Exemplar: Lunar Innovation Park Pre-Commitment Screen

A Pre-Authorization Determination for Capability Demonstration, Resource-Data Sufficiency, and Infrastructure Lock-In

Executive Summary

The Lunar Innovation Park concept addresses a real and important gap in lunar surface development. Sustained lunar presence will require power, communications, landing protection, excavation capability, construction support, mobility, logistics, customer services, and eventually resource-linked infrastructure.

This screen does not ask whether those capabilities are useful.

They are useful.

It asks a different question: can an initial Lunar Innovation Park demonstration proceed without silently becoming the anchor for a larger lunar base before site, subsurface, operational, resource, customer, economic, and governance assumptions are decision-adequate?

The core risk is not technical failure. The core risk is uncontrolled transition. A capability demonstration can succeed technically while still creating premature commitment. It can establish a preferred location, surface access pattern, landing geometry, power architecture, customer expectation, interoperability assumption, or value-chain narrative before the evidence has earned authority to guide long-term infrastructure.

For that reason, the Lunar Innovation Park should be treated as a commitment-admissibility decision, not only as a technical feasibility decision.

The determination of this screen is:

1. DEFER AS INFRASTRUCTURE COMMITMENT.
2. PROCEED ONLY AS A BOUNDED, REVOCABLE, NON-ANCHORING CAPABILITY DEMONSTRATION WITH EXPLICIT RESOURCE-DATA AND VALUE-CHAIN TRANSITION GATES.

Under this determination, an initial demonstration may proceed only if NASA or the relevant authority explicitly separates:

- demonstrating a capability
- validating a site
- anchoring infrastructure
- activating customers
- forming a value chain
- establishing base precedent

Only the first may proceed under the initial authorization. The others require additional evidence and separate authorization.

Mission 1 success should not automatically authorize Mission 2. Demonstration success should not be treated as evidence that the location is suitable for long-term base development, ISRU dependency, customer geography, interoperability standards, or lunar surface logistics architecture.

The governing principle is simple: Evidence must earn authority before it governs commitment.

Decision Under Review

Should NASA authorize an initial Lunar Innovation Park demonstration that begins fixed or semi-fixed lunar surface infrastructure deployment before the evidence is sufficient to justify long-term site, architecture, customer, resource, and value-chain commitment?

This is not a decision about whether the Lunar Innovation Park concept is valuable. It is a decision about whether the first demonstration can remain bounded, revocable, and non-anchoring.

A **proceed** decision would authorize a controlled demonstration under explicit limits.

A **defer** decision would require additional evidence, transition criteria, or governance conditions before infrastructure-forming activity proceeds.

A **refuse** decision would apply if the demonstration cannot be cleanly separated from long-term site commitment, economic geography formation, resource validation, customer dependency, or infrastructure lock-in.

Why This Screen Matters

The first Lunar Innovation Park demonstration may create facts on the ground.

Even if framed as a bounded technology demonstration, it can begin forming preferred landing geometry, surface access routes, power placement assumptions, communications coverage, excavation precedent, customer expectations, interoperability assumptions, public narrative, and follow-on mission dependency.

Once those elements begin to form, later decisions may no longer be evaluated neutrally. Future missions may inherit the first site, the first architecture, the first access path, the first power geometry, or the first customer promise as a default condition.

That is the decision relevance.

The demonstration is not just a test of capability. It may become the first move in a path-dependent infrastructure sequence.

Core Finding

The Lunar Innovation Park may be valuable as a learning mechanism and still inadmissible as an infrastructure anchor.

The correct question is not: Can we build the first elements?

It is: Can we build them without prematurely deciding where the larger lunar surface system belongs?

A second question follows: Can capability be demonstrated without allowing the demonstration to substitute for resource validation, value-chain authorization, or site commitment?

This screen concludes that the Lunar Innovation Park should proceed only as a bounded, revocable demonstration unless and until the evidence earns authority to support a larger commitment.

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1. Missing Link

The Lunar Innovation Park concept addresses a real and important gap in lunar surface development. Sustained lunar presence will require power, communications, landing protection, excavation capability, construction support, mobility, logistics, customer services, and eventually resource-linked infrastructure.

The missing decision layer is not whether those capabilities are useful.

They are useful.

The missing decision layer is whether an initial demonstration can proceed without silently becoming the anchor for a larger lunar base before site, subsurface, operational, economic, and governance assumptions are decision-adequate.

A capability demonstration can be technically successful while still creating premature commitment. It can establish a preferred location, sequence, operating geometry, customer expectation, or infrastructure pattern before the evidence has earned authority to guide a larger system.

The additional missing layer is resource-data sufficiency. A demonstration may validate a capability, but that does not mean the site has been validated as a resource-dependent infrastructure node. Resource location, accessibility, state, distribution, concentration, operational relevance, and economic viability must be evaluated before a demonstration is allowed to become a value-chain anchor.

The governing problem is therefore not simply whether the Lunar Innovation Park can be built. It is whether it can be demonstrated without allowing demonstration success to substitute for site authorization, resource validation, or infrastructure commitment.

2. Decision

Should NASA authorize an initial Lunar Innovation Park demonstration that begins fixed or semi-fixed lunar surface infrastructure deployment before the evidence is sufficient to justify long-term site, architecture, customer, and value-chain commitment?

This is not a technical feasibility decision alone.

It is a commitment-admissibility decision.

The decision under review is whether a bounded capability demonstration may proceed without becoming the de facto starting point for a larger lunar surface system.

A proceed decision would authorize a controlled demonstration under explicit limits.

A defer decision would require additional evidence, transition criteria, or governance conditions before infrastructure-forming activity proceeds.

A refuse decision would apply if the demonstration cannot be cleanly separated from long-term site commitment, economic geography formation, or infrastructure lock-in.

3. Evidence Stack

Relevant evidence includes

- candidate site rationale
- landing access assumptions
- surface traffic assumptions
- power architecture
- communications architecture
- excavation feasibility
- berm and landing-pad construction logic
- ejecta and plume interaction assumptions
- regolith mechanical properties
- subsurface uncertainty
- resource location data
- resource accessibility data
- resource state, distribution, and concentration
- instrument resolution and uncertainty
- ground-truth requirements
- ISRU relevance
- expected customer demand
- interoperability requirements
- value-chain assumptions
- economic viability assumptions
- relocation feasibility

- follow-on mission dependency
- Mission 1 to Mission 2 transition criteria
- public and political commitment risk
- strategic location value
- governance and revocation authority

The critical issue is not whether any one evidence source is promising. The issue is whether the total evidence stack is sufficient for the specific commitment being considered.

A capability demonstration requires one level of evidence. An infrastructure precursor requires a higher level of evidence. A value-chain anchor requires a still higher level of evidence.

The evidence stack must be evaluated against the commitment class, not against general enthusiasm for lunar development.

4. Decision-Relevance

The first Lunar Innovation Park demonstration matters because it may create facts on the ground.

Even if framed as a bounded technology demonstration, it can begin forming:

- preferred landing geometry
- surface access patterns
- power placement assumptions
- communications coverage assumptions
- excavation and construction precedent
- customer service expectations
- operational standards
- interoperability expectations
- site-centered political attachment
- follow-on mission dependency
- resource-adjacent economic geography

Once those elements begin to form, later decisions may no longer be evaluated neutrally. Future missions may inherit the first site, the first architecture, the first access path, the first power geometry, or the first customer promise as a default condition.

That is the decision relevance.

The demo is not just a test of capability.

It may become the first move in a path-dependent infrastructure sequence.

5. Plausible States

The initial Lunar Innovation Park site may later prove to be:

- genuinely suitable as an infrastructure nucleus
- technically workable but not strategically optimal
- useful for demonstration but poor for base expansion
- operationally convenient but resource-misaligned
- commercially attractive but scientifically premature
- politically attractive but physically fragile
- adequate for Mission 1 but misleading for Missions 2 through 4
- suitable for power or communications but not for resource-linked operations
- useful as an interoperability testbed but not as a value-chain anchor
- locally viable but poorly positioned for regional surface logistics
- safe for initial landing but difficult for sustained operations
- compatible with early customers but misaligned with future ISRU demand
- successful as a capability demonstration while unresolved as an infrastructure site

These plausible states matter because the same initial demonstration can have very different implications depending on what the site later proves to be.

A successful demo at a poor long-term site can still create lock-in.

A technically useful testbed can still distort future architecture.

A strategically visible location can still be physically, operationally, or resource-wise premature.

The purpose of the screen is to prevent one plausible state, the optimistic one, from being treated as the only state.

6. Commitment Under Review

The commitment is not simply "build a demo."

The commitment under review is whether an early capability demonstration may begin organizing future lunar infrastructure around one location, one architecture, one access geometry, one operational sequence, and one assumed value chain.

This distinction is essential.

A bounded demonstration asks whether a function can be tested.

An infrastructure precursor asks whether the tested function can responsibly become part of a larger surface system.

A value-chain anchor asks whether the site and architecture are adequate to support downstream dependencies such as ISRU, construction, logistics, power, customers, and commercial services.

The Lunar Innovation Park may be admissible as the first and inadmissible as the second or third.

The authorization must therefore specify which commitment is being approved.

7. Commitment Classes

Likely commitment classes include:

- site preference
- landing-zone hardening
- surface access routing
- mobility corridor formation
- berm construction
- landing and launch protection
- fixed power placement
- fixed communications placement
- excavation capability deployment
- construction capability deployment
- customer service expectations
- interoperability precedent
- ISRU-adjacent dependency
- material handling dependency
- thermal and power dependency
- economic geography formation
- partner lock-in
- public narrative lock-in
- precedent for concentrating activity at one location
- precedent for "claiming" or functionally reserving strategic locations

These commitment classes differ in reversibility.

Some may be acceptable as temporary demonstrations.

Some may be acceptable only with revocation conditions.

Some may become inadmissible if they begin constraining future base architecture before site evidence, resource evidence, and value-chain evidence are sufficient.

The screen must identify which class is actually being activated.

8. Irreversibility Map

What becomes harder to undo:

- moving the park after initial investment
- changing landing approach geometry
- changing power and communications architecture
- relocating berms or landing protection altering mobility corridors
- removing excavation precedent changing customer assumptions
- revising partner commitments
- reopening alternative site selection
- admitting that the demo site should not scale
- separating demo success from base authorization
- protecting alternative sites from being deprioritized

- preventing temporary infrastructure from becoming default infrastructure
- preventing public narrative from turning a testbed into a base

The irreversibility does not only come from hardware.

It also comes from institutional attention, follow-on planning, partner alignment, budget continuity, mission sequencing, and public claims.

A small physical demonstration can create a large decision shadow.

The irreversibility map should therefore include physical, operational, political, economic, and narrative lock-in.

9. Coupling

The Lunar Innovation Park concept couples several systems early:

- landing precision ↔ berms
- berms ↔ site geometry
- power ↔ infrastructure placement
- communications ↔ operational radius
- excavation ↔ construction sequence
- mobility ↔ access corridors
- customers ↔ service geography
- ISRU ambitions ↔ resource interpretation
- resource data ↔ site validity
- economics ↔ repeat use
- interoperability ↔ architecture standardization
- public-private partnership ↔ institutional
- momentum

That coupling is the core issue.

Once coupled, the system may continue advancing because each element justifies the next.

A landing zone justifies berms.

Berms justify repeated access.

Repeated access justifies power and communications.

Power and communications justify customers.

Customers justify additional surface services.

Surface services justify continued investment.

Continued investment turns an initial demonstration into a preferred infrastructure geography.

The question is whether that sequence is being governed explicitly or allowed to occur by default.

10. Dependency Surface

Dependencies include:

- repeated lander access
- landing accuracy
- surface power availability
- communications reliability
- ejecta protection
- regolith mechanical properties
- excavation repeatability
- surface mobility
- ability to protect assets from plume and blast effects
- customer arrival schedule
- customer willingness to use shared infrastructure
- usable commodity pathway
- local resource relevance
- regional resource distribution
  availability of ground-truth data
- ability to distinguish demonstration success from site validation
- NASA authorization continuity
- commercial partner continuity
- political tolerance for early infrastructure
- ability to revoke or relocate after Mission 1

The dependency surface should be treated as a decision object.

If the demonstration depends on assumptions that are not yet validated, those assumptions must be named.

If follow-on missions depend on the demonstration location, that dependency must be declared.

If customers depend on services that convert the site into an anchor, that dependency must be governed before authorization.

11. Outcome Divergence

11.1. A good outcome:

The demo proves selected capabilities while preserving relocation, redesign, non-scaling, and alternative-site options. Mission 1 produces learning without becoming site authorization. The result is a stronger lunar infrastructure program because the demonstration improves evidence without prematurely narrowing the future architecture.

11.2. A bad outcome:

The demo works technically but becomes the default anchor for a larger base before the site, resource environment, access geometry, customer demand, or value-chain logic is decision-adequate.

11.3. The worst outcome:

Early success creates institutional lock-in around a site that later proves suboptimal, fragile, resource-misaligned, operationally constrained, politically contested, or strategically mis-sequenced. By the time the inadequacy is recognized, the cost of changing course is too high.

The divergence is therefore not between success and failure.

It is between learning and premature anchoring.

A successful demonstration can still be a bad commitment.

12. Admissibility Tests

Before authorization, the Lunar Innovation Park should pass tests such as:

12.1. Demo Independence Test

Can Mission 1 succeed without implying that the site must become the base?

The demonstration must be able to validate capability without validating the larger infrastructure geography by implication.

12.2. Relocation Preservation Test

Can NASA walk away, relocate, or redesign after Mission 1 without political, economic, operational, or partner penalty becoming prohibitive?

If relocation is technically possible but institutionally unrealistic, the demo is not fully revocable.

12.3. Assumption Exposure Test

Which assumptions does the demo depend on that are not yet validated?

These may include landing repeatability, regolith mechanics, power needs, customer demand, site safety, resource relevance, surface traffic, and follow-on mission cadence.

12.4. Customer Dependency Test

Would customer arrival convert a demonstration into irreversible infrastructure geography?

If customers are invited in a way that creates dependency before site adequacy is established, the demo may become an anchor prematurely.

12.5. Infrastructure Escalation Test

At what point do power, communications, berms, landing pads, excavation systems, and customer services become a commitment system rather than a testbed?

The transition from testbed to system must be governed.

12.6. Resource-Data Sufficiency Test

Are the location, accessibility, state, distribution, concentration, and operational relevance of local resources adequate for the specific commitment being considered?

If the answer is no, the demo may proceed only if it remains explicitly non-resource-validating.

12.7. Value-Chain Independence Test

Can the demonstration validate power, communications, landing protection, excavation, construction support, or customer-service capability without implying that the location is suitable for a

future ISRU, construction, logistics, or commercial value chain?

If the demonstration creates value-chain dependency before the value chain is decision-adequate, the commitment is premature.

12.8. Interoperability Boundary Test

Are interoperability assumptions being tested, or are they being embedded as standards before enough evidence exists?

A demo may inform standards. It should not prematurely become the basis for standards unless the evidence supports that authority.

12.9. Mission-to-Mission Gate Test

What evidence must exist before moving from Mission 1 to Mission 2?

The demo must include explicit transition gates. Without them, the program risks sliding from demonstration into commitment.

13. Decision Authority

Potential authority holders include:

- NASA mission directorate leadership
- NASA program executive
- Agency Program Management Council
- surface systems program authority
- ISRU program offices
- commercial partnership authority
- independent review bodies
- partner agencies or operators where applicable
- interoperability or standards bodies where applicable

The key question is: Who has authority to stop, relocate, redesign, or prevent scaling after Mission 1?

A demonstration is not truly revocable unless the revocation authority is explicit.

The authority holder must be able to distinguish between:

- technical demo success
- site validation
- infrastructure authorization
- customer activation
- value-chain commitment
- base-precedent formation

If those authorities are distributed across different offices, partners, or stakeholders, the decision structure must state who controls each transition.

14. Admissibility-Blocking Condition

The demonstration is not admissible as a scalable infrastructure precursor if:

- it cannot be cleanly separated from future base commitment
- Mission 1 success will be treated as site validation
- relocation is politically or operationally unrealistic after Mission 1
- customer assumptions are used before site adequacy is established
- resource assumptions are used before resource-data sufficiency is established
- the demo becomes a value-chain anchor before the value chain is decision-adequate
- the demo becomes a land-claiming mechanism without explicit governance criteria
- interoperability standards are embedded before evidence justifies them
- no Mission 1 to Mission 2 transition criteria are defined
- no revocation conditions are defined
- no authority holder can stop or redesign the sequence after initial success

The blocking condition is not technical infeasibility.

The blocking condition is uncontrolled transition.

If a bounded demo cannot be prevented from becoming an infrastructure anchor, the commitment is inadmissible.

15. Implication

The Lunar Innovation Park may be technically valuable and still inadmissible as an infrastructure anchor.

The correct question is not: Can we build the first elements?

It is: Can we build them without prematurely deciding where the larger lunar surface system belongs?

The additional question is: Can we demonstrate capability without allowing the demonstration to substitute for resource validation, value-chain authorization, or site commitment?

This reframes the Lunar Innovation Park as a governance problem, not only an engineering problem.

The park may be a strong mechanism for learning.

It should not become a default mechanism for committing.

16. Determination

DEFER AS INFRASTRUCTURE COMMITMENT.

PROCEED ONLY AS A BOUNDED, REVOCABLE, NON-ANCHORING CAPABILITY DEMONSTRATION WITH EXPLICIT RESOURCE-DATA AND VALUE-CHAIN TRANSITION GATES.

The Lunar Innovation Park is admissible only if the authorization distinguishes between:

- demonstrating a capability
- validating a site
- anchoring infrastructure
- activating customers
- forming a value chain
- establishing base precedent

Only the first may proceed under this determination.

The others require additional evidence and separate authorization.

17. Decision Statement

NASA may proceed with an initial Lunar Innovation Park demonstration only if the demonstration is explicitly bounded as non-anchoring, non-scaling, and revocable.

The demonstration must not be treated as evidence that the location is suitable for a larger lunar base unless additional site, subsurface, operational, resource, customer, and architecture evidence converges.

The authorization should state that Mission 1 success does not automatically authorize Mission 2.

It should also state that demonstration success does not validate:

- long-term site selection
- resource-dependent infrastructure customer geography
- ISRU relevance
- surface logistics architecture
- interoperability standards
- base expansion

Those transitions require separate admissibility review.

Evidence must earn authority before it governs commitment.

18. Revocation Conditions

The demonstration should be reconsidered, stopped, relocated, or prevented from scaling if:

- new subsurface evidence changes site interpretation
- resource distribution is weaker, more uncertain, or less accessible than assumed
- landing or ejecta risks exceed assumptions berm construction creates greater disturbance than expected
- surface traffic creates unintended path dependency
- power or communications geometry constrains future site decisions
- customer demand does not materialize
- customer demand materializes too early and creates premature dependency

- alternative sites become more attractive interoperability assumptions prove premature
- Mission 2 requires assumptions not validated by Mission 1
- infrastructure geometry begins constraining future decisions
- the demo starts being described publicly as the beginning of a base
- the site becomes politically difficult to abandon
- the value chain depends on resource assumptions not yet validated

Revocation conditions must be defined before authorization.

A revocation condition that is created after the fact is usually too late.

19. Decision Audit Layer

19.1. Basis for Determination

Early infrastructure can create lock-in even when framed as demonstration. Capability validation, site validation, infrastructure authorization, and value-chain formation must be separated.

19.2. Dominant Uncertainty

Whether the initial site, architecture, customer model, and resource assumptions remain valid after further evidence.

19.3. Irreversibility Topology

Site preference → landing geometry → infrastructure placement → customer dependency → value-chain assumption → economic geography → base precedent.

19.4. Authority Holder

NASA authorization leadership and relevant program authority, with explicit authority assigned for stopping, relocating, redesigning, or preventing scale-up.

19.5. Decision-Dominant Uncertainty

Can the demo remain revocable, non-anchoring, and independent from future base commitment?

19.6. Non-Tolerable Outcome

A capability demo becomes the de facto lunar base anchor before evidence justifies that commitment.

19.7. Reason for Determination

The project may be valuable, but scaling logic must be separated from demonstration logic. The demonstration should generate evidence, not substitute for it.

19.8. What Would Change the Determination

Explicit relocation authority, bounded demo criteria, revocation conditions, resource-data thresholds, value-chain transition gates, and a formal Mission 1 to Mission 2 admissibility review.

20. Allowed Actions

Allowed:

- bounded capability demonstration
- temporary power deployment
- temporary communications deployment reversible test infrastructure
- bounded landing-protection experiments
- limited excavation or construction tests
- explicit assumption register
- explicit resource-data sufficiency register
- explicit value-chain assumption register
- post-demo admissibility review
- mission-to-mission authorization gates
- public distinction between demo success and base commitment
- public distinction between capability demonstration and site validation
- documentation of what the demo does not authorize
- independent review before scale-up
- option preservation for alternative sites and architectures

The allowed actions are designed to preserve learning while preventing premature commitment.

The demo may produce evidence.

It may not become the decision by default.

21. Refused / Inadmissible Actions

Refused unless further evidence and authority exist:

- treating Mission 1 success as site validation
- treating the demo site as the default base location
- inviting customers in a way that creates dependency before site adequacy
- using “strategic location” as sufficient authorization
- hardening landing zones without revocation criteria
- installing infrastructure that cannot be politically or operationally abandoned
- allowing demo infrastructure to become base infrastructure by default
- using resource potential as infrastructure
- authorization without resource-data sufficiency
- using customer interest as proof of site adequacy
- embedding interoperability standards before enough evidence exists
- turning temporary access routes into permanent corridors
- allowing public narrative to convert a testbed into a base
- advancing Mission 2 without a separate admissibility gate

The refused actions all share one feature:

They allow commitment to form faster than evidence.

22. Core Takeaway

The Lunar Innovation Park is a strong case for why commitment governance matters. A demonstration can be technically successful and still create premature infrastructure lock-in.

The governing question is: When does a lunar capability demo become an irreversible surface commitment?

A second question exists: When does a capability demo begin functioning as a resource, infrastructure, customer, or value-chain anchor before the evidence is ready?

The Lunar Innovation Park should proceed only as a bounded, revocable demonstration unless and until the evidence earns authority to support a larger commitment.

Evidence must earn authority before it governs commitment.

23.