

# Lunar Land Claims Recognition: Designing the Ultimate Incentive for Space Infrastructure Development

*Space business is being impeded by the lack of necessary big-ticket space infrastructure. To jumpstart space development, an economic incentive is needed to motivate private industry to finance and build this infrastructure.*  
by Douglas O. Jobes

**While** the National Aeronautics and Space Administration (NASA) often interfaces with the private sector, the government cannot -- and should not -- be expected to bear the entire burden for developing space. NASA's primary focus is exploration and discovery. That means a comprehensive approach to space development depends on finding ways to make space profitable for private industry -- if possible, convincing corporations, institutions, wealthy individuals, and venture capitalists to invest billions of dollars in space.

Consider the satellite industry, once the sole province of government but now a private sector success story. In 2003 the commercial satellite industry grossed over \$90 billion, according to the Satellite Industry Association. Revenue has been increasing year after year in this industry

because the profits to be made outweigh the expenses of doing business. But for more ambitious ventures -- such as businesses based on the Moon and in Earth-Moon space -- the financial hurdles of getting from the drawing board to profitability are much greater.

## No Rest Stops in Space

Besides the much-discussed issue of high launch costs, there is another big obstacle to overcome on the way to opening space to entrepreneurialism: the lack of basic space infrastructure. The launch vehicles, cargo transporters, orbital facilities, refueling stations, lunar surface facilities, and so forth on which businesses will depend are the missing pieces of the puzzle. There are business models that potentially would be very profitable if

only the space infrastructure was there to support them.

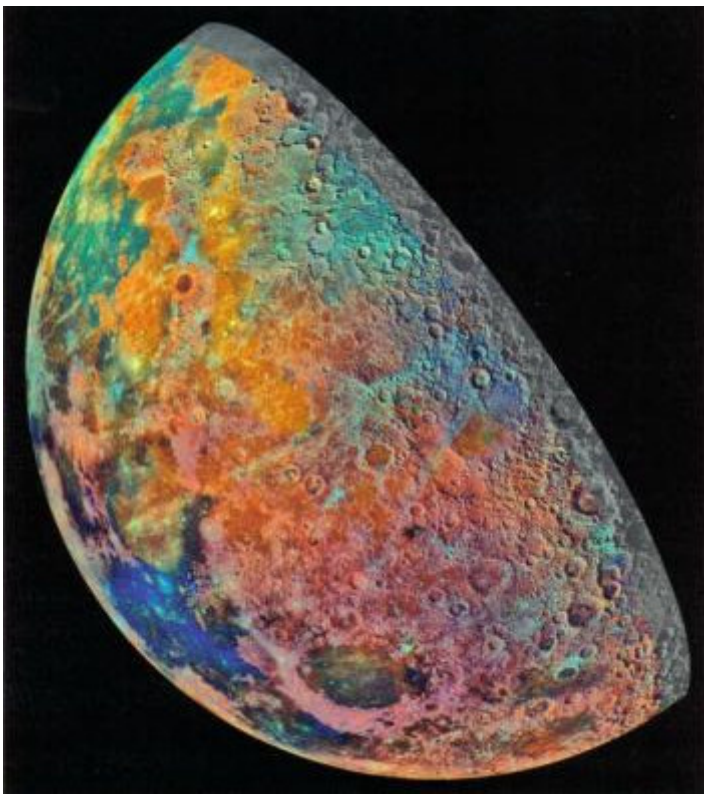
As one example, consider a business plan proposed by Dr. Michael Duke and associates at the Colorado School of Mines. This plan involves processing lunar soil, or regolith, into rocket propellant for use by the commercial satellite launch industry. As it turns out, a big expense for most satellite launches is the cost of boosting the satellite from low Earth orbit (320-800 kilometers above Earth) to its final geosynchronous orbit (about 35,000 kilometers up).

These researchers recognized that lunar regolith from certain regions of the Moon is relatively abundant in hydrogen and oxygen, which can be extracted by known processes and converted into liquid rocket fuel. Instead of inefficiently lifting large quantities of propellant from Earth's gravity well to take spacecraft from low Earth orbit to geosynchronous orbit, as is done today, the propellant could be manufactured on the Moon's surface then shipped to a waiting orbital transfer vehicle based at Lagrange point L1 between Earth and the Moon. The orbital transfer vehicle would transport the fuel from L1 to low Earth orbit and rendezvous with the satellite there. The transfer vehicle, laden with the fuel produced on the Moon, would then carry the satellite to its geosynchronous destination, the transfer vehicle afterward returning to its L1 home base to await the next load of propellant.

Analysis of the proposal showed this business model would be economically competitive, generating significant savings for the satellite industry. The problem is that the model is only profit-



*An early part of space infrastructure development will be finding out what lunar resources can be efficiently harvested and utilized. A small robotic rover takes samples of lunar material for testing in this artist's rendering. (Source: NASA)*



*LEFT: This false color image captured in 1992 by the Galileo probe shows the Moon's expansive compositional variation. Such images will be closely analyzed by lunar businesses involved in mining operations, propellant manufacture, and other possible lunar development industries. RIGHT: The same hemisphere of the Moon is shown in a more familiar light. (Source: NASA/Jet Propulsion Laboratory-Caltech)*

able if the existence of basic space infrastructure is assumed.

Businesses need considerable infrastructure to have a foothold for operations: space facilities in low Earth orbit that can act as cargo transfer and rendezvous points; trans-lunar and lunar landing vehicles to carry cargo and personnel; surface facilities on the Moon that can accommodate lunar launches as well as landings; and lunar surface facilities for housing personnel, maintaining equipment, and performing business activities.

One of the more intriguing efforts to evaluate space infrastructure requirements is the research being done by the organizers of the International Space Settlement Design Competition. These annual competitions are open to student teams from any high school anywhere in the world. In the United States, competitions are held at the Johnson Space Center, the White Sands Test Facility, and the Jet Propulsion Laboratory, involving hundreds of participants. To help define realistic criteria for the competitions, the founders have for several years been in-

vestigating the space infrastructure that space-based businesses might require, including businesses based in orbit around Earth or the Moon, on the surface of the Moon or Mars, and even in the asteroid belt between Mars and Jupiter.

Anita Gale, a co-founder of the competition and a senior project engineer at The Boeing Company, notes that a space-based business further out than geosynchronous orbit starts with nothing. Outside Earth's atmosphere, she says, "there is vacuum, a variety of environmental hazards, unrealized access to extraterrestrial resources, and solar energy - nothing more. There is currently no scheduled transportation service, no port to pull in to for supplies or repairs, no grocery store, no refueling station, no building supply store, no dirt to grow food in, no water."

### **The Problem: Who Will Pay for Space Infrastructure?**

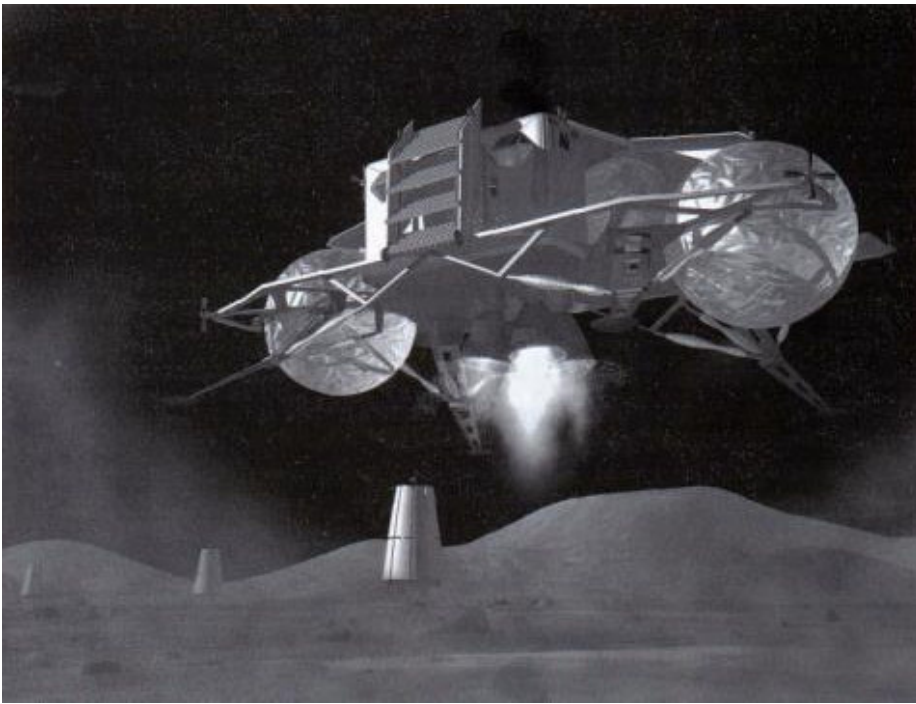
Private investment is needed to create much of the space infrastructure

needed for doing business, but without the space infrastructure to allow the establishment of profitable businesses, the private investment is unlikely to happen. This is the catch-22 of space development in today's current political and economic environment. A catalyst needs to be found to motivate the private sector to invest not just millions or tens of millions but billions of dollars to build the necessary structures in space.

Private industry is motivated by the potential for profit, so a considerable return on investment is needed. Some have proposed government cash prizes and even huge tax breaks for companies that help to develop space. Both of those concepts involve an obvious deal-killer: they both would drain the U.S. Treasury at a time when budget deficits have reached record levels. It is very unlikely that Congress would approve multi-billion-dollar, government-funded space incentives.

There is, however, one possible incentive that would not cost taxpayers anything but could generate an incentive of billions of dollars for construction of space





*Before businesses can begin industrial development on the Moon, a reliable and inexpensive vehicle will need to be developed to transport materials and people to the lunar surface. Here, an artist's rendering shows a concept vehicle landing on the Moon. (Source: NASA)*

infrastructure: rewarding anyone who establishes a privately funded, permanent lunar base -- along with a regular Earth-Moon space transportation service open to all paying individuals -- with the right to claim ownership of a large tract of land on the Moon surrounding the base. A large section of raw land on the Moon could have a potential value billions of dollars to investors, venture capitalists, and speculators. The key to translating this potential value into actual value is a concept known as "lunar land claims recognition." The basic principle underlying lunar land claims recognition is that Congress would pass legislation recognizing private claims of land on the Moon -- but only claims based on the tangible achievement of establishing a permanently inhabited facility. This is, in effect, a prize concept -- a "Space Settlement Prize" if you will.

To enable lunar land claims recognition. Congress would need to pass legislation outlining the specific conditions under which a private lunar land claim would, following the establishment of a privately funded lunar base, be recognized. The U.S. government itself would not claim any land, but would instead recognize the right

of the private group, consortia, or business that finances and builds a permanent base to make a claim.

Lunar land cannot be bought and sold today because there is no legal basis for ownership or exchange, but that could be changed by a land claims recognition law. A lunar land claims recognition law would use property rights as an incentive to motivate private individuals and companies to do something of great value for all of society.

The legislation could easily be structured to include participation by the international community -- and in fact *should* be so to make it clear the plan is not an American attempt at a land grab on the Moon. It would, of course, be desirable if other nations were to pass similar laws, although initially that would not be necessary. Because the United States represents such a large fraction of the world's economy and often leads the way on economic matters, the United States's recognition of a private lunar land claim would be a sufficient start.

To head off objections that other nations might have to the United States passing such a law, it could be written into

the law itself that the private groups who construct the permanent lunar base be international consortia -- even to the extent of requiring inclusion of citizens from at least one developing country as investors or providers of an equatorial launch site.

With a prize of billions of dollars' worth of lunar real estate, as well as the potential to operate profitable businesses once the infrastructure is in place, consortia of companies, wealthy individuals, and other private entities should be willing to begin making plans and investing funds to develop the lunar base and space transportation service. To build a permanent base and regular space line will require investing in not only the technology to make it feasible but also the construction of the structures.

Once human and cargo transit vehicles and orbital and lunar surface facilities are developed, these structures and the technology behind them could be used by many types of space-based businesses. The same reasoning applies to the construction of better spacesuits, robotic tools, crew support infrastructure, and so on. In the process, innovations that would result in lowering launch costs might come about.

## **The Value of Lunar Land**

Right now, the value of an acre of land on the Moon is not zero. In fact, the value is actually null - that is, absent or non-existent. Land cannot have value where land sale transactions have no basis. If land cannot be owned and exchanged, then it truly isn't worth anything in the sense that a commodity or investment has value.

Land claims recognition legislation would turn land on certain areas of the Moon into a legally tradable commodity without invoking government sovereignty. Lunar real estate will acquire enormous value after the establishment of a permanent base or settlement, regular commercial access, and a system of property rights.

So how does the legality of lunar land claims recognition stack up in the eyes of space lawyers? Currently space law contains a number of gray areas. Humanity simply hasn't had enough experience in space to develop laws for every scenario, so there are those who would argue for and against it.

But consider the evaluation of Declan J. O'Donnell, a tax, securities, and space law attorney in private practice in Denver, Colorado. O'Donnell is publisher of the *Space Governance Journal*, president of the World Space Bar Association, and a recipient of the Indira Gandhi Award of India for International Space Law. He says the legal basis used for lunar land claims recognition is "a valid approach to real property rights in space resources. In fact, compared to most of the proposals out there, the basic assumptions are not radical at all."

The legal aspects will be considered in more detail shortly. But first, more about the profitability of land in a lunar land claim. Under lunar land claims legislation, plots of lunar land would be offered for sale by the prize winner (the private entity that financed and built the lunar base) following months of worldwide press coverage produced by the race to establish a permanent settlement on the Moon. There will be those with specific business purposes for buying and using the land, but there will be a much bigger speculative and investment market. Many people who will never leave Earth will buy lunar land.

The dollar value of a lunar land claim will only become high enough to be extremely profitable when people can actually go there, and speculators and investors know this. Therefore, under the legislation, the lunar land deeds recognized by the United States would be offered for sale by the private claimants who established the permanent base only after the land is actually accessible -- that is, when there is a transport system

going back and forth often enough to support a permanent base.

It isn't necessary to guess what the rock-bottom value for lunar land would be, either. Over the last twenty-five years, an entrepreneur named Dennis Hope unwittingly conducted an experiment that indicates the potential market for lunar deeds.

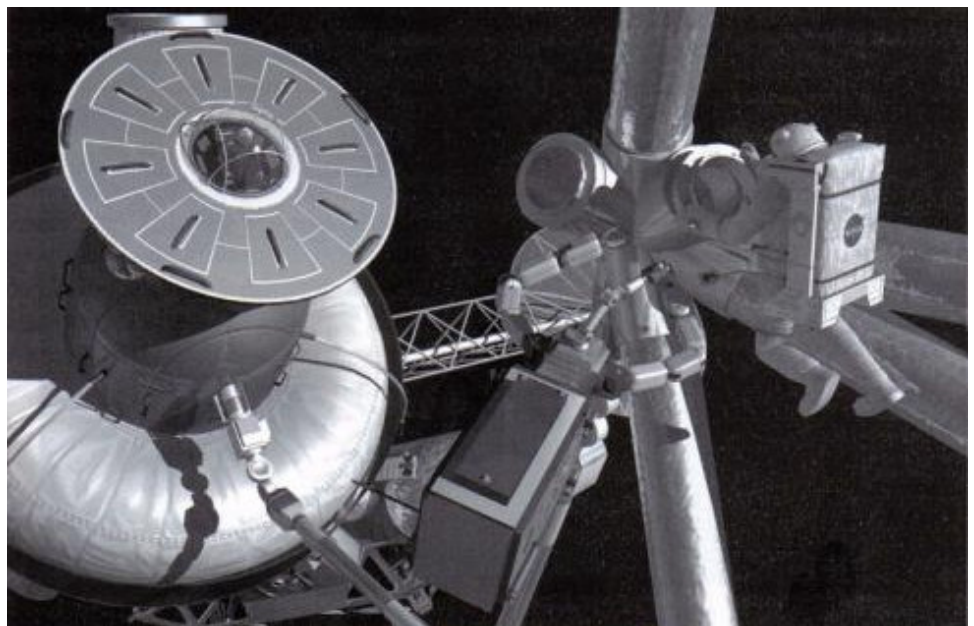
In 1980, Hope "claimed" the Moon and started a business selling lunar land "deeds." Thanks to Hope, the average value of lunar land, even on the most remote regions of the Moon's surface, is clearly no less than about \$20 per acre -- even with the land undeveloped, completely inaccessible, and barren and airless.

Because Hope's claim is not recognized by any court, he is in effect selling the deeds as novelty items. As startling as it may be, Hope has sold over two million of these deeds since 1980, according to his website ([www.lunarembassy.com](http://www.lunarembassy.com)), with the base price for lunar land currently \$19.99 an acre.

A nationally recognized real estate expert. Dr. Jeffrey D. Fisher, believes Hope's sales of novelty deeds represent a fair comparison with the real lunar deeds that may one day exist. As the director of the Center for Real Estate Studies at the

Indiana University School of Business and professor of real estate, Fisher is an expert in the science of property valuation, having authored such books as *Real Estate Finance and Investments* (2005), *Income Property Appraisal* (2004), and *Income Property Valuation* (2003). He notes, "One way appraisers estimate value is the comparable sales approach. That Mr. Hope has been able to sell novelty deeds for lunar land at this price may be an indication of the actual novelty value per acre. If an entity were selling land sanctioned by the U.S. government, which would make the ownership rights more official, then I can see the value being even greater."

Of course, an officially recognized lunar land deed would have some novelty value, but more importantly it would be a tradable commodity with intrinsic value like the deed to any other undeveloped land. How large a claim the United States should recognize would be up to Congress to decide. Logically the claim should be large enough to create a very compelling incentive for taking the financial risk. For example, the U.S. might decide to recognize a claim of no more than 4 percent of the Moon's surface -- about 1.5 million square kilometers, or the size of



*This artist's rendering shows people and robots performing construction in space. The development of space infrastructure will require a variety of space stations that may act as fuel depots or large vehicle assembly facilities. (Source: NASA)*



Alaska. A claim this size would be worth \$8 billion at \$19.99 per acre, while at \$100 per acre the value is nearly \$40 billion.

Once its claim was legally recognized, the organization could immediately start mortgaging or selling plots on its claim to investors, real estate speculators, and members of the general public.

### Private Ownership and International Law

Land claims in space are addressed by the 1967 Outer Space Treaty and the 1979 Moon Treaty. The United States and most other spacefaring nations are signatories of the Outer Space Treaty. In article two, the treaty sets restrictions on national ownership of property, as follows: "Outer space, including the Moon and other celestial bodies, is not subject to national appropriation by claim of sovereignty, by means of use or occupation, or by any other means."

During the decade before the treaty was written, when the need for the treaty

was being discussed no one was much worried about a private company launching a rocket to the Moon. What Americans were worried about was the Soviet Union landing on the Moon and claiming the ultimate high ground -- and the Soviets were worried about the United States doing the same.

On September 15, 1959, *The New York Times* reported: "[United Nations] Secretary General Dag Hammarskjold, in the introduction to his annual report last year, urged 'agreement on a basic rule that outer space and the celestial bodies therein are not considered as capable of appropriation to any state.'"

The Moon Treaty, on the other hand, very clearly attempts to ban private ownership of land in space. The very existence of the 1979 Moon Treaty is a clear indication that the 1967 Outer Space Treaty does not ban private ownership of land in space and that lawmakers and diplomats recognized that to be the case. The Moon Treaty, however, was an abysmal failure: of the 191 member nations of the United Nations, only five nations, none

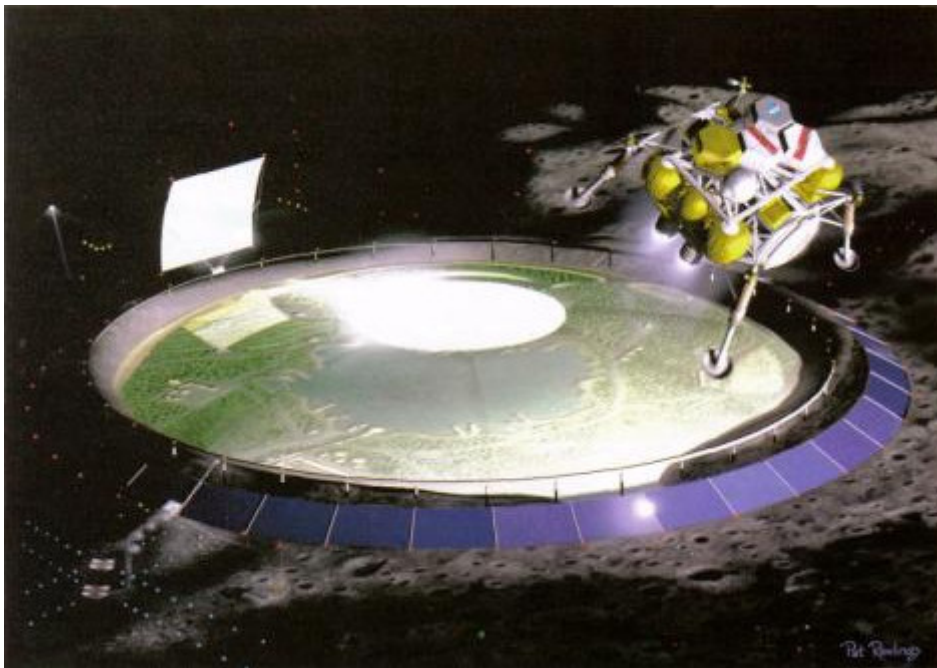
of them spacefaring, have ratified the treaty.

The Moon Treaty is widely regarded as a dead letter, and because the United States never ratified it, the Moon Treaty is not binding on this country or its citizens. That the United States refused to sign the Moon Treaty strongly indicates that Congress never intended property rights to be placed in jeopardy by either treaty.

The Outer Space Treaty specifies that outer space should be considered the "province of all mankind," but such a provision does not imply private property ownership in space should be banned. To ensure that people of all nations would have access to a lunar base, it could easily be written into the land claims recognition law that any land claimed must necessarily be open to other nations. In other words, the owners of the land claim would be required to provide reasonable accommodations for visits to the areas of the claims and could not bar access under normal circumstances. Restrictions would only be allowed in cases where such access might create a physical hazard, such as preventing access to areas of the lunar base under expansion or construction, where safety issues might be involved.

In addition, article six of the Outer Space Treaty mentions that the activities of non-governmental entities require authorization and constant supervision by the appropriate government bodies. Compliance with article six requires private consortia that would attempt to build permanent facilities on the Moon to adhere to the requirement of governmental supervision of their activities (perhaps as overseen by the United Nations); however, article six says nothing about the validity of private ownership of property in space and does not imply that private claims would be based on sovereignty. It quite clearly states that a system of registration and monitoring would need to be implemented, not that a nation could own land, or that a private entity could not own land.

The bottom line: in an era when government-run space programs were the



Developing lunar infrastructure may require the extraction of resources from the lunar regolith. Perpetually shadowed craters at the Moon's south pole may contain ice, which, if made into water, could be very useful for sustaining life and could aid in power generation. This artist's rendering depicts a solar-powered colony near the Moon's south pole. (Source: NASA)

only game in town, the last thing on the minds of legislators when the United States ratified the Outer Space Treaty was a concern that the private sector might someday finance a mission to the Moon and establish a claim.

## Legal Framework for Land Claims

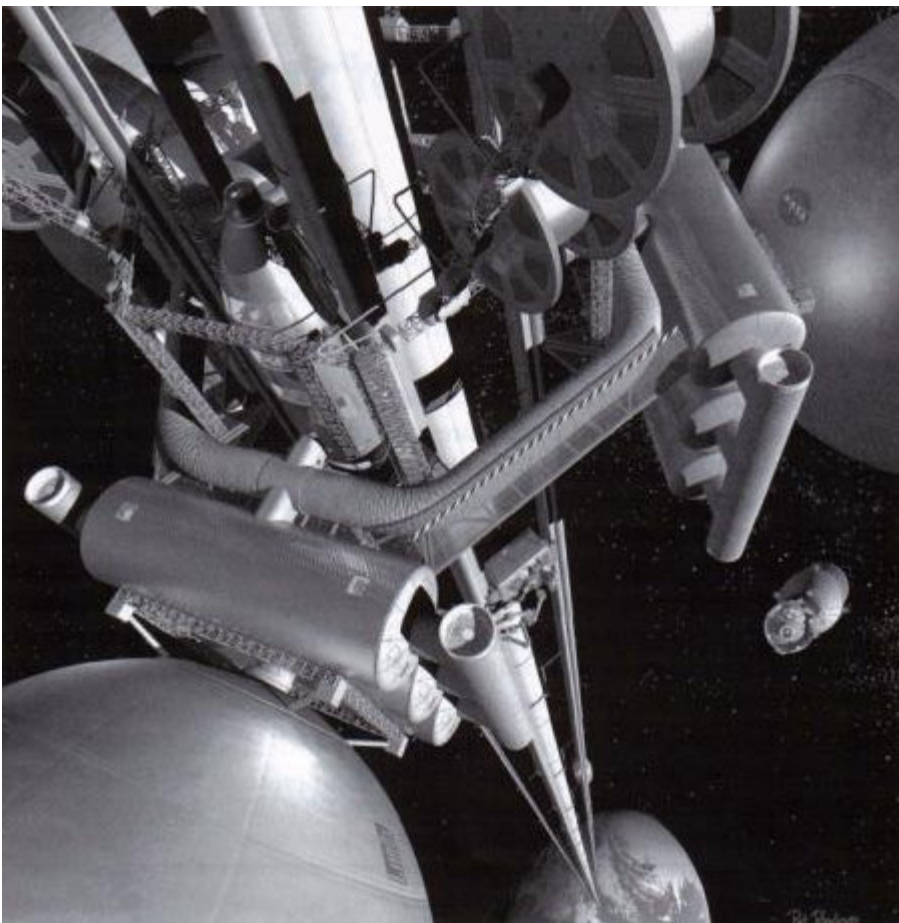
So if private property rights in space cannot be derived from a "gift of the sovereign," how can private land rights be derived? The appropriate legal framework for private land claims in space is the "use and occupation" standard from civil law. "Use and occupation" means the claimants, by establishing a permanent presence on the land, have mixed their labor with the soil and created property rights that are independent of government.

In civil law countries like France, property rights have never been based on sovereignty as they have in the United States (which inherited the common law standard from England). Even in the United States the line is not black and white between common and civil law; derivatives of civil law are used by states such as California, New York, and Louisiana.

"Use and occupation" must be the standard for any land claims regimen in space because the common law standard cannot be applied on the Moon, where sovereignty is barred by international treaty. Congress will have to decree that, because there can be no government on the Moon, a permanent base or settlement can give itself title just as though it were a government. Property deeds for land under its control will be recognized by U.S. courts of law, subject to specified limitations -- just as titles issued by France, China, and even Iran are recognized by U.S. courts.

### Needed: A Few Good Congressmen

Creating an incentive for private industry to finance the construction of expensive space infrastructure without imposing a huge burden on American taxpayers could be achieved if Congress were to pass a lunar land claims recognition law. The Space



*Governments are often seen as major supporters of new ideas for space. Proponents of a "space elevator," shown in this artist's concept, are hoping the U.S. government, through NASA's Centennial Challenges Program, will help to incentivize the development of a strong yet lightweight tether to support the elevator. (Source: NASA/Marshall Space Flight Center)*

Settlement Institute has developed a draft of such a law, called "The Space Settlement Prize Act" ([www.space-settlement.org/law](http://www.space-settlement.org/law)), which could be a starting point for Congressional debate. As proposed by the Space Settlement Institute, the law would give the first private entity to establish a privately funded, permanent lunar base and space line the right to legal recognition by the United States of the entity's claim to a piece of lunar territory about the size of Alaska, approximately 4 percent of the lunar surface. Each successive lunar base and space line established by other, subsequent private groups could receive recognition of a claim of 15 percent less land than the previous one (to place a premium on being the first to succeed in establishing a base). Such a law would ensure that, if all its conditions are met, U.S. courts will accept

private entities' claims and allow private groups to recoup their investments and make profits by selling deeds to parcels of its lunar land to American citizens, and everyone else, back on Earth.

It would be very desirable if as many other nations as possible joined in granting recognition. Therefore, the draft legislation strongly encourages reciprocal arrangements with other nations. Among the conditions that would have to be met to comply with international space law would be the requirement that the space line and lunar base be open to all peaceful, fare-paying passengers, regardless of nationality. U.S. recognition of land claims would be an open proposition, equally, to consortia from any nation, and, in fact, it is very likely that some lunar bases would be established by multi-national consortia



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and launched from non-American spaceports.

Without something like the land claims recognition law, it may be a very long time before the space infrastructure that space businesses will need is financed and constructed.

On February 10, Congressman Ken Calvert, the newly appointed chairman of the Space and Aeronautics Subcommittee of the House Science Committee, spoke before the Federal Aviation Administration's annual commercial space transportation conference. Calvert stated, "In 2010, the shuttle will be retired, so there is right now a need to move people into space quickly, safely, and reliably, I believe that need could be met in large part by the private sector.... The job of Congress is to pass legislation and exercise its oversight functions in such a way that will enable this industry to succeed."

In June 2004, the President's Commission on Implementation of United States Space Exploration Policy (also known as the Aldridge Commission) spe-

cifically recommended prizes, tax incentives, regulatory relief, and the assurance of "appropriate property rights for those who seek to develop space resources and infrastructure." It's hard to imagine a more effective way to help the private space industry succeed than by passing legislation creating a financial incentive worth billions of dollars to research, design, develop, and build vital components of the infrastructure in space.

And what would motivate Congress to pass a lunar land claims recognition law? Unlocking billions of dollars in private investment for the development of the space industry and space infrastructure would create an economic boom for this country in the aerospace and technology sectors. Untold new technology jobs would be created. More young people in this country would become interested in pursuing science as a career, inspired by a private industry race to the Moon in which they could possibly participate, just as the young generation was inspired during the Apollo era. An intensive effort

on the part of the private sector to develop space infrastructure will have many economic and societal benefits.

A catalyst like that which a lunar land claims recognition law would provide is needed now to jumpstart the development of space infrastructure. As Anita Gale points out, "The effect of adding space infrastructure will be like building a freeway in Southern California. After the first elements of infrastructure are in place, gas stations and restaurants are built at the exits, then hotels, and finally entire towns. After the first big spaceport or settlement is established, there will be a space construction boom."

We can only close our eyes and imagine - and then open them and get to work to make it happen. •

*Douglas O. Jobs* is president of the Space Settlement Institute, a think tank dedicated to finding ways to make space settlement happen in our lifetimes. ([www.space-settlement-institute.org](http://www.space-settlement-institute.org))