

Space Capital Podcast S01E01 - Commercial Lunar Ambitions with John Thornton Transcript

People have a hard time recognizing that, yes, it's one of greatest mankind's feats to have landed on the surface of the Moon so many years back. And now the idea the you could build a business there seems so far-fetched. But when you actually look at the numbers, and you look at the customers, and you look at the market, it's very much there.

Welcome to The Space Angels Podcast. I'm Chad Anderson, the CEO of Space Angels, which is the leading source of capital for early stage space ventures. Because this is the inaugural episode, I want to take a moment and properly introduce the podcast before getting into the program. This podcast is meant for Angel investors, people who are searching for not only financial returns but also meaning in their investments. I'm excited to bring you this podcast, because it gives me an opportunity to bring some of these conversations that I have with CEOs who are doing very big things in space and changing the course of humanity. I get to bring those conversations to you, and help you understand the real opportunities and risks in this sector. In each episode, we plan to provide context and information to help you make sense of this dynamic new industry, and we'll hear from some of the leading entrepreneurial space CEOs, thought leaders, and movers and shakers, anyone that's making waves in this market. We chose to launch The Space Angels Podcast on this, the twelfth of September 2017, because it's the fifty-fifth anniversary of President John F. Kennedy's speech at Houston's Rice University, where he announced United States' intention to land the person on the Moon within a decade. On that auspicious day, September 12th, 1962, in his speech, the President stated, among other things, that, "No man can fully grasp how far and fast we have come. If the history of our progress teaches us anything, it is that man, in his quest for knowledge and progress, is determined and cannot be deterred." He goes on to quote that, "All great and honorable actions are accompanied with great difficulties. And both must be enterprised and overcome with answerable courage." At Space Angels, it is our strongly held belief that, in our generation, the people who carry the mantle of this answerable courage are not only the young men and women who are risking their lives to go into space, but also the entrepreneurs who are putting everything they have on the line to build a future in space for all humanity. Much has changed since the days that the world governments held a monopoly on the space race. Today's space race is being led by entrepreneurs and Angel investors, as much as it's being led by government space agencies. And the mission of Space Angels Podcast is to bring to light the stories of these entrepreneurs and the private investors who fuel their growth. So, this is our inaugural episode, and I want to make a promise to you, our listeners, that in every one of these episodes, we are going to be speaking with a mover and shaker in the industry. Someone who is working on something big, who is shaping the future of humanity, who is helping to take humanity to space. And we're gonna ask questions that get to the heart of what you want to know as an Angel investor. As to what are the real opportunities and risks about these entrepreneurial ventures, before putting your money in. Our key thesis at Space Angels, is that there has never been a better time to invest in early stage space ventures, and we're gonna use these episodes to get to the heart of what matters. As an investor, what do you look for? What is the market opportunity? What are the real risks? What should I be looking at? These are the types of questions that we are going to be exploring and asking of our guests. And I'm certain that you are going to be enlightened by the answers. Without further ado, our first guest, John Thornton, CEO of Astrobotic. For anyone with their finger on the pulse of the entrepreneurial space race, it should come as no surprise that the Moon is becoming prime real

estate these days. As interest in investment in commercial space heats up, and as government agencies and commercial companies alike focus their attention beyond low Earth orbit, competition between multiple private companies looking to provide access to the Moon is creating a market for commercial lunar services. Back in 2013, we had a good look at the lunar market. And what we determined was that there was a lot of pent up demand. Since then, a number of announcements from Bigelow Aerospace, announcing an inflatable lunar habitat. Jeff Bezos, his Blue Origin company, announcing their Blue Moon aspirations to develop a lander for NASA to land on the Moon. And just recently, SpaceX, on their roadmap to Mars, has turned and looked to the Moon as a stepping stone. I'm really excited to welcome John Thornton to the podcast today. As CEO of Astrobotic, John is one of the most influential leaders in the entrepreneurial space sector. He's planning the world's first commercial mission to the Moon in 2019. And while we went to the Moon as a one off in the Apollo era of the '60s and '70s, Astrobotic is taking us back to the Moon for good by developing an economically viable transportation service and enabling a sustained human presence. So, welcome to the podcast, John.

John:

Oh. Thanks for having me, Chad.

Chad:

So, you want to introduce yourself to the audience?

John:

Sure. My name's John Thornton, I'm the CEO of Astrobotic. Our business is building lunar logistics. So, our goal as a company is make the Moon accessible to the world. So, towards that, we're building a DHL delivery service to take payloads from all over the world, bolt them up on our lander, and fly them up the surface. We've got eleven deals so far from six nations for our first mission, and we're excited to kick things off in 2019, which will be the fiftieth anniversary of Apollo and a perfect way to transition to the next generation of settlement and exploration on the Moon.

Chad:

Awesome. So, this obvious question, is there a market? And who is paying you, these eleven nations and these customers, and why?

John:

It's a great question. And it's one of those question that, if you talk to anyone down the street, walking down the street, and you say, "Hey, I'm gonna build a Moon company." You might get some crazy looks. So, people have a hard time recognizing that, yes, it's one of greatest mankind's feats to have landed on the surface of the Moon so many years back. And now, the idea that you can build a business there seems so far-fetched. But when you actually look at the numbers, and you look at the customers, and you look at the market, it's very much there. It's space agencies, and research institutions, and commercial organizations looking at early prospects for mining that make up the majority of the customer base. We have over a hundred payloads in our pipeline today from all over the world. These are space agencies that want to send science, and research, and exploration items up to the surface. Research institutes in a

similar kind of vein. And then we've got commercial groups that are sending mining precursors. Commercial groups that are starting new businesses around out service offering. And all in all, we're seeing a big market shift in the world, where the Europeans and Asians, and the whole rest of the world is really recognizing that the Moon is the next place to go. And what we're seeing here domestically, is that US space policy was reset with the election, and now we're seeing a strong shift back towards the Moon. And we think that's gonna result in a very strong domestic market that we're already seeing the beginnings of. And ultimately, it's gonna sync up perfectly with the rest of the world, and we're right on the cusp of a big market shift to be... a lot of lunar activities in space. So, all in all, that's kind of a shift that has opened up the opportunity for the Moon.

Chad:

So, what percentage of your current customers in your pipeline that you mentioned is government versus commercial, let's say?

John:

So, we're about fifty-fifty, in terms of government and commercial. Which is not that different compared to launch industry. So, you know, you look at SpaceX or United Launch Alliance, it's a mix right down the middle. I mean, just look at our payload manifest for Mission One, and we have mostly commercial on there at the moment. So, it's... we've got some groups looking for sponsorship and marketing opportunities. We also have some groups looking at exploration on this first mission, we also have groups looking to do some mining precursor kind of development. Space agencies are... maybe a little slower on the uptake on this first mission, but future missions they're gonna be the bulk of it for missions two, three, four, five. And then in the medium term, we're gonna see a transition where the Moon is gonna become more and more interesting for resource mining. So, extracting water, extracting the metals, extracting precious resources, and turning the Moon into a gas station or a waypoint in space to go to deeper destinations. So the market's really gonna be changing over time. It depends on where we're at in the market dynamic to who the customer's gonna be.

Chad:

That makes a ton of sense. And you're saying that in space, as we've seen in so many other industries, right, is that before there's a commercial market, a lot of what's being done is funded by the government, and the government is a key- well, starts as, you know, the only customer, and then moves into being a key customer, an anchor customer that we're seeing in space now. Still an integral piece of the new market dynamics. But commercial starts to play a larger role, right?

John:

Yes. That's absolutely right. The government's take- they take a key role in being the vanguard for establishing possibilities of new markets, then establishing the market itself. So we saw this in the launch with the Lunar COTS Program that NASA did. They recognized that commercial launch could be achieved for resupply to the International Space Station. And now they're using that same model with a program called Catalyst for the Moon. So, they're goal is to... to offer, commercially, they want to have the capability for US companies to offer payload delivered to the surface of the Moon. And NASA wants a hand in helping cape that technology and make

sure that it's a building block that they can build on and use and move forward. So the government takes a real key role in fostering that innovation for new markets.

Chad:

This is great. Because we're starting to touch on what really excited me about what's happening right now with your company and with space as a whole, right? So, all of this innovation is... a disruption in existing markets and creating entirely new markets. We're watching all of this, you know, business case studies, we're watching it play out in real time. And so, John, you and I have been talking now for a number of years, and... it's been really interesting for me to see. You know, in the beginning it was, "Those Astrobotic guys, yeah, they've got some great technology. But what's the business plan?" Right? And then, you come up with a business plan and they say, "Well, that's great, you know, that you've got a business plan. But who's gonna buy this thing?" And then somebody pays you, and then another, you know, somebody pays you. And then they say, "Oh. Well, that's great that you got some people to pay you. But where's the long-term, you know, where's the long-term market for this thing?" And then you see the European Space Agency, the new head of the European Space Agency come out and talk about the lunar village concept. And then you see ULA talking about the... Unite Launch Alliance... large launch provider in the US, talking about CisLunar space, the space, you know, between here and the Moon, and the lunar economy, and they're getting involved in putting real money behind this. And then you hear, you know, Blue Origin and SpaceX, and others, and everyone's talking about the Moon now, right? And so, this long-term market is finally starting to open up. But you've been involved since those early days when people would say, "That's a great new technology, but where's the business plan?" Right? So, how did Astrobotic come about, and why did you decide to get involved?

John:

All great ideas start as a crazy idea, and then someday matured and blossom into, "Why haven't we been doing that all along?" And we're right at that inflection point for exactly transformation. I think you described it very well. It's very, very exciting to see. And it has been an interesting experience with investors. If you compare our financials and our revenues compared to any other startup, there's no other startup than can show- well, there's not very many startups that can show the kind of revenues that we have where we're at. And we're a space company flying thing to the surface of the Moon, and I think it's hard for investors to wrap around that. But it all started ten years ago. We just celebrated our tenth anniversary this month in August. It started with the Google Lunar X Prize as a catalyst to get us going, and to get a space race around the Moon going. Originally it was just a prize and maybe more of a novelty to attempt to get a new business and new market going. So, we're kind of started back then. We focused on the prize, and then over time, it took about five years or so for us to, you know, work out some early company kinks and get our technology feet under us, and the really hone in on the business of selling payloads to fly to the Moon. So, in the last five years, we've especially grown substantially. We're up to eighteen full-time people here in the strip district of Pittsburgh. And we're off and running at this point.

Chad:

So you have significant revenue, and I think that's gonna be a big surprise to people that, you know, your, for one, that you're launching, you know, that you're a lunar transportation company

and you're going to be on the Moon in two years. And two, that you have revenue today. Right? Can you talk a little bit about, you know, without giving specific numbers and things but, you know, what are we talking about here? Is it thousands of dollars? Is it millions of dollars? What... what are we talking about?

John:

We're talking about millions of dollars. The majority of- well, the vast majority of the money that we have collected as a company has been in the form of revenue. So, it's- that's what we've grown the company on. Almost entirely revenue. And that's revenue from down payments from customers. It's revenue from technology contracts, and development contracts related to the Moon. It's money from- we won some Google X Prize money a little while back, and then we did take some, two and a half million dollars in investment led by the Space Angels network a few years back. But the vast majority of our growth has been the revenue side. And I think that is surprising and quite cool for us. And I think a lot of people might be taken... taken aback by that and surprised. But the way our business model works is that we take down payments and progress payments from every payload customer that flied with us. So essentially, the customer is helping us finance the mission. And what's remarkable is we haven't done one yet, right? And our customers are so excited about going that they're willing to take the risk with us. They're willing to pay for the alpha version of the product service offering. So, we're able to fly the first mission with a shared risk and demonstrate the technology that way.

Chad:

Yeah. So, the company's been around for ten years, and you're launching in 2019, in two years. You've got customers that are giving you millions of dollars in prepayments. And you haven't been there yet. So, how is it that you've convinced all of these customers to get onboard with... with Astrobotic, and view you as somebody that can get, you know, get their valuable payload to the Moon?

John:

That's a great question. And the way we approach this is it's our partnerships and our people here at the company that are gonna make this happen. So, first, is our partnership with NASA. We have a partnership for a program called Catalyst, where we have tens of engineers from NASA working on our program at any given time. They're goal is to stand up a commercial capability of flying payloads to the Moon, so that they can purchase it and so that the rest of the world can purchase it. So, NASA has a stake in the technology's success right there. The next is our partnership with Airbus. Airbus has a long, long, long history of great space flight. They're gonna be supporting our systems engineering and helping us also with landing legs for the program. And then, we have our partnership with United Launch Alliance, one of the most reliable launch companies in the world, that has a long, great history of flying payloads to the surface of the Moon. The vicinity. They have a long history of payloads to the vicinity of the Moon. So, if you were going to put together a team to create a business of flying payloads to the Moon, you'd get your best space agency in the world, you'd get a top aerospace prime that's been in space for... for decades. And then you get the best launch company in the world. And you put a wrapper on that with a young entrepreneurial approach that can kind of reset our approach to space. So that's the team. That's the sauce. That's how we're gonna make this thing happen. And

that's how we are very confident that the first mission is gonna be a success, and it's gonna be the first of many successes in the future.

Chad:

That is a beautiful thing. The fact that you're able to convince customers that you've got the right technology, the right team. There are a few others out there that are trying to do a similar thing, and... they're customers are deciding to put their money with Astrobotic to get them to the Moon. So, you just explained why customers are trusting you and your team, and your group of partners to take their payloads to the Moon. But what is it that has- that brought these established partners onboard? How did you convince NASA, DHL, Airbus Defence and Space, United Launch Alliance. I mean, these are all big names. How did you get these guys involved? How did you convince these organizations, you know, that you are the right team to partner with, and what does that mean for you guys going forward?

John:

I think there's a few key pieces that have attracted these world-class partners. I mean, the first is that we are out to build this company brick-by-brick by showing the technology and demonstrating good work. We've been doing that for ten years. You look at our track record, we have some the world's first demonstrations in several areas, including terrestrial visually guided landed, propulsive landing. So, we've been at the forefront of technical development. The second is that each of these organizations are seeing a huge opportunity in the lunar market. And that's motivated them to say, "Okay. Well, who's operating in this space? Who else is out there? Who can we partner with? How can we actually make our first step and make a big splash here?" And in, you know, looking at the landscape, they see us and our competitors, and we certainly stand out on the page. We're the only ones with the pipeline, we're the only ones with the customers, and it all kind of... it feeds on itself. One thing adds to another, adds to another, adds to another. So, it's about building that momentum and doing good work, and hitting your milestones at each step of the way. So, you have to demonstrate to these majors that you can hit milestones and take on tough things and accomplish them. And that's what we've been doing for the last ten years.

Chad:

So, you've recently announced your new launch partner, and I just wanted to understand, why ULA?

John:

So United Launch Alliance has been around in launching space vehicles for a long time. They are the proven, most proven, most successful launch provider out there. The Atlas, which is the launch vehicle that we're gonna be flying on, has an impeccable launch record. We're gonna be flying as a secondary, a shared space on that launch vehicle. So between their great launch success, high reliability, they also have a great pedigree for lunar missions themselves. It just kind of made sense to go with United Launch Alliance. They've also been very helpful in our partnership. Working with our suppliers and working with us to make sure that the lander is accepted into the launch vehicle, and it all works with the environment, and everything else. And they're also very keen for a lunar economy, as we've seen with their vision for the Moon and what the Moon could turn into. So, we see them as not only a first launch provider but also as a long-term partner in the development of the Moon.

Chad:

So, you are working with ULA as your launch partner. If they're launching you, what part of the mission are you doing and why is that the launch company can't just come in and do the entire thing themselves?

John:

So, what we are is we're- we are essentially like a last leg logistics approach here. So what we have is the launch vehicle gets us to space, we are a secondary vehicle that rides on top of that. Once we're in space, the launch vehicle lets go, and we fly the rest of the way out to the Moon. So, if you want to go to an orbit around Earth, you call up a launch vehicle company. If you want to go to the Moon, you have to call us, because we're gonna get to the Moon and we're gonna land down on the surface. None of the launch vehicle hardware is designed to land on the surface of the Moon. So we are that last leg logistics. So, we get the launch to ride to space, the lander to take us to the surface.

Chad:

So, this makes a whole lot of sense then, why DHL is involved, because isn't their- isn't that what DHL does? Is get your package, or whatever you're sending, to like the far reaches of the Earth?

John:

That's right. I mean, it starts at our customers door when they hand their payload over to DHL. So even road traffic. How do you transport it to the launch site can be an important factor? So, you've got to track all your loads and make sure you don't break it on the way. That's what DHL can help a lot with. And then you've got to survive launch, you've got to survive space, and you've got to survive a landing, which is even larger launch loads. So, DHL has been in the business of logistics for a long time, and they know how to do this business very well.

Chad:

Let's say that I'm a customer, right? So, I have a rover or something. And I work with you, and then we get to the surface, and then you deploy, you know, my rover on the lunar surface. Then what? Are there other services that you guys provide? Am I on my own from that point? You sort of drop me off and it's up to me, or how does that all work?

John:

Yeah. So, once you land on the surface of the Moon with us, it depends what kind of payload you are, in terms of what the next steps are. But on the surface, we offer communications and we offer power for payloads that come with us. So, we become the local infrastructure. So, payloads that want to drive, so maybe a rover, they will drop off the lander and drive away. And then they'll use our Wi-Fi connection, literally Wi-Fi, to send their signal to the lander, which will then send that signal back home. If you're a payload that wants to stay connected, maybe you're a telescope or something that's looking down at the soil, you can use the power from the lander to operate your... your system. So really it depends on what kind of payload you are, what the needs are, but essentially, we are a one-stop logistics and infrastructure support for anything Moon.

Chad:

Wi-Fi on the Moon. So, is that your next partner? Verizon? Or what do you have in Pittsburgh?

John:

It should be the next partner. Whoever's gonna be the communications connection from the Moon is gonna have a very big presence on this mission. Everything coming back from the Moon in this mission will be phenomenal. It will be the kind of imagery that has never been seen before. And the experience will be something really original and amazing for folks. And anything that any company that's associated with that video or streaming could be very well positioned for being a part of a big piece of history. Something that millions and millions of people will be watching.

Chad:

On the technical piece. I'm curious, in terms of your progress, right? Can you talk about your last big technical milestone, one that you are proud of? And what's next? So, what's the next big technical milestone that you're looking forward to?

John:

One of our recent technical milestones was flying a propulsive vehicle and landing it for the very first time autonomously using just vision systems. So, this is the first free-flying propulsive lander ever. We beat JPL to it. They did it a few months after us. So, what this is, is we took a propulsive vehicle that existed already, and we put our controls and software in charge of the sticks. So, we told it where to fly and where to land. So, we said, "Okay. Here's our landing sites. We're gonna pepper an area with rocks, and we're gonna leave an area open, and we're gonna pepper another area with rocks." And we said, "Okay. Lander, figure out where the safest spot is and land." And it landed right on the clear spot each time. So that was a huge success for us. So, we're gonna be refining that, miniaturizing that, and preparing it for our mission. Our upcoming big milestone is our preliminary design review coming up in mid-September. That is a major, major milestone in a space development program. This is where you have fully defined every sub-system, every component of the spacecraft. And you go through it with a fine tooth comb with all of your major partners. So, we're gonna have more than thirty NASA folks involved at various stages. We're gonna have folks from Airbus, folks from United Launch Alliance, and others combing over our system, making sure that we've found all the errors or mistakes, or anything else, make sure all of that's out and we've got a clean system heading into our next step.

Chad:

So, obviously, you know, the purpose of this podcast is to help investors understand the risks and opportunities and identify some good deals. So, what does it look like for an Angel investor looking to get a return from Astrobotic?

John:

Well, the first thing I would say right out of the gate there is that, whoever is investing in this next round for Astrobotic is looking at about a thirty-six X return. And that's based on projections from just sales of our payload pipeline right now. It's- Exit opportunities are hopeful. First is that you could have a sale to a major company. We are seeing Blue Origin and SpaceX, and other aerospace majors, increasingly focus on the Moon. That is great for the market, it's also great for the possibilities of M&A activity for us out of the futures. We're very, very excited to

see that. The other is that our margins are very high for our missions. So, each mission makes a fair amount of money for the company, so we could potentially even just do returns and dividends. And then owning a long-term stake in the future of humanity.

Chad:

What are the timeframes on those look like? I mean, at what point do you think that Astrobotic would be an attractive acquisition target to these large companies? Or at what point do you think you'd be in a position to returning capital in the form of dividends?

John:

We believe that we'd become interesting as an acquisition as early as after the first mission to the surface of the Moon. It is such a unique capability that no one else in the world, other than China, has done in the last few years. It would put a leg up on any aerospace prime looking for a major Moon-related contract. So, it'd be an easy call at that point. So, any time after mission one, I think that possibility is there. I think the odds increase if you can do it twice in a row. In terms of dividends in maybe the outlying years, we would want to make sure that we'd have strong cash reserves before we started doing those kinds of dividends. So, that might be mission three, mission four or five. And that's about six years- six to ten years out for the dividends side. Acquisition we could see two to three years, shortly after the first Moon landing.

Chad:

For anyone paying attention, there is a lot of focus on the Moon right now. Whether it's, you know, big names. Bigelow is talking about building a lunar habitat, the European Space Agency, as we talked about, with their lunar village concept. The lunar stuff that ULA is working on. Most recently, Blue Origin has come out, we've heard news of them talking about a Blue Moon mission with NASA. SpaceX is reevaluating their Mars plans, how they're gonna get to Mars, and they're now considering using the Moon, it sounds like, as a stepping stone. Which a lot of other people have been saying for a while. How does Astrobotic fit in within that landscape? And how does your product offering, your service offering, compare to these other players?

John:

Yeah. So, that's a great question. And I think there's an important distinction to be drawn there. SpaceX and Blue Origin are building very large-scale payload delivery capacities for the Moon. Blue Origin, with their Blue Moon program, has been much more vocal. They're on order of tens of thousands- about ten thousand pounds. Much, much larger. We're talking hundreds of pounds for our capacity. So, there's room for two different scales. Just like the launch vehicle industry. You've got the super heavy lift, and then you've got the smaller vehicles. Which tends to, at the moment, have the big momentum in the market. So, we're really focused on that smaller scale, numerous customers on a single lander that's, you know, coalesced on it. And we've... that's really the big difference between us and Blue and SpaceX. The good news is that, with Blue Origin and SpaceX in the mix now, it's a great signal that the major players are out to make money on the Moon. And they want to stake their plot on that corner lot.

Chad:

That's exactly, yeah, I mean, that is absolutely a strong market signal. To see these big names and these, you know, these big players getting into... to this market that we've been saying, you

know, for years is... is a big opportunity. And so, curious, you know, tens of thousands- ten thousand pounds of payload with Blue Origin, hundreds of pounds with Astrobotic. What types of things are they taking? What types of things are you taking?

John:

So, our approach is to take, at several pounds at a time, we're gonna take science instruments, exploration instruments, rovers, and some marketing experiences. And even small companies that are building everything from virtual reality experiences to people that are burying human ashes on the surface of the Moon. All things in between there. The Blue and the SpaceX approach, what they require is a much greater range in space policy, in general. Their approach is betting on European Space Agency or NASA, or any one of those, making a big policy bet on the Moon. Our approach does not require that. There is a market out there today for what we have. And we don't need to have any one of these agencies make a big change. Of course, it's great if they do, and we will be right in the mix if they do. But it doesn't require that. Our pipeline, as it stands today, is over a hundred payloads in that pipeline. We're approaching one point five billion dollars.

Chad:

Alright. So, when you and I first started talking and I started getting really, you know, onboard with what you guys were doing, you and I had a conversation. And it was, when you go outside at night and, you know, when you're talking about the Moon all day, and, you know, you can feel how close it is. And then you go outside at night and you see the Moon, all of the sudden it feels like it's a whole lot closer. You know? I mean, it doesn't look like this distant thing. It's like, "We're going there in two years." And that's a really cool feeling. And I'm just on the periphery, right? You live and breathe this thing every day. So, I'm really interested to hear where you think we're going. So in five, ten years from now, what does the Moon look like? What are we doing with it? What kinds of commercial activities are happening there? Who's the players? You know, what's your vision for the Moon in the next ten years?

John:

Our goal, as a company, is to make the Moon accessible to the world. So, the next ten years is about making that possible. We want people all over the world to have that same feeling when they look up at the Moon. We want them to feel that it's closer and feel that it's a part of humanity, and a part of what we're doing here as a species. And that's what it can be, and that's what we see in the future. It will be a destination that we will learn to live off the land. So, it's the closest celestial body to Earth. We're gonna learn to grow food there. We're gonna learn to turn the dirt into 3D printed material that we can create things with. We're gonna learn to manufacture things in microgravity that can be extremely beneficial, to potentially send back here to Earth. We're gonna learn how to 3D print our habitats and homes. And we're gonna use all that capability to learn how to live off the land on the Moon to then learn to live off the land on Mars, and further and further into the solar system. And maybe even outside of our solar system. And it all starts with the Moon. Some big drivers that are gonna power that, that we're gonna see the beginnings of in the next ten years, is the first big economies in resources. We think that first driving resource is gonna be water. And it's gonna be a major commodity like oil is here on Earth. And it's gonna power space transportation and development. If you have water, you can split it, and you have oxygen so you can breathe it. If you split it, you have oxygen and

hydrogen. And if you... you can condense it down to liquid form and use it as rocket fuel. So, water in space is incredibly valuable. And it's very valuable on the Moon, because if you work out the physics, it's very expensive to fly things from Earth up to space. But if you can harvest it from the Moon, it's very cheap to get that same material up into space. So the economics work out.

Chad:

And there is water on the Moon, right? I mean, I don't know if you're paying attention to the news. It was, what? A month or two ago. I mean, we knew that there was some water on the Moon. But now we've found a whole lot more of it.

John:

That's right. Yeah, the water on the Moon has been an interesting story. When the Apollo astronauts landed, they reported that there was no water on the Moon. That is was dry as a bone. But it's kind of like landing in the Sahara here on Earth and declaring that the entire Earth is dry. What they found out through a series of missions and impactors and experiments, is if you go to the poles of the Moon, there are vast, vast quantities of water. Some people think that there's great lakes worth of water at the poles of the Moon. And what naturally occurs there is there's permanently shadowed craters. And that's important because they create cold traps. So, they're ultra, ultra, ultra-cold in a vacuum. So, when you have an icy comet that hits the Moon, that ice is captured in that cold trap. And over billions of years that adds up to a lot of water stored in the form of ice crystals at the poles of the Moon. So, if we can get there and we can harvest it, it can be incredibly valuable for space exploration, transportation, and even in orbit transportation and station keeping for satellites.

Chad:

So, ten years... is a decent amount of time, right? And... and a lot has changed. I mean, even the last five to eight years in space. I mean, it's almost unrecognizable, right? So, considering the dynamic environment that we're in, ten years is actually quite a long time. So, what have you learned over those ten years, and how has your trajectory, your company's trajectory, how has it changed? For instance, the X Prize, your involvement in it, your graduation from it. Your decision to go from the Griffin Lander, that you originally envisioned, to the Peregrine Lander today. These are the ones that I'm remembering off the top of my head. So, you know, what has happened, from your perspective, over the last ten years?

John:

Yeah. A lot has happened over the last ten years. I mean, the biggest is that the market trends are shaping up beautifully on the whole. I mean, ten years ago, we were too early to be the business that we are now. We are seeing is a huge trend in space towards small spacecraft and small payloads. That was the big primary driver between scaling down our Griffin-class Lander, which is on order of about a thousand pounds to the surface of the Moon, down to a Peregrine-class, which is on order of about five hundred pounds to the surface of the Moon. That smaller scale makes it easier to close the mission with numbers of smaller payloads, while still keeping the margins up high. And it also makes it easier to get our first mission off the ground. It flies as a secondary, rather than a primary. Meaning that we share a ride to space, rather than taking the entire launch vehicle. And that kind of opens up a lot more flexibility and a lot more launch

opportunities, and a lot more flights to space. And then, with the X Prize, we started our company chasing the X Prize. That was the whole point in the very beginning. And then over time, we realized that the X Prize is not the end. It's not the end game at all. It's a stepping stone if we could win it, and if it didn't line up, fine. The bigger win is the business. And that's ultimately what we realized at the end of 2016. We said, "Okay. Well, the X Prize is expiring in 2017. You know, we're on track for 2019. We've got customers and everything else lined up for it. Let's separate. Let's focus on the business. It's time to step up and make a real business out of this." So, in the last year, we hired about ninety years-plus of space experience across several different hires. Our mission director now is a twenty-five year Lockheed Martin veteran. You know, has put thirty-plus things up into space. Our systems engineer is another twenty-five space industry veteran. He's been a significant part of thirteen space missions to all various destinations, including the Moon. So, we've really stepped- We're ready to address the market as we see it.

Chad:

So, our audience includes a lot of would-be CEOs and space entrepreneurs, as well. So, as now a seasoned aerospace exec, what advice would you give based on your ten years of wisdom?

John:

Space is hard. And you have to love it. And that's just so important, because it's hard enough to start a business, it's extra hard to start one in space. So, you have to be passionate about what you do. You have to have that passion to get you through the lowest spots, because they will come and they'll come in more ways than one because it's technically difficult and, you know, challenging to build a business in this. So, it's really, you've gotta have the passion, you've gotta have the steadfast approach to just, you know, take it day-by-day and build each day. So, that's really the core to making it in the space industry.

Chad:

This is all very exciting stuff. And so, how can people follow your progress? And how can they watch the launch and the landing in 2019, and how can they follow along?

John:

Yeah. So, you can follow us on our website, Astrobotic dot com, and we have regular news releases there. You can go on Facebook and get the more daily, or weekly, updates on what's going on. We just unveiled today that we've got a new mission video with United Launch Alliance flying with us onboard. It's quite a cool video. So, I'd have people check that out. So, just follow us, check us out on Facebook and on our website, and track the updates as we go. It's gonna get pretty exciting with the lead up to 2019. And the launch and the landing, and the whole thing, you will see us in the press, you will see us in the news, you will see us streaming. There will be all kinds of ways to interact with the mission, and what an exciting one it's gonna be.

Chad:

So, the mission will be streamed?

John:

It will be streamed. It will be broadcast. It'll be on all kinds of different channels. We just made a deal, one of our payload deals with Atlas Space Operations, and they're gonna be providing a laser communication link between us and Earth. So, what that is, is it's about a thousand times faster than what we were previously planning for communications. So, it enables a thousand gigabytes per second, which is- Or sorry, a thousand megabytes per second and one gigabyte per second connection. What that allows us to do is streaming HD video and pictures, and potentially even a virtual reality experience from the Moon. So, we will definitely be taking advantage of that. And, you know, it will be exciting to see all the products that come out of it.

Chad:

So, we always say, at the end of all of our blog posts, that there has never been a better time for an Angel investor to invest early stage space companies. So, John, my question to you is, is that true? And if so, why?

John:

It is true. And there's a few big things that are making that true. First is that we're at the very beginning of a huge seat change in space. And it's early enough right now that not every one of the major institutional investors and major big players has recognized it yet. But it's developed enough where there's real opportunity with real near-term returns. So, this is a perfect sweet spot for Angel investors to grab ahold of huge markets that are gonna be popping up. Everything from Earth orbit and observation, all the way out to the Moon. There are huge opportunities there. So, it really is the right time for Angel investors to get into space.

Chad:

So, if you were going to write a value proposition for the entrepreneurial space industry as a whole, what would that be?

John:

I think the first is that there are very real returns in space. Very real market opportunities. And that is a really important one, because a lot of people are new to space. They're not familiar with it. They still think of space that Apollo and NASA is all about, which is a very dated... that's decades old thinking about space. So that's the first, is that there are places to make real money. And then the next, if you're investing in space, you're investing in the future of humanity. And I don't mean that lightly. That is absolutely true. It is- Space is our future. It's where we're gonna learn to live off the land of other planets, it's how we're going to become a multi-planet species, it's how we're gonna maybe find life in this... in the universe. So, it really is, you know, pushing humanity outward, discovering the unknown, and finding out what could be there and how we can use that back here on Earth. And the fact that there are businesses built around that, and you can actually make money investing in companies that are building those stepping stones is phenomenal.

Chad:

So, John, this has been fascinating. The Moon is a whole lot closer than you think. Companies making money today and people living and working on the Moon, and using it as a step stone for deeper space missions. Following it all in ultra HD, streaming from the Moon. I mean, this is all really good stuff. Thanks very much for joining us today, John, appreciate it.

John:

Sure thing. Thanks for having me, Chad.

Chad:

Thanks for tuning in to our inaugural episode. I am certain that after that interview with John, you're gonna want to learn more about becoming an investor in early stage space ventures. So, I wanna invite you to visit our website, Space Angels dot come, where you can learn all about Space Angels membership and how you can get involved in this exciting new sector. And before I sign off, I just want to put in a plug for our next episode. Make sure you tune in, we've got Jeff Manber, CEO of Nanoracks, on the show. He is one of the most influential leaders in the entrepreneurial space race. And he's gonna be speaking to us about commercial space stations, replacing the International Space Station, and all the exciting things that they've doing with their company. These guys are literally shaping our future in space. You're not gonna want to miss this episode.