

## Lecture 9

## The Soviet Moon Program

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To be discussed: Organization, key personalities, competing lunar projects, technical failures, political economical cultural roots.

Lt.-Gen. Nikolai Kamanin was in charge of the Russian air force and space affairs. He kept a diary about his life and work; quote, “We could have been first on the moon” (Dec. 1968). At this point, he knew the Soviets were too far behind to catch up with the US. In his diary, he’s very frank, and expresses his frustration with lack of national vision and leadership; there were bitter rivalries between government and program divisions, and Soviet political leadership was very indecisive, which lead to too little funding and resources for the program to progress adequately.

Overall role of the space program for Soviets:

- political propaganda; display of Soviet superiority
- but propaganda was a small part; other parts became much more important.

Soviet space industry was very convoluted; air force was not able to influence the design of the spacecraft. Bulk of R&D was done in design bureaus, under 2 ministries (Ministry of Defense and another one). Companies under contract to one ministry didn’t usually take orders from any other ministries, and the contracting process was long and convoluted.

Chief designer Sergei Korolev played an important role in getting the system to work, though he was low in the bureau hierarchy.

- Part of the organization of “chief designers” who were put in charge of particular systems or components, which had a direct line to Khrushchev.
- Designed first Soviet ICBM (was part of attempt to duplicate Germany’s V2 rocket). He then convinced the government to use it for a civilian purpose – launching a satellite (Sputnik).
- He established close relationship with Igor Kurchatov (worked on atom and hydrogen bombs) and Keldysh, a mathematician (together, they were referred to as “the three K’s”).
- Council of Chief Designers: Korolev set this up while he was developing ICBM. 6 members, informal. Used the council to pull together resources and make deals to develop space systems. Despite being informal, it was rather authoritative.
- Was arrested under Stalinist regime in 1940 after being named as a co-conspirator by Khrushchev. Sentenced to 10 years hard labor.
- Prison labs and design bureaus were established so that imprisoned engineers and scientists could be put to work using their skills. Korolev spent time there developing airplanes.
- Clashed with Kamanin many times over many issues.
- Not particularly interested in lunar expedition, thought it was more of a diversion; wanted to go to Mars. Soyuz 7K-9K-11K was a modified R7 rocket, with

multiple modules for different tasks. Each module would be launched independently and docked together in Earth orbit, then would go to the moon. This was complex and unwieldy, and there was no docking tech back then, so it wasn't approved.

Vladimir Chelomey:

- refined, well-dressed; very different, personally, from Korolev.
- Accomplished specialist in mechanics and math; had an academic manner, projected an image of scientific expertise, and possibly more skillful than Korolev in building alliances (brought Khrushchev's son into his fold).
- Eventually able to get access to Khrushchev, and proposed a different plan for lunar flight: LK-1 spacecraft (single launch, no in-space assembly, circumlunar flight). This alternative plan became a point of contention between he and Korolev.

1964: the Soviets realized that neither Korolev's or Chelomey's projects were proceeding very fast, while the American program was really going forward. (Up to this point, they'd thought Kennedy's declaration was just propaganda). Korolev's Mars proposals were discarded; he converted his N-1 rocket into one for lunar flight, modified Soyuz and combined with Chelomey's design to design a new plan for circumlunar flight. Korolev proposed a separate project for the lunar landing. In August, the government approved two projects: circumlunar flight (spacecraft from Chelomey, rocket from Korolev), and lunar landing, which also combined the two men's designs.

In October of that year, Khrushchev was ousted by Brezhnev, so Chelomey lost the power he'd been wielding due to his closeness with Khrushchev and his son. Korolev was quick to capitalize on this; he proposed that the parallel programs were a waste of money and suggested combining them. Top priority was given to circumlunar flight since it was easier.

Cosmonauts of L-1 would not have access to the main computer; would only be able to read the display and monitor the state of the craft's systems, and abort as needed. "Zond" was the name given to test launches; most of these were unmanned, as they did not launch manned missions without first testing the launch in the unmanned mode. Zond-5 was their first unmanned circumlunar flight (had tortoises on board, which survived fine).

N-1 rocket with L3 spacecraft also carried LK (lunar lander) and LOK (lunar orbital craft). LOK was basically a modified Soyuz.

Cosmonauts were trained for lunar landings by training in helicopters with engine cut-off. Cosmonauts were to make a space walk to get into the lunar lander; same space suit would be used for the space walk as well as the lunar landing (Krechet).

1966: Korolev died after an operation; may have been a result of injuries he'd received in prison.

N-1 rocket could not find military uses due to the fuels it used; wasn't feasible. Developed further until 1969, when it was first launched in February (ended up with 30 engines ringing the base).

- First launch: 68 seconds after launch, one of its engines exploded; it was designed so that if an engine malfunctioned, the engine on the opposite side of the circle would shut down to balance it. The system for this also malfunctioned, however, and all other 29 engines shut down.
- Second launch, July 1969: As the rocket was lifting off the pad, one of the engines exploded (don't know why), other engines caught fire, and rocket lifted barely above the tower before exploding. The lunar orbiter's failsafe went off successfully, at least, firing it off the rocket and flying it safely away.
- Third N-1 launch also ended in failure.
- Fourth launch, 1972: 107 seconds of flight, one of the fuel lines burst, engines caught fire, and rocket exploded. At the time, it had been gradually shutting down, to prepare for the second stage to take off.
- At this point, work on the N-1 was stopped. Head of the project was fired, and a new person was hired to head Korolev's design bureau.

Soviet government decided that though they weren't first on the moon, they could follow up the American landing with one of larger scale; more research resources, longer stay, etc.

- When they learned about the American shuttle program, they scrapped this and duplicated the U.S. space program's direction – that of developing a reusable spacecraft.

Systemic problems with Soviet programs:

- no coherent national program; changed priorities all the time; no specific long-term projects or funding
- no recognized authority or central agency like NASA. Program was essentially under the Ministry of Defense, and it wasn't a high priority for them. Program was pushed forward by the assertiveness of individuals.
- Program relied on personal styles of management, due to how much the program relied on strong personalities pushing it forward. These styles, unfortunately, did not bring any established or trained systems of management to the system.
- Parallel projects split up the already insufficient funding.
- Inadequacy of economic mechanisms; Soviet economy was not monetary.
- Political pressures; pressures from both Khrushchev and Brezhnev for particular launches on particular anniversaries, or to keep up appearances against the U.S. and programs kept having to divert resources to these projects.
- Risk-averse culture; emphasis on automation. Tested unmanned modes all the time, which took time and resources.

Prof. Mindell's comments: this is very much the opposite of what most Americans thought the USSR's program was like, and it's very different from NASA's highly centralized, top-down organization.

Americans tended to test their designs on the ground until they felt ready to launch; Soviets would launch as their tests.

Korolev may not have been the best choice for his position; many experts think Chelomey's designs were more viable (he had one for a lunar lander, as well). But, because the N-1 rocket was already under development, and with Khrushchev out of power, he wasn't able to push his way through.

Additionally, Soviet electronics weren't as advanced as American ones; they could have gotten there eventually, but they were decidedly behind at the time.