How to Build a Lunar City

A Capital, Procurement, and Infrastructure

A white paper on the structural alignment required to fund a permanent human presence on the Moon.

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Executive Summary

A permanent human presence on the Moon, referred to in this white paper as a lunar city, will be built as the emergent outcome of decades of coordinated work across thousands of actors: government programs that anchor demand, prime contractors that integrate major systems, specialized vendors that supply critical components, subsystems, and even full systems, and capital that funds the vendor layer through equity, debt, and government cost-share.

This white paper argues that a permanent human presence on the Moon will not be built by a single architecture studio, a single launch company, or a single fund. It will be built by a structural alignment of three layers that currently do not work in coordination: government procurement, strategic acquirer pipelines, and patient, long-term, institutional capital.

Most space ventures fail because they cannot bridge the gap between government cost-plus development funding and commercial revenue at scale. The companies that survive almost always do so by winning a foundational government contract early, then iterating toward strategic acquisition by a prime contractor.

The roadmap proposed here is to build a capital recirculation layer dedicated to crew health, habitation, and human flourishing technologies, modeled on conservation finance and land trust precedents rather than venture capital. Pair it with a portfolio strategy that funds technologies aligned with NASA's human health and performance procurement, the lunar surface architecture under NASA's Moon to Mars Architecture, and the international partnership programs run by ESA, JAXA, and ASI. Use the resulting portfolio as the substrate from which the primes acquire the capability and solutions.

1. City Building

City building emerges from the coordinated work of governments, infrastructure providers, capital allocators, builders, and residents over decades. Apollo to ISS took thirty years. ISS to a

sustained lunar presence is taking another twenty-five plus. A lunar city in the meaningful sense, a permanent multi-hundred-person settlement with sustained economic activity, is a fifty-to-hundred-year project.

The right questions are more granular and more useful:

- Whose technology becomes the standard that primes integrate and coordinate to make a robust system solution?
- Who controls the procurement pathway from government program to commercial revenue?
- Who provides the patient capital that bridges decade-long development cycles?
- What is the institutional and capital infrastructure that recirculates exit proceeds back into the next generation of companies?

Answer those four questions correctly across thirty years and you have built the substrate for a lunar city. Answer them incorrectly, or fail to ask them at all, and you produce a pile of beautiful concepts and meaningless Powerpoint presentations that do not compound.

To understand what builds a lunar city, separate the actors into three layers by their structural function.

1.1 Government Demand Layer

National space agencies set the demand, the standards, and the pace. NASA, ESA, JAXA, CNSA, and ISRO will collectively define the regulatory, technical, and commercial framework for the lunar economy through the late twenty-first century. Their procurement choices, more than any other variable, determine which technologies get adopted and which fail. The COTS program created SpaceX. The CLPS program is creating the lunar lander market. NASA Ignition, announced March 2026, is creating the lunar surface architecture market. NASA's human health and performance procurement is creating the crew health vendor market.

1.2 Prime Contractor Integration Layer

The prime contractors, including Leidos, Lockheed Martin, Boeing, Northrop Grumman, Mitsubishi Heavy Industries, Thales Alenia, and IHI, build and integrate the major systems that the agencies procure. They are not, contrary to popular framing, monolithic blockers of innovation. They are systems integrators with limited internal R&D capacity, and they need a steady pipeline of acquired technologies to fulfill their contracts. The primes regularly acquire mid-sized technology and engineering firms to add capability against contract scope, and several are standing up dedicated technology-solutions divisions that accelerate this acquisition pace. The strategic insight is that primes are buyers, not competitors, for technology vendors aligned with their contract scope.

1.3 Vendor and Capital Layer

The vendor layer is where most innovation happens. It includes early-stage companies developing crew health technology, habitation systems, life support, EVA training, ISRU, communications, surface mobility, and in-space manufacturing. Some sell directly to the

government. Most sell to primes as subcontractors. A small number eventually exit by acquisition to primes or by initial public offering after sustained government revenue. The capital that funds this layer is currently fragmented and structurally mismatched to the development cycles required. Venture capital expects unicorn returns on five-to-seven-year horizons, which does not match the ten-to-fifteen-year arc of crew health and habitation technology development. Government grants are non-dilutive but do not provide growth capital. Strategic CVCs are emerging but lack thesis depth. The result is a chronic underfunding of the vendor layer relative to the demand from primes and agencies.

This is the gap. This is where structural innovation in capital is the highest-leverage move available to anyone who wants to accelerate the lunar economy.

2. Why Existing Capital Fails the Vendor Layer

2.1 The Venture Capital Mismatch

Traditional venture capital is structurally incompatible with the development cycle of crew health, habitation, and human-rated hardware in space. The standard ten-year fund life with a five-to-seven-year deployment window cannot underwrite technology that takes a decade to reach Technology Readiness Level (TRL) 7 and another five years to reach commercial deployment. Venture funds expect 10x or greater returns on a portfolio basis to clear hurdle rates. Most viable space companies will exit at $100 million to $500 million strategic acquisitions, which is excellent for founders and direct investors but does not produce the venture-grade outcomes that fund managers need to raise their next vehicle. The result is that VCs allocate to space only when the company has a near-term software-style scaling story (Earth observation, satellite comms, defense AI), and avoid the deeper hardware that the lunar economy actually requires.

2.2 The Government Funding Gap

Government cost-plus contracts and SBIR awards fund development but do not fund growth. A Phase III SBIR is roughly $1 to $2 million. A typical crew health technology requires $20 to $50 million to reach commercial deployment. The gap between government funding and a strategic acquisition is the famous valley of death, and it kills more space companies than technical failure. The Office of Strategic Capital, established in 2023 within the Department of Defense, is a partial answer for defense-aligned dual-use technology. It does not address civil space.

2.3 The Misalignment

Mission-aligned foundations and family offices that care about long-term human flourishing have capital that could in principle fund the vendor layer at the right cost of capital. They typically do not because their investment policies were designed for either grants (philanthropic, no return) or impact investments (program-related investments at sub-market returns). Neither instrument is shaped to underwrite decade-long, exit-driven technology development. The capital exists. The structure to deploy it does not.

3. The Conservation Finance Analogy

The capital structure problem the lunar economy faces is not new. Conservation finance solved a similar problem for ecological preservation over the past forty years, and it offers a direct template for crew health and habitation.

Conservation finance works through a layered structure. A 501(c)(3) entity holds long-duration assets such as land easements and intellectual property, with permanent stewardship as the operating mandate. A for-profit vehicle, often a limited partnership, deploys capital into operating ventures aligned with the conservation thesis. Philanthropic capital underwrites the long-duration layer, accepting modest returns or no returns in exchange for permanent mission alignment. For-profit capital underwrites the operating ventures, accepting market-rate returns. The two layers are structurally connected through licensing, royalty, and impact-sharing agreements that recirculate value back to the philanthropic layer over time.

NatureVest, the conservation finance arm of The Nature Conservancy, has deployed over $4 billion using variations of this structure. Blue Haven Initiative, the Pritzker family's blended finance vehicle, applies similar principles to climate. Conservation easements held by land trusts permanently protect over 60 million acres in the United States alone.

The structural insight that conservation finance offers the lunar economy is that long-duration mission-aligned capital can be unlocked, at scale, when it is paired with the right institutional architecture. Crew health and habitation in space is a near-perfect analog. The development cycles are decade-long. The mission alignment is generational. The intellectual property has long-term value that exceeds the lifecycle of any single venture. The exit pathway exists through strategic acquisition by primes.

4. A Blended-Finance Model for the Vendor Layer

4.1 Structure

The model proposed here is a blended-finance vehicle modeled on conservation finance precedent. It comprises a 501(c)(3) entity holding intellectual property and providing philanthropic capital for long-duration technology development, paired with a for-profit limited partnership that invests directly into operating companies. A representative configuration targets a philanthropic close at the 501(c)(3) layer and a separate for-profit limited partnership close, sized so that the philanthropic layer de-risks long-duration IP while the for-profit layer captures market-rate returns from operating companies.

4.2 Investment Thesis

Such a vehicle allocates capital to crew health and habitation technologies aligned with NASA's human health and performance procurement through 2035, the lunar surface architecture under NASA's Moon to Mars Architecture, and adjacent international programs. The thesis is that primes will acquire the most capable vendors in this space over the next ten years. The

vehicle's role is to fund those vendors through the valley of death and de-risk them to the point where strategic acquisition becomes the natural exit.

4.3 Portfolio Construction

A portfolio of fifteen to twenty companies, deployed over a four-to-six-year window with initial checks in the $500,000 to $3 million range and follow-on capacity, can cover the core of the crew health and habitation segment. Concentration areas include:

- Full-body haptic EVA training and crew physical readiness systems
- Habitation interior systems including circadian lighting, sleep optimization, and behavioral health
- Life support and environmental control technologies
- Medical diagnostics and treatment for spaceflight-relevant conditions
- Sensory systems for monitoring crew health continuously and for long-duration missions
- Adjacent technologies with dual-use applications in longevity, rehabilitation, and elite performance

5. The Procurement Pathway as the Defining Variable

Every space company that has succeeded has done so by winning a foundational government contract. The companies that died, at every level of capitalization, almost universally died because they could not access the procurement pathway. This pattern is so consistent that it should be treated as a near-law of the sector.

The procurement pathways relevant to the lunar economy include:

5.1 Direct NASA Contracts

SBIR, STTR, Tipping Point, ECF, and direct mission contracts. Generally small, stage-gated, and slow. Useful for technology validation and revenue runway. Not sufficient for growth capital.

5.2 Prime Contractor Subcontracts

Subcontract awards under primes' major NASA contracts: crew health and human performance contracts, civil group contracts, Orion subcontracts, Starliner subcontracts. This is where the meaningful revenue lives for crew health and habitation vendors. The strategic relationship with the prime, more than the underlying technology, determines whether a vendor wins these subcontracts.

5.3 Commercial Services Contracts

CLPS for lunar landers, COTS legacy structures for cargo, and emerging commercial LEO destinations. These have the highest potential for non-government scale revenue but are concentrated among a small number of awardees.

5.4 International Partnership Pathways

ESA Lunar Remote Camp, ASI lunar habitation through Thales Alenia, JAXA Artemis contributions, and emerging Indian and Korean programs. Strategic for vendors with technology that fits international system architectures.

The structural recommendation is that a fund focused on crew health and habitation should treat procurement pathway access as a primary diligence factor for portfolio selection, not a downstream concern. Relationships with the relevant primes, NASA Marshall, JSC, and the international integrators are core to deal flow and value creation.

6. The Strategic Acquirer Map

Exits in the crew health and habitation segment will occur primarily through strategic acquisition by primes. The map of likely acquirers is:

6.1 The Lead Crew Health Prime

Approximately 45 percent of acquisition probability for a crew health and habitation portfolio. The prime holding NASA's principal human health and performance contract is actively building its acquisition pipeline and represents the single most likely acquirer for vendors in this segment. This prime's recent corporate-development activity, acquiring engineering and technology firms to add capability against contract scope, establishes the pattern a portfolio should underwrite toward.

6.2 Leidos

Approximately 15 percent. Its civil health group competes on NASA work and acquires complementary capabilities.

6.3 Lockheed Martin, Boeing, Northrop Grumman

Combined approximately 15 percent. Larger primes that occasionally acquire crew health and habitation companies as part of human spaceflight program execution.

6.4 International Primes

Approximately 15 percent. Mitsubishi Heavy Industries, IHI, Kawasaki, Thales Alenia, Airbus Defence and Space. Acquisition activity tied to specific international programs (JAXA Artemis, ESA Lunar Remote Camp, ASI lunar hab), and this category will expand as signatory nations' lunar programs mature.

6.5 Adjacent Acquirers

Approximately 10 percent. Apple, Meta, Whoop, Oura, Peloton, large pharmaceutical and medical device companies. These become relevant only if the portfolio company has a credible consumer fitness, longevity, or healthcare adjacent application beyond space.

7. The Institutional Capital Argument

Institutional capital, including pension funds, sovereign wealth funds, large foundations, and family office CIOs, has not yet entered the space economy at scale. The reasons are structural, not philosophical. The asset class lacks track record, the fund managers are mostly first-time, and the underlying companies have unclear paths to scaled revenue.

Structural innovation can change this. The conservation finance precedent established a template that institutional LPs eventually accepted. The same template, applied to space, can do the same. The conditions for institutional adoption are:

- A fund manager team with experienced principals who have prior fund management track record
- A blended structure that allows philanthropic and for-profit capital to coexist with appropriate risk and return profiles
- A clear thesis on procurement pathway and exit pathway
- A portfolio strategy that produces both venture-style upside and infrastructure-style stability
- A mission alignment compelling enough to differentiate from generic deep tech allocations

The most common bottleneck for an emerging vehicle is the first condition: pairing a thesis-driven team with a principal who carries institutional fund management track record. This is consistently the highest-leverage strategic priority on the path to a first close.

8. Why

The lunar economy is not a financial product. It is the substrate on which a multi-generational human project will be built. Anyone allocating capital to it is making a wager on what kind of civilization will exist in 2050, 2075, and 2100.Most capital flowing into space today optimizes for short-term outcomes: launch cadence, satellite imagery, defense AI. These are valuable but they are not city-builders. The crew health, habitation, life support, behavioral health, and human flourishing technologies that allow humans to live, not just survive, in space are the actual substrate of permanence.

The intellectual frame for this is that spacecraft and habitats function as conditioning environments for human consciousness and culture, not merely as vehicles. The capital structures that fund them should be built with the same generational horizon.

9. Recommendations

9.1 For Institutional Limited Partners

Allocate to space through blended-finance vehicles modeled on conservation finance, not generic venture capital. Demand thesis depth on procurement pathway and exit pathway.

Underwrite teams with at least one experienced fund principal. Treat first commitments as relationship-building rather than maximum exposure, and plan for follow-on commitments across multiple fund cycles.

9.2 For Mission-Aligned Foundations and Family Offices

Use the philanthropic layer of blended-finance vehicles to fund long-duration intellectual property development that the for-profit market will not underwrite. Treat this as ecosystem infrastructure, comparable to the role of foundations in the early biotechnology and clean technology sectors. Recognize that the highest-leverage philanthropic intervention in space today is capital structure innovation, not direct grants to individual research projects.

9.3 For Strategic Corporate Investors

Engage as both LPs and direct co-investors. Blended-finance vehicles offer access to the vendor layer in a curated form. Strategic alignment with NASA's human health and performance pipeline, JAXA's crewed lunar role, and ESA's habitation programs creates parallel deal flow that single corporations cannot generate alone.

9.4 For Government Programs

Continue and expand commercial services procurement models. Extend the COTS and CLPS templates to crew health, habitation, and surface infrastructure. Provide non-dilutive matching capital through the Office of Strategic Capital and analogous civil space mechanisms. Recognize that the vendor layer is the strategic asset and treat it accordingly.

9.5 For Founders

Solve for the procurement pathway first. Identify the prime contractor whose contract scope your technology fits. Build the relationship before you raise. Plan for strategic acquisition as the primary exit, not IPO. Avoid venture capital that demands unicorn outcomes incompatible with your development cycle. Seek capital structures that match the cycle of the technology you are building.

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Appendix: Key References and Precedents

Capital Structure Precedents

- NatureVest (The Nature Conservancy): blended-finance vehicle deploying over $4 billion in conservation finance
- Blue Haven Initiative (Pritzker family): blended capital across climate and impact
- Conservation easements through US land trusts: over 60 million acres permanently protected
- Program-Related Investments (PRIs) under IRS rules permitting foundations to deploy capital at sub-market returns

Government Procurement Mechanisms

- NASA human health and performance procurement: multi-billion-dollar prime contract pipeline through 2035, crew health and human performance
- NASA Moon to Mars Architecture: lunar surface, transit, and Mars-forward planning
- NASA Ignition (announced March 24, 2026): approximately $20 billion over 7 years for the lunar base, plus $6 billion over 10 years for expanded CLPS operations
- Office of Strategic Capital (DoD): non-dilutive matching capital for dual-use technologies

Strategic Acquirer Activity

- Lead crew-health prime: building an acquisition pipeline of engineering and technology firms aligned to NASA crew health and human performance scope
- Prime contractors broadly: recurring acquisition of mid-sized technology vendors to add capability against major NASA and defense contracts
- International integrators: acquisition activity tied to specific JAXA, ESA, and ASI program awards