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# PRINCIPLES FOR A PRACTICAL MOON BASE

**Abstract**

NASA planning for the human space flight frontier is now coming into alignment with goals promoted by other planetary-capable national space agencies. The US now admits that the "horizon goal" of Humans to Mars requires significant system, operations, and partnership learning in the cis-lunar and lunar-surface environment first. Since the 68th IAC in Adelaide, US Space Policy Directive 1 made this shift explicit: "the United States will lead the return of humans to the Moon for long-term exploration and utilization, followed by human missions to Mars and other destinations". The stage is now set for sufficient public and private American investments to implement a range of lunar lander capabilities. At the 67th IAC in Gaudalajara, the author identified American commitment to develop lunar landing/ascent as essential to make any kind of Moon Village real. Assumptions about Moon base architectures and operations will strongly drive the requirements used to specify system developments, commercial-services purchase agreement partnerships, and technology investment priorities. Some fundamental architecture-shaping lessons captured in the literature are not evident in recent Moon base concepts. A prime example is failure to recognize that most of the time, before and between intermittent human occupancy, a Moon base must be robotic: most of the activity, most of the time, must be implemented by robot agents, not astronauts. This paper reviews key findings of a seminal robotic-base design-operations analysis conducted for NASA Ames in 1989, then addresses implications of these lessons for key aspects of today's Moon Village paradigm: public-private partnership development and operations; cis-lunar infrastructure; globally-distributed scientific exploration by multiple actors; production-quantity exploitation of water resources near the poles to bootstrap enhanced space activities; automation capabilities that were novel in 1989 but are now increasingly widespread. It is time to engineer justifiable, practical, and genuinely modern Moon base concepts.