

**Jacob Morgan** 00:00

Now I'm just push recording. I'll just jump right into the first question, if that works for you. Sounds good. Do you have any questions that I can answer for you

00:07

before? What's that? What's the target audience? How big is the audience?

**Jacob Morgan** 00:12

So we get 100,000 downloads every month for the show, it goes out to around 353,000 people on LinkedIn. So goes out everywhere. A lot of people subscribe and listen, a lot of business leaders and business professionals, but I've been trying to pull in a lot of insights from fields outside of business that leaders could learn from. And there's a lot of stuff that I found that you've done, that would be very relevant. So I've had like the world's number one chef as a podcast guest talking about innovation and creativity. So I'm trying to get people to learn outside of their their comfort zone, so to speak.

00:49

I just want to make sure that Do you hear a little bit of delay from time to time your your recording on your recording on my computer? Right? Is that correct?

**Jacob Morgan** 00:57

Yeah, everything's recording directly on your computer, and then it'll upload every good cloud,

01:03

then I'm not worried. Okay, good. Okay, go ahead. Whatever you want.

**Jacob Morgan** 01:07

All right, then I'll jump right in unless you have anything else. No, that's it. All right. Thomas, thank you for joining me on the show.

01:15

So glad to be here.

**Jacob Morgan** 01:17

So first question for you. Maybe you can give a little bit of background information about what you do. And the organization that you work for in our present, because I have I've had a lot of really interesting guests on the show. But I don't think anybody quite like you yet. So if you can give us a little bit of background information about you, and I guess your company is you could say that would be great.

01:38

So I'm the, what they call Associate Administrator for the Science Mission Directorate. That's another way of saying I'm the head of Science at NASA. So as part of that I'm running close to a third of the agency, a little bit less than a third of the entire agency. And basically, everything that encompasses science missions are you look at them, there's 140 or so missions, the big ones, you may know the Hubble Space Telescope, James Webb Space Telescope, perseverance, lander, but then also,

missions that are, you know, all the way to the Voyagers that were launched in the early 70s. And Earth science missions. So what my our organization does is both running those missions, deciding on which ones are the next ones, but also den, supporting the research and analysis and technology programs that both analyze the data from these missions, but kind of develop the technical foundation for the next missions.

**Jacob Morgan 02:35**

And it's, it's a pretty cool job to have. How many employees are you responsible for? And how many are the company?

02:42

So here at headquarters overall, and that's our headquarters, we have close to 400, who are just basically kind of if you want the leadership team, if you look at everybody who's kind of in, kind of that we're supporting and that our matrix to it. In our programs, it's closer to 10,000.

**Jacob Morgan 03:03**

Wow. Well, I thought we could actually get started first with some non business questions. Because I'm, when I was younger, I was very fascinated with with space. And the other day, actually, my wife and I were laying outside and we were looking at constellations and trying to point things out. So I'm really interested specifically, obviously, the James Webb Telescope received a lot of attention lately, and I saw some interviews that you did fairly. I think recently, over the past few weeks, where you talked about that light from the James Webb telescope, was received over 13 point 1 billion years ago. Does that true?

03:39

Right, that's absolutely true. Some of them even earlier. Yeah.

**Jacob Morgan 03:42**

Wow, that's crazy. So does that give us more context around how old the universe actually is older than we thought.

03:51

So we know quite accurately how old the universe is. And frankly, we figured out from spacecraft that NASA built are no longer operational right now and actually got Nobel Prizes, one of them our NASA colleague. And so the way we do that is really look, if you want the, the leftover sound, kind of the echo of the Big Bang, which is the background radiation that that is out there, and really is in printing, if you want that kind of the fingerprint of the Big Bang, which is at 13 Point 8 billion years ago. So that's kind of the beginning of space, the beginning of time, is where that is, and the meantime, the universe has been expanding, and has been expanding kind of the way that frankly, keep surprising us. And what we're really trying to learn with the James Webb Space Telescope is going back to the first generation of stars and galaxies because the stars that are in our environment, you know, and we are kind of even our star in our planetary system. I came from stars that were I had, you know, kind of the way I always talk about it, I look at the rings on my hands I one of them is gold. The other one is platinum. They these materials we know now with very high degree of certainty come from merging white dwarfs that

that are kind of kind of leftover stars that that are sorry, neutron stars, leftover stars that are coming together and create new materials. So kind of my point is we're made out, every atom in our body is at least a billion years old. Many of the atoms older hydrogen, much of the hydrogen is over 13 and a half billion years old. So we're trying to see that first generation of stars.

**Jacob Morgan 05:42**

It's crazy when you think about that. Human civilization is just such a tiny blip on that radar of, you know, 13 point 8 billion years. And it's interesting, because the other day, I have a six year old daughter, and she likes to read space books, and she's really interested in black holes for some reason. And the other day, she was just asking me like, Daddy, what if there's a black hole in my room, and we all get sucked in there and disappear, and I have to like, calm her down and tell her that she's not gonna get a black hole in her bedroom, while she's sleeping. But what attracted you to to science? And to space it? How did you get involved in this realm?

06:22

That's a really good question. And of course, as a very highly personal one I grew up, you hear from my accent and, and Switzerland and Swiss mountains, and a really small village, a small farm village, and frankly, for me to the sky was really a place I like to look at it was it's beautiful, it's wonderful. The more you read about it, the more beautiful the night sky gets, the more you observe it, the more amazing it gets. And I always looked at the sky and and wondered about looking at the sky from somewhere else. Because Because I grew up in a highly religious community, but also in a small town. I really always knew I wanted to move away, both emotionally but also geographically move away. So for me, the night sky was always the place that was kind of the anchor going off from moving me away. So So I started being excited about it, I took over the library, I think in fifth grade, and just started to read some of the science, you know, sections from left to right, including physics books, and, and I never really had the confidence of being able to study that. But I was encouraged by a teacher Finally, after being discouraged a number of times to go study science, which is what I did, and that's how I became an astrophysicist.

**Jacob Morgan 07:43**

Interesting. So I love that it was a teacher who encouraged you to go into that field. And ultimately, you know, I guess you could say, changed and shaped your life. Right? Because had she not done that, or he not done that you probably wouldn't be in the in the space that you are. But how much of this was about curiosity? You know, I think a lot of a lot of leaders out there curiosity is something that we talk about quite a bit, but I don't think we spend enough time actually cultivating. And so what does curiosity mean to you? And how important was that in your career trajectory, as you became, you know, one of the top executives in NASA.

08:22

So it's really interesting. At the beginning, I would say it was one of the most curious people whether it's looking at the sky or looking at the books, reading them, and kind of, frankly, I read a lot of exploration stories I you know, like Magellan and you know, Columbus all stories that of, of people who did unusual things. I just, I love that. And then what happened, I realized that it's kind of as I went through the school system, I kind of asked viewer questions, and I had to really focus on that again, because I

really believe ultimately, Curiosity is really the fuel of innovation outside of asking questions that are out there kind of reaching into the future with a question or thinking about something that is not yet or is even in the realm of what many people consider crazy. Asking questions, and that space is what ultimately creates a future, you know, that we can manage to pull into the, into the realm of reality, through hard work and, you know, creative solutions, and I believe that curiosity for people like me, but also I've seen it in, in business leaders and elsewhere, kind of kind of many of them my sons get off. It's really interesting. You go into a roomful of CEOs, and you realize how many of them have already read the papers because that's what drives them. And they know that common trade, I just believe often is common to do very effective leaders.

**Jacob Morgan 09:53**

What are you still curious about? So if there were some questions that you could answer them where you can find answers to in regards to space or you know, anything outside ever? What are some of the things that you would like to know the answers to? What are questions that you're still curious about?

10:12

So for me, the first question that I spent a lot of time on here at NASA, and we put a lot of missions and play, is there life elsewhere outside of the earth? You know, it's not a question that we made enormous progress in the last 20 years, right. 1995 was the first observation of planets on the outside of the solar system. In the meantime, we know that basically every star we're looking at has at least one planet. By the way, we learned that five years ago, just so you know, I mean, get off day, we also learned about some of the kind of evolution processes already talked about, you know, neutron stars, and how they relate to gold and platinum, and so forth. But, but we learned all about this. We learned about water on Mars being important in the past, during the time when life formed on Earth, we also learned about oceans and outer worlds. So for me, the location of lives have multiplied potential lives, but we haven't proved that it exists elsewhere. So for me, that's one of them that a corollary to that is to intelligent life elsewhere. And I think it's a really good question to ask, and I don't I mean, we don't know on that clinically, that there is but we'd like to know.

**Jacob Morgan 11:27**

Yeah. And I liked the distinction between life and intelligent life. So life could be something like I don't know, an amoeba bacteria, just something and intelligent life, obviously something that can, you know, think, like humans, and another another, another part of the universe or the galaxy? What is your hunch? Tell you? Obviously, we haven't proven that intelligent life exists elsewhere. But deep down inside, if somebody were to ask what what do you think? What do you what do you internally feel about that question, what would your answer be?

11:57

So relative to life in general, I think it's a matter of, I believe, I cannot prove that it's a matter of when not if there's life elsewhere, we just need to go find it and prove it to ourselves. And I feel frankly, the same way about intelligent life I just really having a really hard time. And I think Carl Sagan said it right? In his book contact, right will be an awful waste of space. See, the universe is even bigger now than when Carl Sagan left this earth relative to what we are understanding. And the image is on James Webb like

that. There's many, many, many more early galaxies than we ever thought. And so for me, a will be hugely surprising if we were the only ones.

**Jacob Morgan 12:40**

Can you give us a little bit of context around it? How big is space? So we obviously we have galaxies, we have universe, but you know, and even I, sometimes I use that interchangeably without knowing the difference between a universe or a galaxy. How vast is space? How many stars? How many galaxies are we talking about there? Just so people can understand? How expansive everything outside of Earth really is?

13:06

Yeah, so So let's start with our solar system, right? You know, there's a sun, one star and a metal, and there's planets start with mercury all the way to Neptune. And there's a lot of small planets out there with Pluto and so forth. In that, in that system, these few planets that fit on two hands, right, kind of the ones with names, there's probably six or seven locations where potentially life could exist, because they're standing water or they used to be water like Mars. Okay. So there's one star. So if you manage to pull the camera back, the next big unit is a galaxy, our galaxy is called the Milky Way. There is between three to 400 billion stars under Oh my god. So basically, so it's a lot of them, right. And then so that's one, by the way, each one of them has at least one planet. We already proved that probably more. And so that's how many times just in our own galaxy kind of life, possibly can evolve. So you basically say how many galaxies are there? Well said, I'm going to give you the answer. The answer is another two to 300. Sorry, 300 billion galaxies. But let me give you the answer a different take a straw, drinking straw, and pulling it to the kind of darkest place in the sky. There's no star there. It's just as stark with your eyes. If you had a telescope like the James Webb Space Telescope, in that little space, another way of doing it is put sand, a grain of sand on your finger and put it up into the sky, kind of whatever you cover, in that are 1000s of galaxies all the way land up in time and light that if we could put a telescope up there, just arrived it left that galaxy 10 billion years ago. 13 billion years ago, 5 billion years ago. And so there's 1000s of galaxies in that space. So again, it's hundreds of billions of galaxies, each one of them hundreds of billions of stars. So you mentioned and that's one universe, that's one universe together. And the question is, are there many universes and frankly, we're arguing about there are other universes that are parallel that are there, for example, we see so much matter, but very little anti-matter, whereas organic matter is during an antimatter universe, so we're having discussions about it. So that could be many of those. We just don't know when we couldn't we can prove it at this moment in time.

**Jacob Morgan 15:40**

You mentioned Pluto, right? Pluto got demoted from being a planet, right?

15:46

Yeah, you know, so Pluto is a dwarf planet, you can call it a planet. I'm not offended, offended by it. But but you know, like the wait, this is one of those things, you know, like, suppose we knew everything we knew today? Would we have called Pluto a planet? And the answer would be, why would we call it a planet? There's so many other bodies that are similar in size, and so forth. Perhaps we call all of them

planets. But you know, and I usually get really uninterested in labeling things. It's beautiful acid is no matter how we call it.

**Jacob Morgan 16:17**

So how far out exactly can we see? So obviously, the James Webb telescope, I think that's the telescope that allows us to see the forest. And so how, how far out are we talking about as far as our ability to see like, the images that we're capturing from the James Webb telescope, how far out are those images, those galaxies, those planets and stars.

16:40

So I'm going to use the dimension of time, because that's easier to talk about than the dimension of space, because otherwise, I need to talk about more space, which you know, like, so even though it kind of it's a much farther than he would have guessed, than, you know, because space has expanded in the meantime. So what we can do, just to give you a feel, right, kind of to get to the edge of the galaxy is like, you know, all the way kind of across the galaxies like 100,000 deers, so the light can go on, base come out the other side as 100,000 do. So to give you a comparison, for light, if you look at the sun right now. And you see light that light left Assan, between eight and nine minutes ago, so, so time and distance relate to each other, again, 100,000 years across the galaxy here, so so we can go up to right now we believe there's publications with the new James Webb Space Telescope up to 13 and a half billion years back in time, so it's close to 300 millionaires after the very beginning, right. So get over it really is the first generation. And we're just, by the way, this is just the first data we've taken, we have not even tried to go as low as we possibly can. But that's where we are kind of between 300 to 500. Millionaires, from the very beginning is where we see the first galaxies now. And there's this red specks that are there. And, and frankly, a lot of people are excited worldwide about these red specks

**Jacob Morgan 18:12**

not to kind of geek out more on science. And people listening can probably tell it I get very excited about the space stuff and learning these things. If you can even see to the beginning like past 13 point 5 billion and get to 13 point 8 billion I kind of the beginning, what would you see at the beginning, if you could.

18:31

So what you would see at the beginning, as I normally release kind of a ball of energy that releases into space going off as a ginormous release kind of minutes after that, that energy you can be many kind of high energy particles would form into the first atoms, you know, 10s of minutes later, the first atoms especially hydrogen, helium can have very light atoms will form and it stopped bases together with some contributions we call something we don't really understand fully. And not to scare your, your little daughter, but the dark matter is what that what that material is called that it's gravitationally also there. It's there at the beginning. And by the way, the theories that are out there based on on web the first web observations there's some theories and very narrow type of theories that this gaining some updraft which has not been proven, but it actually says that actually asked matter forms early on that could be very small black holes, black holes that are generated much early so dark matter in this model would very much be focused on black holes. So there may be a black hole in the solar system somewhere right so it's a smaller one, but that not not in the room of your daughter but you get the point kind of a

lot more abundant by calls are usually in the center of galaxies, but it may very well be that black holes were there first and Ben galaxy so so there's stuff we know instead If we don't know all of it happens in the first 1015 minutes or so. And then after several 100, millionaires, stars for Master matter falls on Twitch outer and start lighting fusion.

**Jacob Morgan** 20:11

That would be amazing to see as far as images with with a telescope, I'm sure that would change the history of science forever. You know, there's also been a lot of talk. Some people say, oh, you know, we're living in a computer simulation, maybe there's parallel universes, when you hear those types of things? Do you think that there's any possibility for those scenarios? As far as parallel universe? This is just a computer simulation? Or do you kind of just laugh at that and say, that's, that's just crazy.

20:42

Oh, I don't buy that. I think it's very much reasonable. That could be the case. I don't know. I mean, it's, it's kind of the question is, how do you prove it? Yeah, I think it's, look what we're doing. Like, like, the question is what reason? When we think about nature, right? I mean, everything I just told you, that we know today about the early universe, if we had that discussion, 100 years ago, people would laugh me out of the room. And we've proven these things, right. And if we've proven these things, some of these things we've proven even I did my PhD in the late late 90s, the models that we had is up to 100 stars, in 100 stars, or so one of them will form planets. Absolutely wrong. Every one of them on the average, will form planets, right? So it's kind of so the thing is, like, we're learning kind of what's really important about the difference between science and, and, and some other belief systems, right, is we keep learning and there's things that now are correct, that used to be wrong, or they're now realistic, that used to be crazy. And so for me, when somebody comes up with, Hey, we may be in a simulation, or a there's other universes, as first of all the models look quite promising for some of this stuff, string theory and other models. But, but I can't prove it. So it may be in the realm of a little bit crazy or not, not clear. But but the right experiments, you know, like somebody may sit on the phone with somebody else. 10 years from now, it's like, well, everybody in Oh, Stan today.

**Jacob Morgan** 22:16

Yeah, that would be quite shocking. I'm sure a lot of people listening to this for like, what compute how could it be possible that we're in a computer simulation? It's yeah, so some of the stuff is just mind bending. You know, some of us are just trying to get our pants on in the morning, let alone thinking about that. We're in a computer simulation. When you look out, you know, during the course of your career, is there still something that you are shocked and amazed by where you're just like, I can't believe that that's true, or I can't believe that. We, you know, whatever, XYZ.

22:55

Wow, there's many of those where I can affirm me that. I think every time we look at nature, every time I look at that, I'm frankly, puzzled by its astonished by its beauty takes my breath away, especially if you have a new telescope, we look at it when we land, somewhere on Mars, and we look around, right? And it's like, it's it. It knocks your breath out of you. It's so incredibly beautiful. And there are some things that you know, if you think about it, like why would that be like? Why would the whole universe as far as we know have the same atomic building blocks, hydrogen, helium, carbon, oxygen, Iren,

everything in between uranium? Like, why would the whole universe half died, right, kind of, in many ways, as beautiful and as complex as that it's also enormously simple. It's like a Lego set. You know, somebody, it's an incredibly beautiful universe made of very simple tools. And so for me, I think that's mind boggling, right? Because of that, I mean, for me, that's, that's what's beautiful about the universe. It's not just that it has all these structures, and you know, has these time dimensions that blow your mind, but it's also in at some level, remarkably simple. So it blows my mind. It's good. I mean, I think quite a lot of time about justice. And the question is, is life inevitable? Or is it is there a fragility to life? Right, so in other words, will we find life anywhere? It's just a natural consequence of the physical and chemical world that is everywhere that we now know, or is it its own thing that a much higher threshold to get those over me that I mean, those are the things that I would like to know. And that keep me awake at night, just because I think their questions were at the verge of solving.

### **Jacob Morgan** 24:47

Yeah. I want to shift gears a little bit to talk about something that you mentioned in an interview that you did, and that is this idea of separating, making a mistake from almost is making a mistake. And I thought perhaps you can give an example of both of those and why it's important to differentiate between those two. And I suppose for you, it literally comes down to a lot of life and death situations. But also perhaps you can apply this to leaders inside of organizations as well, and why they should be thinking about this concept of mistake versus almost mistake and why we should even be talking about this to begin with.

### 25:27

So you can ask, why is aviation so safe? Because it does not take many mistakes to take a plane out of the sky. Like if you really think about it does not take many mistakes. And frankly, they notice the time of aviation is full of tragic disaster with the debris fields, why is it so safe? I think the most important idea that was put to bear and, of course, NASA was involved in it somewhat, but it was done elsewhere is by basically saying, if a pilot sees an almost mistake, bow, we got really close here, and we just caught it. Beside, if there's not any kind of, you know, the pilot was not drunk, or you know, some kind of kind of disregard of regular kind of, you know, kind of normal norms. If they immediately tell a common position, the FAA, that that occurred, they will not be prosecuted. So it's kind of day eight, they're motivated, in other words, to immediately talk about almost mistakes. That itself had an enormous consequence. Because if you look at those almost mistakes, see the difference between a mistake and an almost mistake at this sastra. And almost, it's basically the same dish just ended up on two sides of a line, that almost is arbitrary. And if you solve the problems that create the almost mistakes, the almost disasters, you solve the disasters many times also. And so for me, what is absolutely critical as a leader is to half an organization or almost mistakes, almost near misses, get used to improve. So So really taking those dates like wow, we never thought that these things together could create an opportunity for massive the bulk call, which, like we never thought of that, like talk about it. Because surely it will happen again, in some other kind of, you know, in some other configuration and, and dealing with almost mistakes, taking them seriously not punitive, relative to the people who created it. But, but really as opportunities of learning, I think I can have some of the most important positive consequences for the entire system.

### **Jacob Morgan** 27:54



Do you have an example of an almost mistake at NASA that you had to go over?

28:00

Oh, we have a both real mistakes and almost mistakes, right? So. Yeah, so so. And I'm going to share a really stupid one, right? Because what many people think kind of we're failing on equals MC squared stuff, right? Kind of complex kind of context, contextual thing. One of the mistakes that occurred in the James Webb Space Telescope, just before we were ready to go into test is that we realized in acoustic test to you if you need to survive a rocket on the way up, right, you need to survive noise. So we put in an acoustic test. So basically, think of a tremendous rock band with a lot of loudspeakers at the hardware. What happened is fasteners tiny, little faster, started falling off. Offense, like, why does that happen? And of course, if you've ever fixed the bicycle, you realize that you can you need to lock the screws, the fasteners, right? If, if you don't tighten enough, you know, you go down the gravel path and the first cruise falls off because you shake it loose, right the fastener leaves. So in this telescope, which was close to eight and a half billion dollars in cost at that point, we had not locked the screws. How did that occur? Right? So it's a mistake that happened, somebody solved a secondary problem inducing from the top a process change. Frankly, they didn't want to scratch a foil. And I basically caught off the tips of the fasteners in a process frankly, every somebody if somebody read it with an open mind, it's like wait, they're not locking down. And of course what happened? See, it's not just one mistake. So die was a process mistake. I'm sure what happened and I cannot guarantee that because I was not in a room. A technician was attaching those fasteners and said Wait, they're not locking turned around to the manager. It's a As they're not locking here, what do I do? The manager says, shut up and tightened, because the process is correct. And we're short on time. Right. So going off, it's what I'm doing is, of course, amplifying and making a caricature out of a discussion that happens. If you're not taking seriously what is there, though there's so that's, that's a mistake. Right? So So kind of a tiny mistake, massive consequences, that mistake cost the taxpayer \$150 million. Wow. So So I was devastated when we found that right. And, of course, what we had to do to fix it is really focused on the culture. By the way, this all matter of public record, people can go look at the descriptions of that, we came clear talk to calm Congress about it. But that's a mistake, simple, huge consequence of almost mistake, there's a famous almost by stake it related to entering Venus's atmosphere and an early mission that that went there. And basically what happened is, what do you want to do when you hit the atmosphere, you want a switch to let the parachutes out. So basically, when you hit it, when you break, it's almost like the, you know, the shock, you know, the seatbelts in your car, when you go forward, right? It basically wanted to kind of have something happen right? Now, when you do that, it's important which way the sensor isn't. Because if it's backwards, pushing, it does not release the parachute, it just pushes against metal, so it needs to be the right way. And what's his famous story with a, with a, with a technician, that basically work during shifts, this is really kind of when you put the spacecraft together, shift work, three shifts off, and really tired people. He puts it in the switch. And he basically goes to sleep. And he comes back the next morning and says, Hey, I put the switch in backwards. On the same day, in a mission assurance person, I go, here's all the paperwork, you sign and three other people signed that you had it the right way, it says no, I know, I did it backwards. And he did not go away. People yelled at him, it's like, you know, and it propagated up, he did not move like it propagated up and also on a kind of a high enough level, they said, go check. So they're ripped away to kind of the solar protection fall there was on top of it. And sure enough, we had it done backwards. So see both our stories of the same thing, which is going to mistakes happen in the organization, by people who

either pay or do not pay attention, who are either empowered to speak up or are not empowered to speak up. And so both, in many ways, they're both the same story, one of them turned out well, the other one didn't.

**Jacob Morgan** 32:50

How do you create that kind of a culture where not only people can speak up, but leaders are receptive to it? And has that ever happened to you? Or somebody said, Hey, Thomas, that that's not correct. And you had to take that feedback and say, You're right.

33:05

Oh, it happened to me many times. And I think it's really important as a leader, that we're modeling that really carefully. So I mean, in our team and our leadership team, if you don't know me, but um, I have a pretty opinionated, I'm not patient, make quick decisions. And sometimes I don't listen to the end of the sentence because I before I jump to a conclusion, and what I really need people on my team is to say no, and I there's specific, my deputy you and I or my deputy, I sat her down visit is that your job is to say no to me. And it's not because it's not some kind of fake reason I've observed I told her, let in every leadership team, if I had somebody who says no to me, we're better as a team. So it's not that I want to take away my impatience. That's sometimes a huge strength, especially if you're in a bureaucracy, make decisions, don't just stand around. But I want somebody to say no, if I'm wrong, and that happened many different times. I mean, we would have made stupid decisions here and there if she didn't say no, in many cases, by the way, was right. But there were certainly decisions. And so it's really important to propagate that down. Be really clear I actually in with James Webb Space Telescope, after we found these mistakes, I actually addressed the whole workforce, so that the companies we we retrain them basically create a kind of an open process for suggestions that hey, I worry about this deposit, we reward that. So you become an organization that deliberately looks for input as opposed to stifle said

**Jacob Morgan** 34:43

I suppose that requires a certain level of vulnerability, right? A certain level of vulnerability on behalf of the leader to acknowledge I don't know everything, I can't do everything. Sometimes my decisions are going to be wrong. Sometimes I will make the wrong choices. And that's not something that a lot of leader are oftentimes very comfortable with because it can potentially show weakness or insecurity. So how do you Has that ever crossed your mind? By the way of you know, I shouldn't say no or admit to a mistake, because people might question who I am. And how do you think about vulnerability and leadership?

35:18

So I actually think that as I got older, and kind of more kind of understood that I could do certain things that I'm better, you know, like I'm making experiences, the more I got comfortable being vulnerable. And I really think it's critical as a leader, especially if you want to be at a top tier of leadership, kind of really, kind of building and impossible companies, impossible teams, right things, teams that really reach to have that ability to listen, there's very few people and they may exist, right? That, that are do not need that, because they're just have this kind of Uber drive, and basically a normal person like everybody else, right? Certainly at the 99th percentile I am I may be a little bit better educated than

others, but, but the point is, like, I would rather work on the best idea, not my best idea, I would rather do the right thing, not what I just thought right now. And if you communicate that it's enormously empowering, frankly, it's a lot easier to hire your bullet very turnover and your team goes down. Because people actually feel engaged in decision making. And you know, I'm really watching those things, frankly, in my entire organization. I know that voluntary turnover by your code, right? Because bad leaders light up like a sore thumb, like and if everybody underneath them constantly. You know, it's like, either that purpose is not clear, or we just have a bad leader. So let's go figure out which one it is and fix it. So for me, it really is doing that kind of Yes, vulnerability is it takes courage but see, security, I believe it's not, you know, kind of being certain of yourself kind of, for me, it's not about not having any weaknesses, it's knowing my weaknesses, and being okay with them. I know that okay. I'm not that good at this helped me right. But so that that is really what ultimately protects, you know, like, being certainty and security, and it's inspiring others, not kind of standing on, you know, on a football or sitting on a throne directing people with a golden stick.

**Jacob Morgan 37:28**

Yeah, yeah, that makes a lot of sense. How do you deal with mistakes? So when a mistake or a failure occurs? And actually, I'm really curious, you obviously, you know, a lot of people in the business world, you worked with a lot of people in the business world, do you notice a difference between how you and your team approach decision making and things like mistakes versus how traditional business organizations approach these things, or leadership for that matter?

37:59

So yes, I've observed that there's many different approaches to mistakes. And very often, these approaches kind of correlate with the innovative potential of an organization. So you know, iteration and innovation go together, you know, you cannot be an innovative organization without ever making a mistake, kind of call it iteration, kind of without having to reset and say, Hey, that did not go exactly like we hoped. And so for me, like, I think you can be an organization that doesn't make mistakes, but you're not probably not gonna make it long. Right? So it's much better to build an organization in which you define excellence, not as absence of mistake, but as constant learning, constantly getting better constant improvement, right? And so for me, what drives me crazy is we make two mistakes, make the same mistakes over and over, like, Are you kidding me? Like we're better than this, right? But the first time we make a mistake, like, let's thank the people who found the mistake, and let's go fix it, right. And I really, it makes us better. If we do that. And we can innovate that way. Again, we will not be innovative if we kind of shoot the first person or make a mistake, because people will be in a comfort zone will never, never leave that comfort zone. And I've seen businesses that are working like this. And I've seen businesses that are the opposite, and everything in between.

**Jacob Morgan 39:30**

So there's a difference than you think between how traditional business organization organizations versus how maybe specifically NASA approaches, decision making and mistakes. And it seems like in corporations, it's more frowned upon. It's more Dare I say hidden. You don't want to challenge people. Whereas a NASA or at least in the team that you've been trying to create, it's the exact opposite and you want those mistakes to be brought to light and not even mistakes, but even the almost mistakes which I honestly have no Ever heard of a business organization talking about an almost mistake?

Right? They usually just talk about the mistake that happened? And how do you stop it from happening ever again?

40:11

Yeah, and of course, we all have stakeholders, right? I actually felt it was really important, also, in my congressional interactions, to really convince people that what we're doing is rocket science. So it is hard. And we're going to make mistakes from time to time, because what we're supposed to do is lead our taxpayer expect us to lead. And so if we want to see that leadership, you know, like, that, we're no longer I'm mad, we should invent another logo, because the logo for NASA that I want to work for is one that transcends the boundaries, you know, like, you look at Lassa there's this thing that goes beyond the circle, right? The you know, for me, that's what NASA is about is going beyond the boundary. And so for me, that stare now I understand if you have stockholders I, by the way, their CEOs, I listen to podcasts, such as yours, and yours also, right? There are people who are quite comfortable talking about, hey, I got this wrong. There's people you know, you know, blades, Steve Jobs was a lot more comfortable talking about mistakes than the early one as our auditors, right, because it's like, wow, I really got this wrong here. And, but, you know, the ones that do, that really have celebrated or kind of accepted mistakes, you know, like the early SpaceX, right kind of one rocket blew up, second rocket blew up, third rocket blew up, fourth rocket flew, right. And so for me, that's the path to success, right, that kind of the early SpaceX. There's other companies who are doing similar things. And we really feel it's necessary in our space in our kind of environment to accept that, I worry sometimes, that actually at NASA, as we get older and get kind of also a big kind of at times, more bloated organization, that we you lose the ability of experimentation, and lose the ability of iteration. And, and we are trying to over design and kind of get to a place where we do very few things in a very expensive fashion. Because we're so worried about making mistakes.

**Jacob Morgan** 42:14

last 15 minutes or so I want to focus on specific action items for leaders and things that people can apply inside their, their careers and even their lives. And one of them is around this theme of separating, doing things that you know, versus doing things that you want to do, but you don't know how to do. And I feel like it's very easy to do things that you know how to do. And one of the areas where a lot of leaders struggle is how do we you know, we have an idea of something that we want to do, and we have no idea how we do it. And I would imagine that for you. This happens all the time, right? Like we've never been to Mars, we want to go we you know, before we went to the moon, we've never been there. We want to go how do we do it? We've never launched something like the James Webb telescope, but we want to how do we do it? So how do you approach something like that, where you want to do something that you've never done before? And there's a lot of variables that you don't know the answers to? Right? I mean, is it possible that the James Webb telescope could have been a colossal failure and just gotten somewhere out in space and just disintegrated? Like, how do you think through some of these types of things?

43:27

So I wrote a blog post before the launch of the attempts to my space telescope and kind of there was a sentence Enders, like, if you're not worried, or even terrified about the success of teams, where if you don't know, you don't understand what we're trying to do. That's what I said. And I really believe the risk

was significantly high for that, and I thought it was really important to talk about it, and frankly, in part, to give our team the ability of working, because I don't want every time we have a little problem, to have a whole investigation coming towards me, let's embrace the risk. And say, this is what we're there. By the way. I don't know about you, but I'm not inspired by superheroes. I'm inspired by people who do amazing things in teams. And even though they're struggle, they have mistakes, just like I do. They can be part of games that could do incredible things, but let's embrace those and let's let's celebrate those people who overcome. And so that's what I wanted to do. So what we're doing in our case, like, you know, go to destination X, we've never done it, how do you do it? So we basically sit down through a process kind of, you know, create an initial kind of system design. And what we're doing is we're accepting what I will call, not everybody calls it that, but I call them miracles. Okay, so I never want to build a mission with zero miracles. So that's a mission that already know everything, not interested. Let other people do it. Their companies are much better at this than we are Are you know, there's other operational things that do it, I'm perfectly fine. I frankly, I want every mission to have a new technology. The simple reason for that is if if we're not doing that, kind of the next missions will not constantly improve, and I want us to be on, I want us to lead. So that's what that means. So what I want though, in some cases, there's 1000, miracles. So the James Webb Space Telescope, depending on how you count is between 10 or 12, miracles, things we've never done, that we need to figure out, for example, deploying a mirror that is made out of many different pieces, and bringing them together as a single mirror with the same resolution, a new type of infrared detector we've never done, has never flown in space with a chip behind it. Or, you know, the sun shield, which has the area of a tennis court times five, with a exact shape that we deploy in space all autonomously, I've never done that. Right? So. So you build like a list of those. And then you go work. So I, I'm a strong believer that be making those miracles happens, right? I want to I bet on it. Right? Every time. You know, it turns out that 10 is hard. So James Webb, we're not we did not get any super prices, we get prices for the amazing success. But we are not getting prices for how well we managed underway because, frankly, until we struggled enormously, because what happens, of course, some of these unknown star coupling to each other like Okay, so we didn't know this, we could fix it. But now it affects the other miracle. We don't know. So if you have n, number n, you know, 510 or so miracles, you have a complexity of n squared, closer to 100. You know, because they coupled into each other. And so yeah, so what do you want to do is kind of find the right number of miracles. It's a problem you want to solve. It's right. It's like, it's like a mountain hike. It's at the at the ridge of a mountain on one side, down. You never want to slide it's the slope of irrelevance. People have already done this, like, you know, the other side is the other side is the slope of impossibility. If you go on the other side, but it's basically like either, you it's not possible, even if you're ever so good. So the trick is to find that rich, and you need to experiment, you can fail, go down this way, go the other way. And then you find the kind of thing that really makes history

### **Jacob Morgan 47:28**

and love that I love that approach and thinking about in terms of miracles. We only have a few minutes left. And I know that it's it's a little bit bittersweet for you this year, because you are fairly, I think, today or yesterday, I saw the video that you did about stepping down from your role and retiring. And I saw an article that you did, where you talked about stepping down as an important leadership skill, which I don't think I've heard many, many leaders out there talk about. And so first, I wanted to ask you why is stepping down an important leadership skill? And in that article, you talked about two specific questions that you ask yourself to know if it is time to step down. So why is this an important leadership skill? And

what are the two questions that you and other leaders out there should be asking themselves to know if it's time to move on?

48:20

So the first question for me is always am I learning? And am I improving? And I just know, if I'm not learning and not improving, I lose focus, right that to everything, but what I'm supposed to do, I'm not as present, I'm not as sharp, I'm not as good. I'm not really elevating the organization with me. And the second question that I'm asking is really, am I the best leader for the organization at this moment in time, and there's kind of a sub text to it, right? So I, I have strengths, there's certain things I can do that many people cannot do, you know, certain skills that I brought to the table approaches. I also have negatives already talked about my lack of patience. There's others, right? We could talk about, then you go ask my employees, they find more. But But basically, if we're any good, right? So so what we're doing is we're coming there as people with strength and weaknesses, what we, if we're good, we're moving the organization in the direction of our strength, right? So I'm really I love innovations or the organization has many more innovation programs where we experimented more, we are much more willing to make some mistakes and to grow if we have to train the organization. But so kind of that strength. If I stayed another five years, I wouldn't get massively better, not a factor of two, I make 20% better, but see the weaknesses I bring to the table. They're just there, they're hanging out. And in many ways to the strength, the weakness ratio moves in favor of the weaknesses because I've been successful. So I think it's really important to look at at this and frankly, what do you do is you go ask people who give you honest feedback in your organization, and also from the outside and you ask yourself, like Am I actually the right person in this in this environment? And I think it's, it takes a lot of wisdom and only history will show it better. I chose it right. But I decided to do move on, because I could not answer both of them with Yes.

**Jacob Morgan** 50:15

So you didn't feel like you are learning or growing anymore?

50:20

I did not. I'm not learning and growing at the speed that I did before. That's correct. I've done it. I've finished missions, I, you know, frankly, we've had enormous series of successes, it's very hard to come up with a time and, you know, last six years that we're successful anywhere, not in a history of NASA, especially in ISO signs, which is what I'm running but but you know, I have to learn a lot Prout new ideas to bear I don't have another kind of bucket of kind of ideas at the same magnitude that that I have anomalies, frankly, I wouldn't be stupid. If I had, right, I did my best bringing the ideas forward.

**Jacob Morgan** 50:57

Well, some people might say, Well, why can't you just kind of take a step back and come up with more ideas? Or why can't you learn and grow? Right? Because sometimes, you know, we, we have these difficult times that we all go through, or we feel like innovation stagnates and stuff like that. And so there's some leaders out there who might say, well, you know, why doesn't Thomas just try harder? Or, you know, try to innovate or try to learn and go, like, why why give up and why retire?

51:26

Yeah, I think part of it is, it's really motivated by my observations. I would say, if I look at bigger organization, and account government, and even big companies into that, I've seen many more leaders that hurt their organization, by leaving too late, that I saw leaders are hurting their organization by leaving too early. And I just really, I really believe that, you know, driven by that, I'm far less worried about that, oh, I'm leaving a little bit too early, that's just maybe a 10 20% rate or 80%, as people stay too late, and kind of in the last couple of years of their tenure track down your organization and, and lose a lot of the positive that they actually injected initially and their auditors, I don't want to generalize, there are people who have done exceedingly well, staying much, much longer. But I think the military has it right kind of rotating through when mission is the most important thing. And that, and we really want to bet kind of bet on leadership changes is absolutely irrelevant and necessary.

**Jacob Morgan 52:31**

And I think a lot of leaders out there struggle with this. Right? They it's sort of like, you know, those rock bands that refuse to retire, and they keep touring, even though they were popular in the 60s and 70s, are still doing tours and in the 2000 20s. And everyone's like, just why? Why are you still doing this? Just stop while you're ahead? So why is this such an important leadership skill? And is this? I mean, how do leaders out there, figure this out? Is it just about answering those two questions that you pose? And if both of those answers are no, it's time to move on?

53:07

Oh, we met, we talked earlier about the importance of being critical about yourself and finding mistakes and so forth. And I think I've really cultivated that as part of my career, frankly, I needed people who are supporting me to get where I am, you know, like, I grew up in this very humble environment. And I had people who took me under their wings and really pushed me, those mentors, those friends, I kept in my life. And those are also the people I'm then having a discussion, when do I leave? And frankly, a number of them have said, Look, you know, and I consider them almost like my board, like my board of directors, yeah, they don't vote together. But I talked to them, and I really am open to their input. And for me, that outside view on me as being very important, and I just, for me, I just You should know, I consider that absolutely essential i for me, and so many times it has given me made me make better decisions. Because I listen, I took the time and listen to some of these people who have wisdom in many domains. They're not doing what I'm doing. Exactly. Some of them are very much entrepreneurial from a different spheres. Some of them are, you know, over time, I realized I need people who are younger to be my mentors, especially when it comes to HR, because they need to, I want somebody to says you really got our generation wrong. Your incentives are not right. You're not empowering them the right way. So so I'm actually spending time with them now to of course, I still mentor them, but they also mentor me and they know that it's their job to help me that way. So it's really that outside view that may be convinced of it. It's not just because I'm like sitting in some room and create wisdom, like a little machine.

**Jacob Morgan 54:55**

Yeah, so it's getting that external feedback in creating your own path. Personal Advisory Board, which seems like a pretty important and useful thing for people to do. When you think about your career, were there any particular leadership hacks or things that you implemented that helped make you more successful or processes or frameworks and things that you have done that are unique to you, for

example, one that I can think of, and I don't know, if you created this, or you learn this from someone, but the idea of the almost mistake versus mistake, I would categorize as being a very unique, you know, decision making technique. Is there anything else like that, that you have used during the course of your career that has helped you?

55:37

So we talked about that, we also talked about the board, really kind of, you know, the advisory board is one of them. I thought the other thing I'm really dwelling on I've I've been very conscientious about is really, really try to take any, any kind of problem that I look at and break it into two systems. The first one is almost first principles physics, right? And if I'm a physicist by training, so I'm trying to kind of, in my mind, build a model of what we're trying to do. And the other one is just the people side. Why are people motivated to do what they're doing? What are they working for? Everybody works for somebody. So why are they there and motivated, and try to understand both of these systems, one way to get to be able to do that is when I listen to presentations, when somebody pitches to me, what I try very hard is to get two inputs that are parallel one of them, I just read what they're saying, I just watch, I kind of turn off your ears. The other one, I just listen and I turn out of my eyes. And I listen to both messages. And I bring them together and say, Where are the disconnects? It's amazing how many issues you find that way, kind of not good thinking I could have. Another way is call it finding whitespaces. Like in that problem that we're talking about? What should we be talking about? So make a list of those, and listen to the team and figure out where to light white spaces are white spaces are either places that just happened to not talk about but more likely to not unfortunately, it's something they're overlooking. Or it's something where there's a problem, and they don't want to talk to you about it. So So for me, those are kind of things that I've learned over time, many more, but those are, those are the ones that I use pretty much every day

**Jacob Morgan** 57:34

and love those. Well, we're near the end of the show, and I thought it would be appropriate to wrap up with a tweet that the NASA InSight mission, which I believe you were you, you were responsible for that one as well, right?

57:48

Yes, I actually went when I came in, it was really in trouble. And I managed to with our French colleagues turn it around, it really helped that I was from Europe to help fix that one inside launched, landed on Mars, but it's getting close to it's live or they did tweet. Oh, do

**Jacob Morgan** 58:03

you not know that tweet?

58:06

That tell me which one.

**Jacob Morgan** 58:07

So it's a tweet, I think it went up yesterday. And it said My power is really low. So this may be the last image I can send. Don't worry about me though. My time here has been both productive and serene.



And if I can keep talking to my mission team, I will but I'll be signing off here soon. Thanks for staying with me. And I love I love that tweet. And I even retweeted it. And I thought I love how you create a narrative and a story. I mean, it's a bot, right? I mean, it's a it's a piece of technology. But it's done so much that it has almost like a soul and a personality behind it. And so it seems like insight is coming to its end, you are retiring. So I thought that would be a good, great way to sign off. What's going to be next for you? Where can people go to find you? Are you going to be writing a book anytime soon? Perhaps.

59:08

So first of all, I would really love feedback if I should. Because I the last thing I want to do is write something nobody wants. I'm of course on Dr. Underscore Thomas C on Twitter. And I will starting January 1 I will put up a website which is Thomas zurbuchen.com, or Dr. Underscore Thomas c.com. So it was owed those those URLs. I'll be there continuing to reflect on what I learned and look for what's next. The only thing I know is I bought a season pass and a ski resort. So I'm going to try to get a lot better at skiing because I have not had as much time as I did before. And I want to focus again on where I can have an impact where I can learn and where I can really be part of an amazing team that makes the impossible possible.

**Jacob Morgan** 59:55

Well thank you for all of the amazing work that you've done. This has been one of my faves. We were in episodes not just because I love space and kind of had the chance to geek out on some of that stuff a little bit but just the insights and the stories have been really amazing. So thank you for taking time out of your day and and sharing that with me and with everyone else.

1:00:15

I really appreciate it and all best to you during the holidays and beyond.

**Jacob Morgan** 1:00:19

Thank you very much