A Platform Approach to Space Exploration

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Abstract

Private rocket companies like SpaceX have driven launch costs so far down that they have increased demand for services in space. The secret to their success is that they treat rocket systems as platforms rather than as bespoke, one-off projects. Having standard and reusable components makes it easier to extend the functionality of rocket systems and the reusability of the components enables these companies to benefit from constant incremental improvement. It's an approach that may well help businesses face other major challenges.

The traditional approach to space exploration is to treat each project, meaning each rocket launch, as a one-off customized megaproject. NASA provides the classic example of this approach. NASA treats each launch as a big, one-off, bespoke

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investment – trying to deliver a "quantum leap" or "big bang". Donna Shirley, a manager on NASA's Pathfinder mission, describes them as "magnificent mission[s] in the grand old style".

The problem with this approach is that the various missions are constructed independently from each other. Components and systems are not updated and transferred from one project to the next – they are instead reimagined.

The downside of this approach is illustrated by the Mars Observer mission. With a 17-year planning and development cycle and a cost of over US$1.3 billion in 2000 prices, the Mars Observer was slow to market and costly. It was launched in September 1992. On August 21, 1993, three days before the spacecraft was set to fire its main rocket engines and decelerate into orbit, flight controllers at NASA's Jet Propulsion lab (JPL) lost contact with the spacecraft—the mission failed.

It's perhaps even more sobering to reflect that if the project had not failed, any follow-up project would have cost as much and taken as long because NASA would have redesigned every component and system from scratch

The new private space tech companies are taking a very different approach, treating its rocket systems as platforms. They create components and technologies that can be reused and replicated, enabling them to start small and rapidly scale up. This is radically lowering costs, making space more accessible, and the demand is fuelling plenty of investment dollars. Lets see how they're doing this.

How platforms work

Big tech giants such as Apple, Google, Amazon, and Microsoft are based on platforms. So are Airbnb, eBay, and Uber, whose multisided platforms have captured the imagination of investors: Airbnb does not own hotel rooms, eBay does not own warehouses, Uber does not own taxis, yet they facilitate interactions at scale among multiple sides (buyers and sellers). This has led some scholars to take a narrow definition of platforms, as capital-light digital systems that make markets.

But platforms aren't just a digital phenomenon. The terminology and industry applications of 'platforms' emerged over the course of the 20th century, notably in the automobile and shipping industries. They are best thought of as a structured assembly of parts, subsystems, interfaces, and processes that are shared among a set of applications designed to create orderly interactions between multiple and potentially non-standard elements and parties.

Consider containerized global shipping. Some of the elements interacting on a global shipping platform are interoperable 20- and 40-foot containers, cranes, vessels, communication satellites, and lighthouses; the parties include shipping lines, port operators, shippers, and regulators among others. Whereas the containers are uniformly standard, vessels — despite many shared elements — are not. Yet the protocols of the global shipping platform enable orderly interactions, and shipping at a fraction of the cost pre-container.

The components of a platform are standardized as much as possible, as are the interfaces between components and users. This facilitates growth, as users and components can be added easily. As platforms grow, their functionalities increase (think smartphones that now host mobile banks, route maps, and streaming services as well as telephony and messaging services). As this process happens, they can evolve into huge and complex adaptive systems (or ecosystems, as some call them).

The outcomes are unmissable: markets with platforms make services faster, better, cheaper, and more omnipresent. These forces, undoubtedly, cause disruption — platforms are not popular among those who find it hard to keep pace.

How is this playing out for space companies?

We'll focus here on just one company, SpaceX, but its competitors are sharing the same experience. The idea for the company was born when Elon Musk, then a newly minted millionaire with an interest in Mars, discovered that, despite spending billions of dollars annually over thirty years, NASA was nowhere near to landing humans on Mars. It couldn't even return astronauts to the Moon.

The problem, he suspected, was precisely that NASA treated each launch as a one-off event. Although they did learn a bit from each launch, they essentially started the next one with a clean sheet. They didn't reuse components, nor did they plan for such reusability. As he put it: "throwing away multimillion-dollar rocket stages after every flight makes no more sense than chucking away a 747 after every flight."

To Musk, reusability would be a key lever in generating commercial activity in the industry since, "the reason there is low demand for spaceflight is because it's ridiculously expensive…[and] the problem is that rockets are not reusable" (Weinzierl et al. 2021, p. 4). In 2021, SpaceX landed one of its reusable rockets for a 100th time. Reusability doesn't mean standing still – any more than Apple's operating system does. SpaceX systems and rockets undergo rapid iterative upgrades, which have expanded the overall capability-set Space X offers its customers, just as Apple's operating upgrades do.

This platform approach to rocket-making creates a virtuous circle. Rocket systems made up of modular components are more easily upgradeable and reusable. This results in an increase in volume – in this case of launches. As people upgrade and recombine the components of their platform (the rocket) they can repurpose it, while continuing to scale. The variety creates the conditions for more scale, because it means that the platform has more value to more users.

In 2009, when its future was still in doubt, the company's only commercial launch took RazakSAT — a Malaysian Earth Observation satellite weighing 180 kilograms — into orbit. In 2021, SpaceX set a record of 31 launches, with payloads of as much as 549,054 kilograms. Each launch now performs multiple functions: in June 2019, one of its Falcon Heavy rockets carried 24 different spacecraft toward three different types of orbit. The cargo included a privately funded solar sail experiment to harvest solar energy for interstellar flight, a NASA-designed miniaturized atomic clock for use in deep space, U.S. Pentagon-funded satellites to measure space radiation, and a container with the cremated remains of 152 people.

All told, SpaceX's 2022 launch revenues are expected to be around US$2 billion for 40 plus launches, each of which costs one tenth that of the typical NASA launch.

Frequency is set to rise with ever lower costs and higher speed-to-market. Edgar Zapata (2017b), a Life Cycle Analyst at NASA for 32 years, argues that 200+ annual launches are within reach for SpaceX.

At its peak in 1964, NASA was launching into space at about the same frequency as SpaceX today, which is remarkable given the technology at the time. But that achievement came at an unsustainable cost of US$40 billion in constant 2020 prices. By 1970, the budget had nearly halved, and by 1987 NASA's launch frequency had collapsed to a mere 4 per year. There was clearly no virtuous circle at play.

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Companies like SpaceX have opened space up for commercial exploitation – and their platform model points the way to how mankind will solve its other challenges. In the context of the climate crisis and increasing levels of political uncertainty, how well we manage and adapt to challenges may well make the difference between survival and extinction. And if we do survive, it will almost certainly be because our solutions have been scalable platforms rather than conventionally planned megaprojects.