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Stephen Ludwig: Welcome to Inflection Point, a podcast series from Jacobs. I'm your host, Stephen Ludwig. That was the voice of Joy Kelly, vice president and general manager for the Jacobs Clear Lake Group, which provides support for NASA. This is a really great conversation that covered all sorts of topics that include the exciting work Jacobs does with NASA, STEM education and the success and challenges of business innovation in large organizations. The Jacobs Podcast is where we meet the people that help create solutions that deliver a more connected sustainable world. With that out of the way, it's on with the podcast.

Joy, thanks so much for joining us today. Can you share a little bit about your background and how you came to be at Jacobs?

Joy Kelly: That's a fun story. I had the opportunity as a young girl to grow up at Kennedy Space Center, entered engineering, thanks to my high school mathematics teacher. I was going to major in math because I loved it. In a 10 minute conversation at the blackboard back then, he said, "You love math and you're good at science, do yourself a favor and become an engineer." So I did. Worked in the robotics field for quite a while, and then left that field and went to [Edwards] Air Force Base, working for [SVADA] Technology, which was purchased by Jacobs. Left there and did five years at two different startup companies. And then about 15 years ago was invited back to Jacobs. We stayed in touch because I love Jacobs, and they bid the contract at the Johnson Space Center and having grown up as a young girl loving space, I jumped at the opportunity to rejoin Jacobs and be at the Johnson Space Center.

Stephen Ludwig: Wow. You're living your child a dream.

Joy Kelly: That's exactly right.

Stephen Ludwig: Wow. So what is it you are doing with NASA, for Jacobs?

Joy Kelly: We have the engineering contract here at the Johnson Space Center. So we are fortunate enough to support most of the human space flight programs through the engineering directorate. So one of the things we have partnered with NASA on is to build the parachute system, which is the reentry system for the Orion spacecraft, which is Lockheed Martin's major development effort in returning humans back to the moon. Another thing we work on is some of the humanoid

robots. So we do so many things on this contract that really span all the pieces of human space flight as well as another very fun thing, which is astromaterials research, and also the curation of astromaterials, which means the moon rocks, Meteorites and also cosmic dust. So the variety of what we do here, I could talk for three hours. So I won't, but just say we are covering quite a variety of projects here.

Stephen Ludwig: Wow. That's really amazing. You're like a science fiction nerds dream working with the parachute, the robots, all the space rocks. That has to be really fascinating. Now when you talk about engineering, why does NASA need help with engineering? I would think or someone would think that they have all those people in house. So why do they need to come to somebody like Jacobs to help with that?

Joy Kelly: That's a really great question. And I think through the years it's been a bit of a misconception. The NASA brand is so well known, which is wonderful because we all as contractors get to leverage that brand. But even during the Apollo years, it really was a smaller team of NASA civil servants combined with the large aerospace companies that put men on the moon in the first place. And so NASA's history has been to have a civil servant team and contractor support. So there's the OEMs like the Lockheed Martin and the Boeings. And then Jacobs is fortunate enough to be the number one services provider, really solutions as we really have shifted our language, but we are at so many NASA centers that we are the go-to workhorse that really works alongside NASA in partnership day in and day out.

Stephen Ludwig: Well, that has to be so interesting of all the different things that you're involved with. Do you have one or two or three favorites?

Joy Kelly: For me personally, I have to say the robotics because that's what I started my career in years ago and to see where the technology has gone and to see artificial intelligence, machine learning and the level of complexity of that particular system, especially the humanoid robot is truly fascinating. But really I love all of it. And I really like variety and I like cutting edge technology. So it's really hard to say there's a favorite, but if I were really forced to say one, it would be the robotics field.

Stephen Ludwig: Now that's super amazing. And again, just all the work you're talking about is so fascinating. And I was thinking about this. So the earth is about 4.5 billion years old. The universe is about 13.8 billion and there's so much we don't know. And it seems like the work that you do and the work that Jacobs is doing and supporting, is really fundamental to helping humanity understand the origins and not just our solar system, but the entire universe.

Joy Kelly: It's amazing to me that we have astromaterials researchers, we have geologists that research the solar system and the origins of the solar system. And then right alongside that, we have engineers who make sure that astronauts on the

international space station are safe. And the equipment they're using that we help build is working and their exercise regime, the equipment is working. So it's very practical. And then there's the origins of the universe side. So it spans really the full spectrum.

Stephen Ludwig: I mean, how cool is your job? That is so cool.

Joy Kelly: And we actually get paid for it, which I'm very grateful.

Stephen Ludwig: Wow. That is really amazing.

Joy Kelly: Yeah. And the work we do at Kennedy Space Center on that contract... When the Space Shuttle retired, there was not a significant amount of work at that particular center. And they have totally revamped and rebuilt the vertical assembly building. There's been a lot of reconstruction there as well as this decades old crawler that used to take the Apollo out and then took the shuttle out and now take new vehicles out to the launchpad, and they've revamped the launch control center. And our Jacobs team is responsible for a lot of that work as well as software development. So when we're getting ready to launch Orion, our Jacobs folks at Kennedy Space Center will be in launch control on console in some areas. So it's truly spectacular the different across Jacobs at the different NASA centers that we have the privilege of being a part of.

Stephen Ludwig: Now, I don't want to overstate this point, but you're really helping shape the future of humanity.

Joy Kelly: It's interesting you say that. I mean, each of us in some small way gets to be part of the larger vision. And I think it's unifying globally and it'll be really fascinating to see years from now, we get to say we were a part of that.

Stephen Ludwig: That's super interesting. What do you think the public would be most surprised about that you might be working on like, oh, that's really... I hadn't thought about that. Robotic, super interesting, incredibly important as we move forward, and the other things you mentioned. Is there anything that comes to mind that would be like, oh, this is really cool that people don't know about yet.

Joy Kelly: Probably to know that we Jacobs are helping to build the next generation space suit because that's not necessarily something that you would think Jacobs is known for. And yet it's something that we've been working alongside NASA in partnership for years. There's certainly been OEM providers that are the heritage makers of the space suit. And NASA is doing this one a little bit differently still with other partners, for sure. It's a big team and we get to be a big part of that. And I just think that's totally cool. So when the first woman and the next man set their foot on the moon, we will get to say we were part of that and keeping them safe in their suit, as well as many other components. I haven't even mentioned yet the Marshall Space Flight Center. And they have quite a contingent that is responsible for systems engineering and testing, and a

significant part of integration for the space launch system, which is the propulsion part of the system that will launch the Orion spacecraft. I mean, we cover it all. It's truly spectacular.

Stephen Ludwig: Yeah. Wow. Now I'm going to shift gears...

Joy Kelly: Right. Sure. To be clear, I'm in charge of the Innovation Grants Program here at our Clear Lake Group contract.

Stephen Ludwig: And where is Clear Lake located?

Joy Kelly: That is in Houston, Texas. We are a mile and a half from the Johnson Space Center is where our office building is. So the Innovation Grant Program was developed a few years ago to cultivate folks on our contract, to have an idea and apply for a grant and work on an idea that supports NASA. And the idea struck me, frankly, because I was accustomed to an OEM contractor for years, and we had internal research and development money. And I was a custom to getting to be part of that next generation technology development. And on these more service type contracts there isn't a budget that necessarily flows for that. So there is a budget for innovations and we help our customers. I said, well, why don't we take part of that money and let's do innovation grants similar to IRAD.

And we started that and it's really blossomed. And a lot of people had better ideas that have added to it. And so it is a way to cultivate the innovative thinking in our scientists and engineers with the caveat that what they work on supports our NASA customer and is aligned with the technology development that they need. And so we've had some really great ideas that are brought forward and the grants are anywhere from 20,000 to 40,000 and people really enjoy getting to work on them. And our customer really likes the partnership in being able to seed an idea and take the technology readiness, perhaps one or two notches up, some things don't work out and that's the whole point of the grants.

Stephen Ludwig: Yeah. So you mentioned IRAD, what does that stand for?

Joy Kelly: Oh, that's Internal Research and Development money, and that's in the larger context of the Boeings and the Lockheeds. And they have an Internal Research and Development pot of money that is partially matched by the government to do technology development. And so it is a way to continue to advance and to create that innovative culture and to advance the technology from where we are today without doing that on a project or a program that you need to deliver, and you can't afford the risk of something not working.

Stephen Ludwig: That makes a lot of sense. And it's interesting, I think just from the public's point of view, from my point of view, I see engineers and scientists that work, and as you've educated me, for NASA, then with NASA, it seems like, wow, they'd be

naturally innovative, but I get how, what you just described, sometimes there's blocks to doing innovation and you're doing that. When you do these Innovation Grants, how do you know what success looks like? What are some of the parameters you set up because you mentioned some it has to apply to what NASA is working on and kind of what we're interested in here, but what else does success look like?

Joy Kelly: Success of the program is people bringing ideas forward and building a team that advances how we understand a technology. If it doesn't work, that's good. Just like Edison, how many times did he try to invent the light bulb before he was successful? So success is about that we've built a team that did something productive, aligned with the customer and advanced our understanding of it. And so if we were going to invest a lot more money, then we would have a more rigorous gate program to say, all right, at this stage, this looks really promising. And Jacobs is doing that at a corporate level in a really lovely way of having a more substantial opportunity for investment, with stage gates to ensure that the project has enough promise to take it to the next step.

Stephen Ludwig: So if I'm understanding correctly, these Innovation Grants are like seed grants to see, okay, should this concept be developed further? Yeah, that's really interesting. Now Clayton Crane helped popularize this notion of disruptive innovation in his book, *The Innovator's Dilemma*, but that has started to lead some people to think that all innovation needs to be disruptive. Now Pixar's co-founder Ed Catmull talks about change as an iterative process in his book, *Creativity, Inc.* Now this is an opinion, I suppose, for you, but can iteration be innovative, or does it have to be disruptive or is that a false dichotomy?

Joy Kelly: I personally think it's a false dichotomy. And this is another popularized phrase, the little eye big eye. So the little eye is a small idea applied over a broad application base, if you will, that has a significant impact. And that's one of the things that we focus on significantly here. We have what we call a new ideas tool and it's for anybody in our employee base to submit a new idea to say, "Hey, what about this idea? If we did this, it would make such and such a lot better."

So we have improved business processes that way, we've improved engineering processes. You don't typically get the breakthrough technology changes, yet those little changes on how we do work can have a significant payoff. And on the other side of it all those disruptive innovations, those can't be planned. They can't go put a whole bunch of people in a room and schedule a breakthrough. We all know that. And so those are very few and far between. So for me, creating an innovative culture, which is really what I think is key is you first have to have a leadership structure that is encouraging of all ideas and welcoming of, hey, that's a good idea. Let's hear more about it. And then you start having that permeate through the culture.

Stephen Ludwig: Do you think that's why it's so hard for many large organizations? Clearly Jacobs and NASA are outliers when it comes to this, but do you think that's why it's so hard for large organizations to innovate because of that leadership components missing and that welcoming idea and the way to move forward with it.

Joy Kelly: So I'm not truly convinced that large companies have a hard time with that. I think that's certainly the view on the street. Yet I think we are in a time that if we don't innovate and we don't have a culture of innovation, the company won't exist. I just think we are in a place technology wise and society wise that change is very, very rapid.

And if companies don't embrace that and have a culture with leadership that is continually welcoming and expecting new ideas, I just don't think they will be in existence in five or 10 years. So I really do think large companies are doing this. It's just that for many, many decades that hasn't been the mantra.

Stephen Ludwig: Got it.

Joy Kelly: But that's just my two cents.

Stephen Ludwig: Well, no, it's a great point of view because I was going to ask you, you mentioned earlier, you worked at two startups and one of the popular mantras out of Silicon Valley is fail faster. And that seems hard for large organizations that have a lot of built and reward structures for the status quo. Is that fail faster idea possible at bigger companies?

Joy Kelly: It's very much a viable strategy and frankly, a large company, if that's run well, has the financial backing to set up an infrastructure, to allow the exploration of technologies in a fail fast mode with the gate reviews that naturally happen and still have the business base that is performing on large programs or we're delivering product that is in the more natural rhythm of sustained production and sustained performance. So I think both of those can very much exist in a large company and you don't have to go out of business.

The Silicon Valley model is if you don't make it, you go out of business, you turn, you start another company and that's a very different model. And some of them are amazing. What large companies are doing now, Jacobs included is... And this is how I think we are more quickly infusing innovation and newer technology is by looking at these very small companies that have incredible promise and we're buying them and that's a win-win

Stephen Ludwig: Got it. So what I'm hearing you say is three separate things. And I just want to make sure I have this straight. One is for large organizations, you need to mine the store to make sure you're remaining profitable and you take care of that. The second part is having a structure and as you shed those gates, in order to explore innovation and reward innovation and make sure it's properly funded.

And then a third approach is seeing what's on the horizon. And if a technology or company matches acquire them. Did I capture that?

Joy Kelly: Yes, much better than I said.

Stephen Ludwig: I think it's super interesting. Now I'm going to switch gears again, because I think there's a program you want to talk about that Jacobs is very involved in. The FIRST Robotics program and FIRST is an acronym for, For Inspiration and Recognition of Science Technology. Boy, that's a mouthful. Now it's designed to help young people get interested in science, technology, engineering and math, which is STEM. That's another mouthful. I understand that Jacobs is a large supporter of the FIRST Robotic program at the Johnson Space Center. Why is that? Why do you guys support that? Why is that important to you?

Joy Kelly: Because we love it for one, but I actually had a call with them today learning about what they're doing in the midst of COVID and now the students are using virtual means to continue some of their research. But on a serious note, we desperately need more people, more young folks to choose engineering and people are not going into engineering as much as they used to. And so for our country to be really viable, we need more younger people to continue to be interested in science and math and engineering.

One of the great things that I love, I'll say most about FIRST, is that it's not just about what they learn technically. It's their moral compass. It is collaboration and integrity. And those teams, when you have the opportunity to go and judge and listen into these young students, they are all inspiring and they help each other.

They'll be on the field competing, but if somebody has a part that's missing, they will go help out. It's truly a remarkable program that does a lot more than gives students access to STEM activities. The other side of that that I've been particularly pleased with is seeing how teams have pulled young girls in at an age where they may start being less interested stereotypically in math and science and pulling them in and giving them meaningful roles.

And the team I was most impressed with is an all girls team from Austin that came up with a way to pull in girls who were interested in art and other disciplines and found things to do on the team. And they actually got interested in engineering and they would've been on the team if there hadn't been a role that was created that brought in more of their skillset.

Stephen Ludwig: Wow. That's really amazing.

Joy Kelly: Yeah. It's truly an incredible organization.

Stephen Ludwig: You mentioned when you were younger in high school, someone had encouraged, you're good at math, you're good at science, go into engineering.

What do you think it would've been like for you or women of your generation in general or moving forward to have had a program like the FIRST Robotics program? What would that have been like for you? How would that have been different?

Joy Kelly: For me, the way it would've been different is very early on, I would've entered college with a confidence level on the mechanical and hardware side of things, rather than just my strong capability to learn math and understand textbooks. So I think it would've just given that hands on experience that it would've made things more fun rather than the struggle to say, "Okay, I've never worked on this system or that system. And trying to sort that out, I would've been totally unequal footing to my male counterparts. I made it through and I made A's, but it would've been a little bit easier.

Stephen Ludwig: Yeah, I bet. Now there's still a huge discrepancy. I mean, we all know this, that fewer women go into these fields. What do you think parents could do to encourage their young daughters that might be interested in... that have a natural proclivity to this? Or as you mentioned, some people might have other skills that would tie nicely into this.

Joy Kelly: I think getting girls introduced early on two things that introduce science and math, there's so many... there's books, there are programs depending on the size of the city you live in, there are kits you can buy. And I think just expanding the physical hands on experimentation, I think is the biggest key for a different set of experiences than what during my era was more common.

Stephen Ludwig: Got it. That makes sense. Jacobs support of the FIRST Robotics program seems to reflect Jacobs' larger commitment to diversity and inclusion. And that seems to be a big thing for Jacobs.

Joy Kelly: It is a huge thing for Jacobs and it's great to see, not only through our STEM outreach, but within our corporation, what we're doing on the diversity and inclusion front. And our core value on inclusion is, and I love this, it's called we live inclusion, and that is so different than a statement about diversity and inclusion.

And if we live inclusion every day, then everyone is welcome at the table. And that then goes to innovation because if I say yes to everybody at the table, I'm going to get a much better product, better solution, a better set of ideas to work from than if people around the table think like me, look like me. And from the top throughout our company, I have been really, really impressed with how our leadership has set that as a non-negotiable.

Stephen Ludwig: Very nice. Now we've covered a lot of topics. We covered the robotics program. We covered innovation. We covered your work at NASA. Is there anything that I failed to ask that you wanted to talk about or mention today?

Joy Kelly: Actually, I would like to go back to the high school math teacher story, because for years I didn't really think about him. And then probably 15 years ago, I said, I really would like to track him down and say, thank you, because he doesn't know what I did with my life. And I finally, two years ago, tracked him down and he actually lives in Austin, and I was able to write a letter. I found him through Facebook, his niece was active. He was not. But his niece was nice enough to give me his email and phone number. And so I wrote the letter and then called him. And then a year later she invited me to his 75th birthday party and I got to go up there and see him. I just think about being able to say thank you to somebody that shaped my life so much, was really, really awesome.

Stephen Ludwig: That's amazing. And what's your PhD and we didn't talk about that.

Joy Kelly: It's in and adaptive control of flexible robots.

Stephen Ludwig: Yeah. And I bet you're the only student of his that has that doctorate.

Joy Kelly: Probably.

Stephen Ludwig: Yeah. That's really amazing. That's a great story. Wow. Jacobs does a lot of really interesting and amazing things. Where can people find out more information if they heard something they'd like to learn more about today.

Joy Kelly: Just Google and go to jacobs.com. We have tremendous amounts of information out there on all the cool things we do around the world. And it truly is amazing, the diversity of what we do in this great company.

Stephen Ludwig: Joy it's been terrific talking to you. Thanks so much for joining us today.

Joy Kelly: Thank you. It's been really fun. It's an honor to get to do this. And I am thrilled just to be part of Jacobs.

Stephen Ludwig: Thank you for listening to Inflection Point, a podcast series from Jacobs. To find out more, please visit jacobs.com. Jacobs, challenging today, reinventing tomorrow.