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Paul Thies: When you manage a life-essential service, you can't simply shut things off as you sort out how to deploy emerging technologies. You have to be agile in your approach while literally keeping things flowing.

In the world of water management, that is literally the case, as operations managers are learning how to deploy tools such as artificial intelligence, digital twins, and big data, and exciting new ways to enhance how they provide water to their constituents without interrupting service or safety.

Hello, I'm your host, Paul Thies, and on this episode of *If When,* our discussion focused on the topic of digital water. Joining me are John Rickermann, Managing Director Technical Services Group for Jacobs, and Gregg Kennedy, Jacobs Vice President Water Platform. We discuss the role that data science can play in water management, including how it can positively impact operational costs and sustainability endeavors.

Well, John, and Gregg, thank you both so much for joining me today. I'm really looking forward to talking with you about the concept of digital water. Water, of course, is life essential resource, but how we're deploying emerging technology to take care of our water. It is a finite resource. It's hard to believe, but it is, and so we really need to take extra care with it, and so I want to thank you both and I'm looking forward to diving into this with you.

John Rickermann: Great, thanks, Paul.

Paul Thies: John, let me start off with you and let me just ask you to describe what digital water is?

John Rickermann: Yes, not only is water, one of those precious resources but so are the people that produce clean water for us. Digital water, to me, is a set of tools that help that limited resource, our people, do their jobs better.

We hear a lot about the do more with less thing and we're really seeing that in water and wastewater treatment from an operational standpoint at our plant sites for ourselves and our clients, and we're asking our operations and maintenance staff to do a tremendous amount of high-value work, critical to public health, just an incredible amount of responsibility but they really, up until now, haven't had all the tools to be effective in their jobs.

For example, we have predictive tools now with data science with digital twin modeling that allows us and our operations staff to know what's coming before it happens. Traditionally, for the past 100 years, it's been a reactive field, something happens at the plant, because you don't control flows, typically, you react to what the community demand is and you have to respond to that. It's always been reactive. Now we've got tools, which I call digital water that allow you to get proactive, and that changes the game.

Paul Thies: Now, you mentioned digital twins, and one of my initial forays into understanding the concept of digital water was the use of digital twins for plants and

through a customer portal about capital activity that might be going on in their area? That customer interaction is the first pillar.

The second pillar is what I call regulatory compliance or operational compliance. How do we make sure that we've got drinking water quality that is meeting standards? How do we make sure sewer overflows are not happening? How do we prevent some of those incidents from happening and stay within our compliance limits?

It's a big part for data science to play there, to monitor and control how we operate those assets. The third pillar is what I call planning and investment. This is when we're thinking longer term. How do we use the data science? How do we use the data that we're gathering on day-to-day operations to inform the assets, the networks, and the decisions we have to make 5 years, 10 years, 15 years down the trip?

As an economist, I'm attracted to a concept called intergenerational fairness. That means the amount of assets I'm consuming today, I have to make sure I'm handing over an asset stock that's fit for purpose to the generation, to my kids, to their kids. This is where data science plays a big role because we now think across the entire asset lifecycle. Data science has a huge part to play there to help us understand the asset lifecycle.

That takes me to the last point, the physical assets themselves. How do we know what state they're in? How do we know how they're operating? Are they operating with intolerance? How do those assets work together? Data science is giving us the ability now, not just to understand single assets, but to group them across networks, to understand how catchments work, to understand how associated incidents impact other parts of the network.

Data science is really lifting back the cover and letting us see under the ground in real-time how is an entire network working together. It's no longer just in the brains of our people who, as John said, are aging out but it's now giving the rest of us a chance to see it in live real time. It's been a real powerful move for water utilities to adopt these data science techniques.

Paul Thies: Amazing. Then, John, let me ask you about the kinds of data that are getting generated and the insights that we're mining from that. I know a little bit in terms of the digital twins and being able to see the asset lifecycle, how close things are to potential failure needing to be replaced. Can you talk to us a little bit about what kinds of insights we can actually mine from water quality **[unintelligible 00:12:33]** that geography? What are some of the things that data scientists are able to look at in this sector?

John Rickermann: Sure. I could probably cite examples in all four of the pillars that Gregg just described because there are applications for all of that, obviously. I'll just give a couple of examples around the regulatory compliance, water quality and compliance, for example. We take a tremendous amount of lab testing data just to meet regulatory compliance standards.

The application of data science and what we call these optimizing models helps us to understand when we change the operating parameters of these assets, we can see the impact on these deliverables. That's where we can make a big contribution to the sustai

Talk to us a little bit, John, about the cybersecurity aspects impacting digital transformations and how do we, or how do these digital water experts, how do you all counter those to make sure that the water stays safe?

John Rickermann: Yes, it's a great question and something we've been thinking about for years. The cybersecurity landscape, even without doing data science is pretty scary, very sobering. We started about five years ago with a pretty rigorous cybersecurity program at some of our most critical sites, typically water plants for obvious reasons.

In fact, quick story on that, we were running at the time a water plant near where a Super Bowl was being held and there's a security protocol nationally for big public events like that, and there's a security perimeter, physical and cyber that is involved in planning for a big event like that and we were within that circle.

The regulatory agencies, one of the three-letter acronym agencies, says, "What's your cybersecurity posture at this drinking water plant which will supply this event?" Oh, we have some really excellent cyber expertise in Jacobs, so we brought them in and says, "Hey, guys, let's take this up a notch," and we've partnered with a vendor that's topnotch that some of our national security agencies also utilize and implemented that at our water plants and it's been astounding what it can do.

That's just a normal course of business for us in a lot of utilities now, is stepping up their cybersecurity defensive posture in the face of bad actors internationally or just your backyard hacker or the ransomware attackers. Those are the three big attack vectors we see.

From a data science perspective, a lot of the source of our real time monitoring is the industrial control system that we use at a treatment plant. These are pretty

The bottom-up is very interesting as well, so you're asking people to trust what their computer's telling them to do and these are folks that have been running plants for decades in many cases and doing quite well at it. Why should I listen?

I'll go back to that GPS example. Who would've thought that everyone would've paid $500 for a computer to tell them how to drive, but that's what a lot of us do now because there's a benefit. We call that with them, what's in it for me and if we can reach our operations and maintenance staff and let them know this is going to help you. You're overworked. We recognize that. These treatment systems are getting more sophisticated to meet environmental needs. We recognize that. Here's a tool to help you do your job that reaches them.

We also give them time, so that's a big factor at the ground level. We don't just throw the system at them and say "good luck". There's a lot of working them into it, helping them understand, working their way down. That one plant that Gregg alluded to previously where we did a blower optimization, we sent them notifications on their smartphone and tablets in the field, "Here's what we want you to change your blower setpoints at."

They didn't embrace that instantly, they wanted to get comfortable with it. "Can we do it partway of what the computer's telling us?" Sure, and they worked their way down to the full recommendations. Now they trust it. They're like, "This is great, this actually works."

There's another critical piece I'll mention back to the cybersecurity thing. Right now, any recommendations we make from the data science is air-gapped. We're recommending it directly to the field staff, not to the plant control system. If there is a breach in security, it's still up to the operator to say, "No, I don't trust that recommendation. I'm going to ignore it and do what I normally do," and that protects everybody, so that's where we're at right now.

Paul Thies: It still keeps the human in the equation, automation hasn't completely just upended everybody.

John Rickermann: Absolutely not. Now, this is just a tool to help them be more efficient and effective and they've still got veto, if you will. The computer doesn't know that this basin's offline or a storm event's coming through or whatever it is, we still need to run the plant. That's our responsibility and we're just here to help him do it.

Paul Thies: Awesome. Then, Gregg, my last question for our discussion today is where do you think the concept of digital water will evolve to in the next couple of years?

Gregg Kennedy: You've actually, you've used one of the words yourself there, Paul. I see the evolution of digital water along two axes. On the vertical, I see increased automation, and on the horizontal, I see increased, what I call, integration. Starting with automation, it is exactly the point that John raised. Right now, we are comfortable using data science to inform the insights that we need to make better decisions but we're still leaving those decisions in the hands of the operators. Certain areas of the world, they're moving more towards automating some of those

decisions, where you're taking the decision-making process because you have enough trust, and you have enough visibility, and you have enough history to allow the system to almost self-regulate.

One of our clients in the UK, Anglian Water, they're trialing a safe, smart system approach where ultimately the system will self-regulate, and they call it a self-healing system.

Very ambitious, but that is where digital water is moving towards on the automation space.

The integration space is just as interesting for me, and this is where you might have a data-led solution in your networks. You might have a data-led solution in your treatment plan. You might even have a data-led solution in your water catchment. Beginning to bring those adjacent data sets together, that's really going to unlock the next level of efficiency in the next level of optimization.

We started optimizing individual assets, then we started optimizing networks, then we started optimizing systems. Now, we're going to optimize systems of systems. This is where the data science is going to take us. I think that's where digital water is going to get to, and I'll give a big shout-out to the UK regulator, Ofwat, who are, they have an ambition to achieve what they call open data.

What they mean by open data is if they can anonymize it, but make all these trillions of data bytes worth of scatter available. Think of what a data scientist sitting in the back of his room might be the person that finds out the relationship that none of the rest of us saw. This idea of democratizing access to information, not just for the operators of the plan, but for those that are in the supply chain, the innovators, the entrepreneurs. I think that'll be the next exciting development.

If we can find a safe and cyber secure way to do that, and open data because it'll benefit customers, it'll benefit clients, and it'll ultimately be efficient because it'll allow the innovators to bring their entrepreneurial skills to work in what is effectively quite a difficult industry to penetrate, I think open data will bring that next wave of entrepreneurs into the water industry.

Paul Thies: John and Gregg, thank you both so much. It's been really fascinating. I really appreciate it. It's terrific to hear the work that Jacobs is doing, and that y'all are leading on. If folks want to learn more, please visit jacobs.com. We do have information about our intelligent L&M product as well as other efforts that we are doing in the digital water space. John and Gregg, thank you both so much for your time today.

John Rickermann: My pleasure. Thank you.

Gregg Kennedy: Thank you, Paul.

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