Lecture 16   "Tales from the Lunar Module Guidance Computer"
by Don Eyles

Slides illustrate the degree of manual control on the spacecraft: NASA looked for a balance between trusting the computer to do everything automatically, or having to constantly check readouts and make adjustments.

Third stage: capsule disengages with the LM; LM drops to a lower lunar orbit, and begins to descend to landing trajectory

Schematic of the LM:
-   windows were relatively large for a spacecraft, even after being scaled down from initial designs
-   two dishes: rendezvous radar dishes
-   fuel tanks; engine
-   ascent stage (~10,000 lbs), descent stage (~25,000 lbs)
-   landing pads/feet (since rigidness of the moon's surface was unknown)
-   3 feet of shock absorbing capability in landing struts (took up hundreds of pounds of weight, but again, it was because they didn't know how rigid the moon's surface would be)

Inside the LM's cockpit:
-   circuit breakers; cycling different circuits by hitting the breaker actually played a critical role in some missions
-   altitude gauges
-   manual throttle (though astronauts never used it during landing)
-   rotational control (controls attitude)
-   astronauts stood rather than sat
-   optical telescope for alignment
-   window for docking with capsule
-   landing point designator (LPD) system

Computer:
-   about 1 cubic foot
-   inertial sensors

LM descent and landing schematic

Cockpit simulator:
-   NASA's was programmed with one wrong number; Grumman had their own simulator with hardware that created a correct simulation and caught the mistake. This was really fortunate, because that wrong number would have caused the throttle to be out of control.

Mission programming was kind of like a "recipe" that used the various subsystems to accomplish things. Subsystems were tested to satisfaction; different programs involving these subsystems didn't have to be tested individually.

Problems that were blamed on the computer system were, more accurately, a wrong readout that was not corrected by the pilot. To a journalist (who wanted their publisher to print their article!), this would count a "computer error" and not a pilot error.

Each of the lunar landing crews were very different in their demeanors and personalities (whether they were formal or informal; open and convivial or standoffish, etc.).

What to do differently now: Now, the politics and policies are a lot different. Going back to the Moon, or to Mars, will take a great deal more time and money than the Apollo project did. It might have been a part of the "free-wheeling" atmosphere of the 60's that even made the project capable of proceeding as quickly and directly as it did; NASA's "managers" were engineers, not professional managers; these days, decisions that could be made in a day will take months in a committee. It's a little discouraging, but this is what things look like today.