David Starr:	[music playing] Welcome to the Microsoft Industry Experiences Team Podcast. I'm your host, David Starr. And in this series you will hear from leaders across various industries discussing the impact of digital disruption and innovation. Sharing how they've used Azure to transform their business. You can find our team online at aka.ms/indxp or on Twitter @industryxp. [music playing]
	Hello listeners. Today we're going to be talking Internet of Things, primarily with Joe Byron, who's chief technology officer for Internet of Things Technology at PTC. In this role, he oversees product strategy and technical architecture of their core Thing Works IOT platform. Analytics connectivity and application development tools, all these things for industrial IT. Joe, welcome to the show.
Joe Byron:	Hi David, thanks for having me. That intro sounds really cool, I'd like to meet this Joe guy.
David Starr:	Yeah, he does sound like he gets a lot done, doesn't he?
Joe Byron:	Yeah, don't let it fool ya.
David Starr:	Also joining us today is Diego Tamburini, the principal industry lead for Azure manufacturing in the Microsoft Industry Experience Team. Diego, welcome.
Diego Tamburini:	Thank you, David. Great to be on your podcast.
David Starr:	And in this episode, we're going to be talking IOT and industrial applications, as we mentioned. The changes these technologies drive, the role Azure played in PTC's solution, and emerging technologies in the industrial or IOT space. We'll get there in just a bit. First Joe, I'd ask you, could you tell us a little bit about PTC, Internet of Things, and your mission in the IOT space?
Joe Byron:	Yeah, you bet. So, PTC's general mission is to help customers that are in the business of creating products, designing and manufacturing products, and operating products and machinery in the course of doing, what I like to call, the grownup work that actually moves the world. So, our customers have enjoyed, you know historically, the original PTC products were the CAD design tools, so a product called Pro/ENGINEER, which was launched in the mid-80's. We now call that PTC Creo. PTC Windchill, which is a product life cycle management system for managing building materials, the project roll out schedule, the design phases of products, and so forth.
	So, for a very long time PTC has served these product manufacturing companies in the design of their products, using digital tools to design what will become a physical production-ready product. But, about four or five years ago, as the IOT was becoming a macrotrend in technology, PTC got the brainwave that we could really help our customers with the full life cycle of their products. Not just in the design phase, but also in the servicing of those products as they're deployed in the field, as operators of those products use the product in the course of doing

their important work, and even in the manufacturing cycle of producing the product themselves.

So, we get on a tear of developing the Thing Works platform, which is an IOT platform. We often refer to it as an industrial innovation platform. This helps us bridge the gap between the design phases, when a product begins its life in a digital world, help it become a physical product. So using IOT and analytics to aid in the construction, efficient manufacturing process to developing and manufacturing the products. And then as the product transitions to its useful life, or its put into the field, it's put into service so to speak, we can our customers, be they the product manufacturers themselves or the operators of the products, better service, maintain, and get the most useful life from the products. Makes the product a lot better, that's why we're a product life cycle management company.

David Starr: I'm very compelled by the idea that built in to your platform. It sounds like you have what amounts to almost project management capability that leads to putting your assets in place, and the devices that you're helping build.

Joe Byron: Yeah, that's right. So, we think of a complete circle of a product's life cycle. Designing, designing means using the CAD to design the physical structure of the product. Managing the project of rolling out this project as a new product introduction. Collaborating with the design engineers and the manufacturing engineers, "Okay, we designed this thing, how are we gonna build it?" So, translating the bill of materials from design to the bill of materials from manufacturing. That's the category of what we classically call product life cycle management.

But, then our Thing Works platform helps those same customers with the efficient manufacturing of the product itself. So, IOT technology to instrument machines in the factory, to connect to PLC's and controllers that dictate the automation cycles of equipment. And reaching out to related business systems in the manufacturing environment, such as MES system or manufacturing operations management system. To bring all of the relevant information together in one place to make smart decisions about how to best optimize the production schedule, quality of the product, and then taking that digital thread, as some people call it. If you gather up all of this information from the design through the manufacturing, everything that we know about this unit as it was produced, that has tremendous impact on how we can best service that product as it's put into the field and begins its operational lifetime.

So, IOT has been a transformation technology for us to deploy to help our customers complete that full cycle.

David Starr: You mentioned manufacturing of the equipment itself, how do you use IOT on a factory production line?

Joe Byron:	Well, you know over the last 30 years there's been a tremendous trend in automating many safety critical and tedious operations in a factory. This automation has typically been deployed on a work cell basis. So, if you're a discrete manufacturer, discrete manufacturing means we're building stuff as opposed to transforming stuff. So process manufacturing would be say, making cornflakes or soda, snack beverages, or oil and gas refineries. Discrete manufacturing means we're making widgets. So if you're making widgets, you organize your factory and production lines, and the production line may have a work cell. A work cell might have classically used a human operator to pull a lever or insert some widget inside of another widget. Over the last 30 years, we've deployed robotics technology and other automation technology that programs how those [inaudible 00:07:20] activities should happen.

But, it'd been little [inaudible 00:07:23] types within the manufacturing floor. Industry 4.0 is a term being broadly used as this next cycle of industrial innovation. We had the industrial revolutions one, two, and three. Number three being this use of automation and computerization. Industry 4.0 would be bringing all of these things together to optimize the entire production. So that often means gathering information from controllers that are controlling CNC machines and robots, sensors that are on conveyor belts, and environmental areas that measure temperature and humidity. And make determinations about the best combination of work scheduling, deployment of human personnel, and looking at the environmental forces and status utilization of the machinery being used in the manufacturing process, to optimize the uptime of that machinery and optimize the use of the machinery.

David Starr:	I'm wondering if you might have a customer scenario or two to share with us about the success of your product in the field?

Joe Byron:	You bet, we have a couple. There are two main categories of use cases that we see for industrial IOT. So, I'll explain those really briefly so that you understand the examples in that context. Many of our product manufacturing customers develop and produce high-complexity, high-value assets. So think about an MRI machine used in a clinic. Think about an industrial air mover used in a manufacturing environment. Or think about a giant hydraulic pump that's used in a wastewater management facility or in an oil refinery.

Those manufacturers often sell service contracts to their customers who are using those products. The service contract says, "We'll come in and fix the stuff when it breaks." Great, so the historical way of doing that was the stuff would break, then the customer would call the manufacturer, call the service team and say, you know, "My stuff's broken." Some dude would get in a truck, roll out to the facility, assess the situation, go back, get the parts, come back the next day and fix the stuff.

That whole category of the product manufacturer who's looking to use IOT so that the experience of using their product is better for their customer, we'll call that building a smart, connected product. It was connected before, so we had to

send people out to fix it. Now it's connected, we can know things about the product's usage and give alerts for improper use. We can predict using machinery and other analytics technologies when the product may fail, and we can make suggestions about how it should be optimized.

So, in that former category, smart, connected products, we have some really exciting customer wins together with Microsoft. Thing Works works very well on a Microsoft Azure platform, and we've formed a very strategic partnership between Microsoft and PTC for that combination. So, Coal Facts is an example here. Coal Facts is a diversified industrial technology company. They've got several divisions of product lines, but just a sampling of their products include their Houdon division.

Houdon manufactures precision gas and air handling units. Think about really giant industrial strength fans. Houdon has used Thing Works and Azure, including but not limited to, Azure IOT, IOT Hub, and IOT Edge, and related services to do kind of the smart connected product remote service use case that I previously described. So Houdon's customers now benefit from predictive and prescriptive analytics used in conjunction with these newly connected machines. So, Houdon's service team can better service the industrial fans because they know when a failure event may occur in the future due to the instrumentation of the products with IOT, and the deployment of machine learning technology that can sense patterns that a human being could never come up with the formula by hand.

David Starr: That senses patterns of possible failure before they happen so you can get to them ahead of time.

Joe Byron: That's right. The way I like to describe wind machine learning is best utilized in these kinds of circumstances, is if there are operators or maintenance personnel who are familiar with the class of equipment, so you've got the machine-whisperer guy right, "I know by the sound of that fan something's gonna happen pretty soon." Maybe those people also have a heuristic in mind, "So I know if we can measure the fan speed or detect the vibration, and the vibration is over this number of G's in the X direction, then we know that that typically leads to a failure."

That's great, that's a rule. So, your IOT platform should have a very easy way for people who know that magic number to dial it in so that they get a proactive alert. That's funny. It's when there is a confluence of information, it might be multiple status indicators, multiple environmental conditions, humidity levels over a certain period of time, operating temperature above a certain threshold for a certain period of time, the number of hours that the last technician who touched the equipment received in training, all of these factors are too complex for a human to dictate the formula. That's a perfect job for machine learning. A machine learning engine and a properly trained algorithm can take in that big data stream and find the patterns automatically.

Diego Tamburini:	I was going to say that Thing Works falls into a relatively new category of industrial software systems, which [inaudible 00:13:30] then goes to your IOT platforms. The way we look at this platform is that industrial IOT platforms are built on top of a general [inaudible 00:13:39] cloud, like Azure, that of course has services for analytics and IOT to support the platform. But, then this IOT platform, like Thing Works are used to build IOT solutions. The solutions are the ones that end users actually use to extract inside, [inaudible 00:14:03] inside out of IOT data. So these platforms have kind of a rapid development tools, if you will, among many other things like UI development and they take care of a lot of the connectivities, as I mean PTC before Thing Works acquire [inaudible 00:14:22] that had all the nasty sausage making, if you will, to connect to devices and handle with different protocols and so forth.
	And then these platforms also do [inaudible 00:14:35], allow people to define the rules and also rebuild solutions that can be used as a starting point for you and solution with configuration. So, that's where we see an importance of this platform is that for most manufacturers, is probably not practical to think, "I'm going to develop my own IOT solution on top of a cloud directly." So, they will get much faster time to value using an IOT platform, which has PTCs.
Joe Byron:	You bet, very well stated Diego. I think this is an important point also that, the way that our partnership between Microsoft and PTC has unfolded is we've really found that these product manufacturing enterprises have a strong desire to optimize the way they're products are used, and the way that they product their products. And there's clearly a role to be played by IOT and analytics. However, these enterprises do not have teams of cloud architects and data scientists. So, the Azure cloud and related tools from Microsoft are extremely capable, sharp tools for experts to get amazing things done.
	So, if the market of industrial IOT was mature to a state of, say, CRM, it would be very straightforward for a solution provider to say there's a one stop shop solution for industrial IOT. We've but all the knobs and dials, you don't have to do any software development, it's all pre-built, just configure your way to using the solution. This is the case today for CRM. There's accounts, there are leads, you've got some support tickets, and so forth. So, we understand that.
	No one would expect they're going to build their own CRM system. You've used Microsoft Dynamics or salesforce.com, right? In industrial IOT, the settings in which these innovations can be applied are so varied, and each manufacturing plant, each product, is a unique snowflake. We need to bridge the gap between custom development with sharp tools and a complete turn key solution. Our approach at PTC has been the Thing Works platform. It is an easier to use set of tools, does not require deep expertise in computer science, data scientists, or tenure software architects, but can be appreciated by such folks. But it allows these manufacturers to design what they need for their solution. Taking advantage of the power of the Azure technology underneath.

And over the top, we've started to layer some pre-built solutions that take advantage of the experience that we've had in rolling out this platform to many customers. Over time, that layer of complete solution will get fatter and richer. We'll have a much broader market that we can address together.

Diego Tamburini: So, Joe, I think it's interesting for the topic of this podcast and this discussion to bring up the strategic partnership PTC and Rockwell Automation announced back in June. Could you tell us a little bit about it and what it means for industrial IOT ecosystem?

Joe Byron: Yeah, you bet. We're very excited about the Rockwell Automation partnership as you can expect. So, think about two ends of a spectrum, on one end there's a company that very deeply understands how products are designed and come into creation, that would be PTC. We help our customers design, manage the design process, and now with IOT we can help them connect their products.

On the other end of the spectrum, is Rockwell Automation who very deeply understands how to instrument a factory with programmable logic controllers, components that goes into industrial machinery used in production, like variable frequency drives, and so forth. And also understands the business of software that manages the manufacturing process. As PTC has learned much more through out IOT journey and helping our product manufacturers, we learn much more about what it takes for a customer to be successful in their manufacturing operations.

Rockwell has equally become much more experienced with the business of developing software that serves that same market. So, the partnership is sort of like the two ends of the spectrum meeting in the middle, helping each other. At the end of the day, it's really all about bringing better value to customers. We truly believe that. The Rockwell team now has the full experience of PTC team and the Thing Works platform, and vice versa. So we're very excited about how we can best serve this manufacturing segment together.

Diego Tamburini: It is very exciting.

David Starr: You had touched on this just a little bit, but I'm wondering if any of the Azure services or capabilities stand out to you as you built out Thing Works?

Joe Byron: Yeah, you bet. So, first of all, my experience before PTC was with a company called Exceeda. And for about seven years I worked as chief architect of Exceeda, which was a remote solution platform, remote service platform. We were totally focused on this idea of helping product manufacturers remotely connect to their machines so that they could remotely diagnose. As chief architect of Exceeda, before Exceeda was acquired by PTC and I joined the PTC team, I was knee deep in building a scalable architecture for connection to millions of machines and receiving high volumes of data in the form of IOT

	messages through these millions of connections. Let me tell ya, that's a hard job.
David Starr:	So that's kind of a homegrown, internal cloud?
Joe Byron:	Doing a homegrown, because it was before there was your IOT Hub. So nothing was available, we had to build it ourselves. When Azure IOT hub launched, I was extremely relieved. We had a very robust system at PTC that we had developed with much blood, sweat, and tears. We were proud of what we had accomplished, but when we saw that Microsoft had put focus on this area, we decided to go all in with Azure IOT Hub. So, today Thing Works on Azure takes advantage of IOT Hub. IOT Edge, and other very related Azure services, such as, of course, compute and storage, but also Azure sequel, and other storage options in the Azure stack. It's really helped us catapult our differentiation, which is understanding the nature of the design of the products and helping our product manufacturers get quick value from this high technology. It's let us focus on that stuff, while we've got our partner Microsoft helping us with the infrastructure and those very, very important characteristics of scale and security for device communications.

Ideally, well no I wouldn't even say ideally, theoretically, they wouldn't need to know it. But, we love to talk about it. First of all, we're excited about the partnership. Our customers are very interested in how we can best utilize their Azure investment. Many of these enterprises have already gone all in with Microsoft as their cloud provider. So, hearing that the Thing Works platform fully utilizes Azure, and by the way, that really awesome Azure IOT service that you hear about, yeah, we use that. Thing Works has clicked into that. Streaming analytics, Azure [inaudible 00:22:46], these very high value platform services in Azure, customers are interested in using them, they just might not have the internal expertise to wield them themselves directly. Thing Works works as the buffer between those sharp tools, has been a very winning combination. |
David Starr:	One more question for you, that is what technologies do you see coming down the pike that get you excited and amped up?
Joe Byron:	Wow, so, technologies across the board or Microsoft specific?
David Starr:	Let's go across the board.
Diego Tamburini:	Manufacturing, yeah.
Joe Byron:	Yeah, that's a great idea Diego, so let's start in manufacturing. One of the things that I think is really gonna help this Industry 4.0 vision come to fruition is taking advantage of the programmable logic controllers used as the link between automating a machine and actuating the machine. These [inaudible 00:23:48], currently, don't really understand IOT. So, we're deploying additional gateway

computers, and other forms of edge computing, into the factory and learning how to help those PLC's interoperate with this new breed of IOT gateways.

An exciting development that I see, which is already started in many of the PLC manufacturers, Rockwell being one of them, is the conversions of the PLC and the IOT gateway. So, one brain that understands how to coordinate with a cloud based system, how to coordinate with manufacturing execution systems, and yes, how to actuate the machine. So, that gap is closing, and that's very exciting to me. You can only get excited if you had spent a lot of time, perhaps, on a manufacturing floor, but trust me that is an important development.

And then broadening out into the wider technology-macro sphere, AI obviously, so I'm a computer scientist and I went through the 1990's [inaudible 00:24:52], forget which AI winter that was, but it's still the first or maybe the second. I was always quite disappointed at how AI was sort of stuck in the mud. It's been so exciting these last several years, particularly with the advance of GPUs, and how we figured out how GPUs are actually really good at doing vector math, which is what much AI is based on. So, the rapid evolution of AI is extremely exciting. I know most people say that, but I'm most excited about it because we have an idea, actually a very well informed idea, that machine learning in particular, can profoundly impact the way that we service and manage the machinery. Again, that machinery that is part of the most important operations in the world. So AI, and the convergence of technology in manufacturing operations is what I'm most excited about.

David Starr: With that, we're about out of time. Joe, I wanna thank you so much for being on the show. This has been an incredibly enlightening episode for me. And Diego, thank you very much too.

Diego Tamburini: Thank you David. And thank you, Joe, for you insights today, and also PTC for your partnership. We appreciate it very much and we're excited to be working together on IOT.

Joe Byron: My pleasure guys, thank you so much for having me. This was a lot of fun and you guys are great.

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