Nations Race Toward Reusable Rockets

The original space race was a bipolar affair with mostly political implications for the United States and the Soviet Union. Out of that space race, commercial and military capabilities began to grow in the realm of communication satellites, collecting intelligence, and global navigation.

We are now looking at an emerging new space race, one significantly different than the competition of last century. Now, it is no longer just the US and Russia, it is also China, India, Japan, Europe, as well as more recent newcomers like Iran. There are also a large and growing number of private companies not only involved in supporting state space programs, but possessing their own space launch capabilities.

These companies include SpaceX in the United States, Rocket Lab (based in the US with a New Zealand subsidiary), but also private companies in China like iSpace and Galactic Energy. All of these companies have successfully placed payloads into orbit, with SpaceX also capable of resupplying the International Space Station (ISS) and also launching crewed missions with its Falcon 9 rocket and its Dragon 2 spacecraft.

The Importance of Reusability and Access to Space

These newer space companies, free of legacy hardware and starting from a clean slate, have looked seriously into varying degrees of reusability.

Access to space generally involves rockets that are expendable. They are launched once and either burn up in the upper atmosphere or crash down onto Earth, never to be used again. This expendability is why access to space is extremely expensive. Each payload launched into space must account for the fact that the entire launch system will be discarded, and a new launch system built to launch future missions.
Companies with capable reusability will outcompete competitors, offering access to space at drastically lower costs than companies using expendable rockets.

For nations with capable and reliable reusability, their access to space will be cheaper. Because reusable rockets are able to be turned around faster than building a new rocket from scratch, a nation's launch cadence will be much quicker. This would allow a nation to build and maintain constellations of satellites essential for economic and military purposes faster and cheaper than other nations, granting them an obvious advantage geopolitically.

With competition for low-earth-orbit (LEO) communication and internet satellites heating up, and requiring large numbers of satellites to be launched to build and maintain global coverage at low latency, companies and nations with reusable space launch capabilities will stand the most to gain, both by putting these constellations into orbit, and from the benefits of building and maintaining the constellations themselves.

The Players

SpaceX has pioneered rocket reusability with its Falcon 9 and Falcon Heavy launch systems. The first stage returns to Earth under the power of its own rockets, touching down vertically either on a land-based pad, or at sea on a drone ship located down range. They can be reused up to 10 times before major overhauls are required.

The spectacular engineering feat accomplished by SpaceX and the economical paradigm shift it has introduced into the aerospace industry has sent out shockwaves, inspiring other space launch concerns around the globe to begin seriously investigating their own reusable launch systems.

State space programs in both Russia and China are seriously investigating reusability.

Russian state media, TASS, in an article titled, "Russia to spend $880 mln on Amur reusable space rocket," would note that:

*Russian State Space Corporation Roscosmos and the Progress Space Rocket Center signed a contract on Monday on the conceptual designing of the Amur-SPG space rocket center for a new Amur reusable methane-fueled rocket.*

The Amur rocket's first stage looks very similar to SpaceX' Falcon 9, but its engines will burn methane and oxygen. The commonality of landing legs and grid fins are not, as some critics suggest, copying SpaceX, but are practical considerations when building reusable rockets with today's technology, similar to all aircraft having wings, a fuselage and landing gear.

Roscosmos reports that initially, Amur's first stage will be designed to be reused 10 times but hopes that up to 100 flights or more will be possible in the future.

While reusability is not a trait associated with the Russian space program, Russian rocket engineers are among the best in the world, with America's United Launch Alliance (ULA) using Russian-designed RD-180 engines on its Atlas V launch vehicle serving as a testament to this fact. It is highly likely that Russia will succeed in implementing Amur, with budget and political issues the only potential obstacles.

The China National Space Administration is also looking into reusability for its Long March 8 rockets.

NasaSpaceFlight would report in its December 2020 article, "Long March 8 – a future reusable rocket – conducts debut launch," that:

*China debuted the new Long March-8 – Chang Zheng-8 – launch vehicle out of Wenchang on Tuesday. This vehicle marks China's move towards a reusable launch vehicle, with the recovery of the first stage and side boosters planned for a latter variant.*

But China's ambitions toward reusability is not confined to its state space program. The government is also promoting private space companies including the above mentioned iSpace and Galactic Energy who have their own reusable designs in the works.

Both companies have already successfully placed payloads in orbit using expendable rockets and both are developing and testing prototypes to eventually reuse the first stages of future vehicles, again, in a similar fashion to SpaceX.
US-based Blue Origin is also working on a similar (but much larger) rocket called New Glenn and already operates a small reusable suborbital rocket design called New Shephard.

Rocket Lab currently operates a small satellite launch system called Electron which recently was redesigned to be partially reusable. More recently, Rocket Lab announced that it will be developing a medium lift rocket called "Neutron" very similar to SpaceX' Falcon 9, but filling a smaller launch market niche.

And finally, with private companies and nations planning to match or best SpaceX' Falcon 9, SpaceX itself has continued to innovate at a break-neck pace.

Its new Starship program features a fully reusable first and second stage that, when combined, will be the largest most powerful rocket ever built and capable of putting massive payloads into orbit. The second stage is not only capable of placing massive payloads into Earth orbit, but is designed to send people and cargo to other destinations in the solar system as well including to the Moon and eventually to Mars.

SpaceX has already built and flown 3 prototypes of Starship's second stage (also called "Starship") to an altitude of 10 kilometers, before flipping horizontally, falling back to Earth using control surfaces to guide it to the landing pad, before reigniting its engines, flipping back vertically and landing. This is a feat the third test flight successfully achieved, raising the bar for the global aerospace industry once again.

The economic and military benefits of accessing space will only be further enhanced by cheaper, more reliable, and more rapid access to space. Nations leading in this regard stand to enhance their wider geopolitical influence. And with dropping costs and growing capabilities in terms of reaching space, the prospect of tapping the vast amount of resources in space becomes possible.

The economic importance of navigational satellites and the constellations maintained by the US, Europe, Russia and China alone illustrate just how important being able to access space is. Dropping costs will also allow other nations lacking their own state or private space launch capabilities to place a larger number of satellites into orbit to enhance their own space-based capabilities, further levelling the playing field and contributing toward a multipolar future, both here on Earth and up above it too.

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