- Chapter Two -
- Computers On Board The Apollo Spacecraft -

Lessons

[62] What did NASA learn from its experiences with the Apollo computer system? At the management level, NASA learned to assign experienced personnel to a project early, rather than using the start of a project for training inexperienced personnel; many NASA managers of software and hardware were learning on the job while in key positions. Also, more participation by management in the early phases of software design is necessary so that costs can be more effectively estimated and controlled.

From the standpoint of development, NASA learned that a more thorough, early effort at total systems engineering must be made so that specifications can be adequately set. NASA contractors in the Apollo program faced changing specifications long after final requirements should have been fixed. This was expensive and caused such problems as Raytheon's retooling, memory shortages, and design insufficiencies.

The realization that software is more difficult to develop than hardware is one of the most important lessons of the Apollo program. So the choice of memory should be software driven, and designers should develop software needed for manned spaceflight near the Manned Spacecraft Center. The arrangement with MIT reduced overall quality and efficiency due to lack of communication. Also, more modularization of the software was needed [180].

The AGC system served well on the earth-orbital missions, the six lunar landing missions, the three Skylab missions, and the Apollo-Soyuz test project. Even though plans existed to expand the computer to 16K of erasable memory and 65K of fixed memory, including making direct memory addressing possible for the erasable portion, no expansion occurred[181]. The Apollo computer did fly on missions other than Apollo. An F-8 research aircraft used a lunar module computer as part of a "fly-by-wire" system, in which control [63] surfaces moved by servos at the direction of electronic signals instead of traditional cables and hydraulics. In that way, the Apollo system made a direct research contribution to the Shuttle, which is completely a fly-by-wire craft. The most important legacy of the AGC, however, was in the way NASA applied the lessons it was beginning to learn in developing ground software to the management of flight software.