the US Federal Budget is allocated.

NASA cannot simply shift funding from one program to another. They must spend the money on the SLS that has already been allocated to it. Congress is not an efficient means of allocating funds. Mini-dictatorships are more efficient, also known as private companies.

Vivek Ramaswamy has spoken about how to fix this. When constructing the Federal budget we should work from the ground up to determine what resources are truly needed. Instead, we work from the top down. This means that the budget is not optimized for the best use of resources.

The system that created NASA's inefficiencies wasn't completely an accident. NASA's distributed nature was planned from the beginning.

Because NASA has centers in multiple congressional districts it has multiple Senators and Representatives that will fight for funding. This keeps NASA's funding high and stable. But it also means that NASA is a jobs program.

I thought NASA was meant to explore space and do science. Not be a jobs program.

How to Fix NASA

What is the goal of NASA?

If you ask most people I hope they would say to do science and explore space.

There is a rhetoric that being a jobs program for people who work on out-of-date technology is a good thing. I disagree. Keeping people employed is good for those people and the economy, but not for science or exploring space.

It is very important to understand the goal of NASA: Science and Exploration. Otherwise, you get sucked into thinking NASA should be a jobs program.

Now that we have set the goal, we can use it as a framework to analyze NASA's current programs and predict its future.

Show me a single example where a government agency has been more efficient than private companies. I can't think of a single one off the top of my head.

NASA should be a customer, not a provider.
"One customer among many" - Jim Bridenstine, former NASA Administrator

Private companies have proven their ability to get to space cheaper and more efficiently than NASA. This is why for most payloads, NASA uses commercial launch providers. Private companies can also get people to space cheaper and safer than NASA could. This isn't purely SpaceX's doing, but they have been the most successful at it.

Is it too far of a stretch to assume that private companies will be able to build and operate space stations, rovers, bases, Moon landers, etc. better than NASA could?

Commercialization is inevitable either way. We might as well embrace it early.

The early voyages to North America were government-funded. How many are today? Almost none aside from the military. The early voyages to the Moon were government-funded. How many will be entirely government-funded in the future? None (ish).

I hope NASA never builds a moon base. They are bad at building big orange rockets, so it's not a stretch to assume a NASA moon base would be far over budget and behind schedule as well.

Commercial Space Stations are already in development and will fly in the next few years. They don't have a proven track record yet, but I am confident they will be successful in being cheaper and more efficient than the ISS.

If Space Stations are commercialized, why not Moon Bases? The technical challenges are not insurmountable for private companies.

Even with the commercialization of space, NASA still has a role to play in development programs. SpaceX would not be where it is today without NASA funding and collaborating with NASA on development. This is especially true for Crew Dragon.

In the next 10-20 years NASA will still need to be involved in private development programs. They will provide funding and expertise. This will allow for privately development programs that can be cheaper and more efficient than NASA could do on its own.

NASA is a stepping stone for commercialization.

The primary challenge in the future of completely commercializing space is the source of funding. How will companies make money if not from NASA? In-space manufacturing and mining offer a solution, but we will have to wait 10-50 years to see this play out.

What will NASA's role be in the commercialized future of space?

NASA will use technology and spacecraft developed by private companies to conduct science and exploration.

This is already happening with the CLPS program. NASA is paying private companies to develop Moon landers. NASA provides the experiments. The private companies provide the landers.

The Commericalization of space is already occuring as private companies are creating an economy in space. NASA should embrace this and use it to its advantage.

This is the first era of commercializing space. NASA provides funding, technical expertise, and the payload. In the next era, private space companies provide End-to-End solutions for missions.

The payloads of NASA missions will be commercialized. Currently, NASA is very much involved in the development of its own satellites and Mars landers. In the future, NASA will provide the mission requirements and private companies build the satellites and landers.

Commercialization has been the trend in all industries. It is inevitable that this will happen in

space. It is only a matter of time.

Updates

[Update Dec 13 2023]
With Smarter Every Day’s latest video, it seems much of the personal push from engineers is good hearted. It’s only when the government gets involved that degeneracy ensues. Also, Destin makes the mistake of simplifing the architecture at the expense of the mission.

[Update Dec 5 2024]
Ozan Bellik summarized the insights in this post well by saying systems engineering and project management should be moved to private companies, while NASA mainly does R&D, data analysis, and mission planning.

[Update Dec 7 2024]
The fundamental issue with cost-plus contracting now is that contractors are not incentivized enough to move quickly. In World War 2, the contracting paradigm didn’t need to include incentives to move quickly because it was implicit in the national priorities of the time (not losing the war). Now, contracting paradigms need to include urgency to complete projects on time because there isn’t this external signal to move quickly.

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Geohot made a blog too. You should be working on hardware