

Century Engineering turns to the cloud to keep our waterways clean

By leveraging IoT and automation, this innovative engineering firm monitors stormwater more efficiently to help remove pollutants, minimize flooding and reduce land erosion.

Our customer

Founded in 1953, Century Engineering is a multidisciplinary consulting firm that assists public and private clients in the planning, design and management of a wide range of engineering services, from civil engineering to wastewater management.

The obstacles they faced

Century wanted to leverage IoT and the cloud to securely scale its tech-driven system that monitored local conditions, assessed forecasted precipitation data and autonomously controlled the operations of stormwater facilities.

How we helped

Managed Public Cloud – AWS, Cloud Native Development, Internet of Things (IoT) and Edge development; Professional Services; Data Engineering and Analytics.

What we achieved together

Onica (a Rackspace Technology company) supported Century's SmartSWM™ product team in designing and developing the micro controller, IoT hardware and firmware, and the IoT backend to its AWS cloud infrastructure to deliver a resilient, innovative stormwater management control system.



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Bob Bathurst
Principal, Century Engineering

Seeking a solution to meet EPA compliance

Stormwater runoff is one of the greatest challenges for water pollution control, because stormwater contamination is a leading contributor to the impairment of water bodies nationwide, according to the Environmental Protection Agency. In 1987, the U.S. Congress mandated the EPA to control stormwater discharges according to the Clean Water Act of 1972. Among the EPA regulations is a requirement to monitor stormwater facility performance to help ensure intended pollution control goals are reached.

Meeting that compliance directive has not been easy, because manually monitoring stormwater facility performance can be difficult. Century Engineering, headquartered in Hunt Valley, Maryland, began looking for a solution that could provide real-time

remote stormwater facility monitoring and automated control. The result is the creation of an intelligent stormwater management system that leverages an Internet of Things (IoT) device and AWS Cloud.

To create the market-ready solution, the company utilized services from Onica. Onica is a leading AWS Partner Network (APN) Premier Consulting Partner and the expertise in IoT and AWS services that they brought to the project made them an ideal partner.

Choosing the ideal AWS partner

According to applicable local, state, and/or federal regulations, owners of developed land are required to treat stormwater runoff to reduce pollutants before releasing it back into the environment. However, without accurate, real-time precipitation

data, stormwater management facilities are predominately designed to retain stormwater runoff for no more than two days so they can be prepared for the next rain event. This uniform modeling assumes that all wet weather events behave in the same ways. This approach is counterproductive to achieving maximum pollutant removal and runoff reduction since prolonging retention time in the stormwater practice is the principal means by which enhanced pollutant removal and runoff reduction is achieved.

In 2013, Century Engineering conceived a new approach to the situation. Principal Bob Bathurst, a professional engineer and Diplomate of the American Academy of Water Resources Engineers, began working on an idea that resulted in the creation of a first-generation smart stormwater management system that used leading web application development frameworks, microcontrollers and sensors. The system was designed

to track current facility storage and precipitation forecasts, then autonomously control a valve to adjust stored water volumes. A stormwater management facility's storage volume is adjusted automatically in response to anticipated inflow associated with forecasted precipitation events. An outflow occurs in response to and in advance of a forecasted precipitation event; therefore, no discharge occurs during the precipitation event nor during the subsequent retention period. This technique provides the maximum retention time as determined from real-time, hyper-local weather forecast data while significantly reducing downstream erosion from flooding.

Our system worked well but needed to be prepared for production-level applications,” said Bathurst. “The system required improvements to the hardware configurations, and we needed to better

leverage the outputs of our on-board sensors so the system could perform more reliably.

“That’s when we turned to AWS, which connected us with Onica through its business partner program. Onica helped us to improve our overall product architecture, design custom hardware and refine our back-end logic to improve overall SmartSWM™ performance and scalability. Working with Onica was probably the best decision we could have made at that juncture of development. We worked really well together, and we appreciate everything the team has done to help us get SmartSWM™ where it is today.”

Solving challenges to deliver higher performance

A key driver for Century was the development of this innovative stormwater management solution into a product ready for commercial-level applications. As a result, the performance of the system had to be resilient under highly variable conditions, reliable so that it effectively improves water quality and reduces runoff, and secure to prevent unwanted intruders into the system.

These objectives were met thanks to Onica’s recommendations. Onica’s team worked on a solution for Century in two phases. First, it focused on refining the prior proof-of-concept hardware solution by integrating useful, disparate functions to read environmental data and control equipment. A key design consideration included overcoming a prior challenge with the analog-to-digital circuitry interface, verifying that the existing loop conversion did not destroy the analog signals.



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Filling knowledge gaps with AWS Cloud and IoT expertise

In phase two, the Onica team focused on enhancing the AWS environment and making improvements to the hardware by defining requirements for tamper detection and alerting, managing the signal-to-noise ratio, and providing component guidance, such as with the water depth sensor.

“The sensor that measures the water depth is an analog device,” said Bathurst. “The signal it sends looks like an EKG report. Obviously, water surfaces don’t modulate like EKGs. Onica worked through tedious issues like this.”

“There were many little fixes like that along the way through which we were able to leverage the experience Onica has and that we lack,” Bathurst said. “We had knowledge gaps around cloud architectures and AWS services in general. I don’t even have enough time in the day to think about these issues. The Onica team filled in those gaps and got our solution off the ground.”

Delivering high performance via real-time remote access

“We can extract hyper-local weather forecast data for any location,” Bathurst said. “We can also monitor our solar generation and consumption, and water temperature. That feeds into our backend decision support system, which sits in the cloud. It computes the optimal water surface elevations of the ponds, along with the discharge rate at which they should be releasing stormwater.

“All of that information is then transferred to our on-site micro-controller. Then it dictates

whether the release valves are opened or closed, and by how much. Everything is programmed. And we can go in remotely and perform actions, such as change the stormwater discharge rate if we need to.”

Making land use more efficient

“A major benefit to smart stormwater management is that we’re able to use land more efficiently,” said Bathurst. “Stormwater management facilities are different sizes and hold different volumes of water. With the SmartSWM™ technology, we can actively manage stormwater facility volumes and, as a result, each stormwater facility can occupy a smaller land ‘footprint.’ This efficiency yields more land for development or alternate uses.

“In addition, our experience has shown that public entities appreciate the higher pollutant removal performance, land efficiency and minimization of flooding and land erosion,” Bathurst said. “It’s just a new era in stormwater management.

“In my mind, the future of stormwater management involves connected, intelligent and adaptive infrastructure. We are already working on making interrelated facilities in a geographic region work as a system to further improve how we manage an entire watershed. This presents us with the ability to improve water quality throughout larger regions, not just discrete facilities, resulting in even greater positive impacts.”

Keeping an eye on the future of innovation

As far as the SmartSWM™ team has come in developing this innovative approach to stormwater management, Bathurst already sees an opportunity to take it to

the next level. “Traditional stormwater modeling techniques consider the hydrologic characteristics of watersheds to estimate runoff volume,” he said. “But we’ve come to recognize those estimates to be somewhat inaccurate. It can vary wildly. This is likely due to the industry-accepted practice to assume average conditions for parameters like antecedent soil moisture condition and mischaracterization of the soil’s ability to absorb water. However, once we have accumulated enough precipitation and runoff data, we can then apply machine learning to create predictive models that tell us how each stormwater facility will respond to weather events based on how the facilities have responded in the past.

“Machine learning is where we think we’re going to make our next big improvement,” Bathurst added. “We’ve already started developing algorithms to begin training. This is going to be another paradigm shift.”

Staying out in front of the market is critical for smart technologies. Bathurst said, “Working with Onica has allowed us to stay on top of the available technologies, and they have supported our project in a way that reinforces we are building one of the most reliable IoT and automated approaches to stormwater management.”

About Rackspace Technology

Rackspace Technology is the multicloud solutions expert. We combine our expertise with the world’s leading technologies — across applications, data and security — to deliver end-to-end solutions. We have a proven record of advising customers based on their business challenges, designing solutions that scale, building and managing those solutions, and optimizing returns into the future.

As a global, multicloud technology services pioneer, we deliver innovative capabilities of the cloud to help customers build new revenue streams, increase efficiency and create incredible experiences. Named a best place to work, year after year according to Fortune, Forbes, and Glassdoor, we attract and develop world-class talent to deliver the best expertise to our customers. Everything we do is wrapped in our obsession with our customers’ success — our Fanatical Experience™ — so they can work faster, smarter and stay ahead of what’s next.

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March 25, 2021 / Rackspace-Case-Study-Century-Engineering-ITT-TSK-3235