Lucas Emanuel Martins Proves *Going Digital* in Water Distribution Analysis is Ethically Responsible

Simulating Several Operational Scenarios of Water Distribution Certifies Water Security for Southern Brazil City

"What I like most about engineering is the impact we can make on society," said Lucas Emanuel Martins, an engineer at water utility Companhia Águas de Joinville (CAJ) for the past three years. "Working with water is even more motivating. This is the most important salable asset for humankind, [bringing] a huge responsibility [because] people's lives depend on what we are doing in our daily routine."

Understanding the great value of water for people, Martins' career focuses on environmental and water process engineering. He considers his most remarkable project one that has increased water security to a city population during future drought periods.

In 2020, the state of Santa Catarina, Brazil faced one of the worst water crises in more than three decades. A severe drought prompted water rationing and supply rotation at more than 100 of the state's municipalities.

Joinville, Santa Catarina's largest city, receives water and sanitation services from CAJ. The city's population of 600,000 draws water from two production systems, the smaller of which was impacted by the drought. Servicing about 156,000 people, the smaller production system retrieves water from the Pirai River, which is easily affected by lack of rainfall. Consequently, CAJ sought to determine an emergency plan to ensure an uninterrupted water supply to Joinville's residents in the event of another natural disaster.

"The project's challenge was to develop a solution to transfer water from the stable system to the fragile one during the drought period without causing supply problems to the other sectors," said Martins, who was project leader and the engineer responsible for developing the studies.

The company implemented a strategic hydraulic simulation of the water supply system to pinpoint what upgrades were necessary to maintain service. CAJ assessed three contingency alternatives and, ultimately, decided to construct a pipeline to connect the two production systems.

They created a digital twin of Joinville's water mains and macro distribution networks using Bentley Systems' water distribution design software to gauge system behavior when the systems

are linked. It was quickly determined that their initial proposed solution would negatively impact the larger production system.

As a result of this failure, Martins launched a complete study of Joinville's water mains and macro distribution system to seek solutions within the city's existing hydraulic structure. He assessed different interconnection points and multiple scenarios to understand how to transfer the water. Through the design software, CAJ determined the linkage points to redistribute flow from one production system to the other that minimizes the detrimental effects, while also improving basic operations and achieving financial savings.

"As engineers, we often cling to solutions that involve the greatest intervention and we overlook small opportunities for day-to-day improvements," Martins said. "Joinville's Contingency Plan project had the view of doing more with less."

How It Began

Martins grew up in the city of Florianópolis in Santa Catarina, Brazil. His initial interest in engineering emerged when he was a young student—he was ceaselessly inquisitive and wanted to understand how processes work.

"Ever since I took my first physics class, I had known where I would find the answers," Martins said. "Having a superficial view of things has always bothered me; I need to have a view of the whole and understand in depth the functioning of the structures I am working on. That was when engineering captured me because, in addition to understanding how things worked, I could now improve how things work."

Martins pursued his interest in engineering at Universidad Federal de Santa Catarina where he studied sanitary and environmental engineering. He spent one year studying in France at Graduate School of Chemistry and Physics of Bordeaux. After receiving his degree, Martins additionally specialized in hydraulic transients at Valencia Polytechnic University in Spain.

"It is such an honor for me to be able to work on something that is fully aligned with my life purpose," said Martins. "Knowing that we are bringing health and quality of life to people is really something that makes me proud."

He was initially employed by SERENCO, an engineering consulting company, where he worked on several water and sewage projects that included water catchments, mains, distribution networks, reservoirs, pumping stations, treatment stations, sewage collection networks, water and sewage master plans, hydro-energy optimization, and studies of hydraulic transients and water loss reduction.

“It was a period of great learning, but I wanted to be closer to where things happened, see projects come out of the paper and understand the operation of a water company on a daily basis,” Martins said. “Thus, I looked for new challenges at Companhia Águas de Joinville. At CAJ, I had the opportunity to work on engineering projects from their conception to the final implementation. I understood the challenges of maintaining and operating a water supply system, and I am now trying to contribute to improve our system.”

Upgrading Water Systems to Improve Lives

Martins has irrefutably enhanced Joinville’s water system with the recent hydro-energy optimization plan. And he recognizes that these advances could not have happened without building information modeling (BIM) software.

“It would be practically impossible to have the insights we had during the development of the project if we had not [implemented going] digital,” Martins said.

Because water is a valued natural resource, engineers can use models and digital twins to reliably assess a variety of operational scenarios on a water system without impacting service to the people who depend upon that infrastructure. Not only is this financially pragmatic, according to Martins, but it is also socially responsible.

“The digital revolution is happening incredibly fast. Each day, models are better representing the infrastructure we manage,” Martins said. “As engineers, we have an ethical obligation to use technology to optimize the use of our resources and effectively contribute to improve the environment and the quality of life for the people around us.”

For more information, contact Christine Byrne at christine.byrne@bentley.com.

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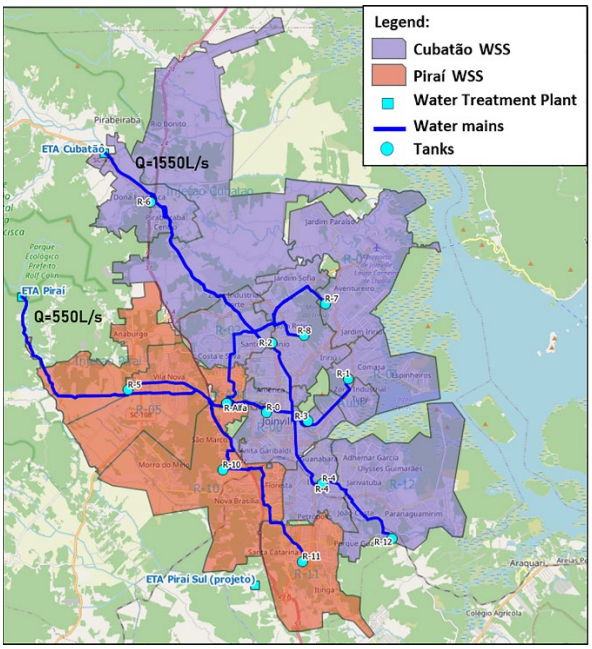
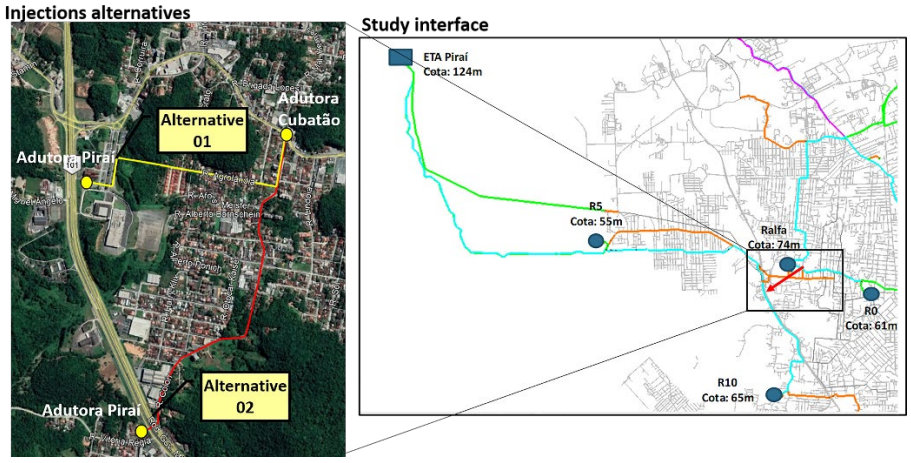
Image 1



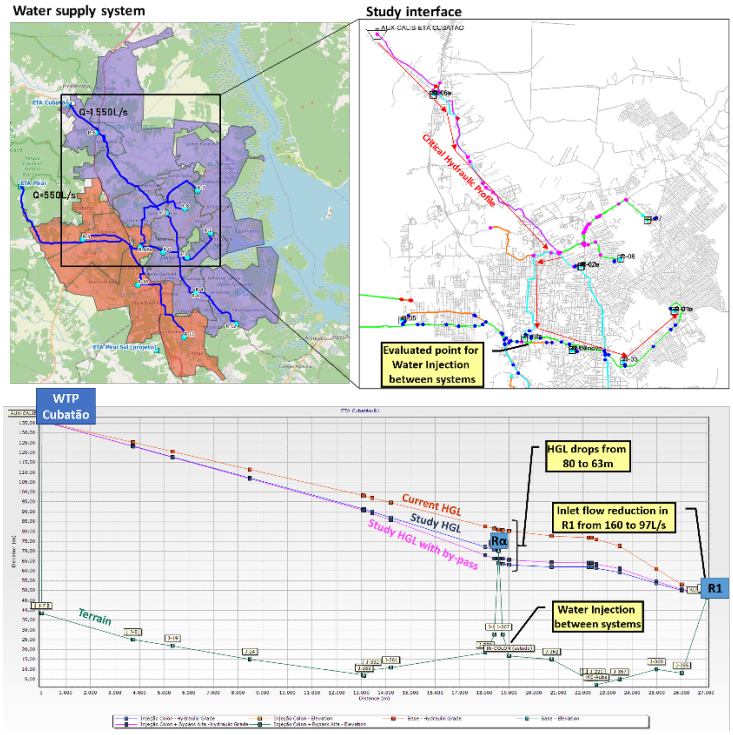
Caption: Santa Catarina's population of 600,000 draws water from two production systems, the smaller of which was impacted by severe drought. The smaller production system retrieves water from the Pirai River, which is easily affected by lack of rainfall. CAJ sought to determine an emergency plan to ensure an uninterrupted water supply to Joinville's residents in the event of another natural disaster.

Image 2



Caption: CAJ implemented a strategic hydraulic simulation of the water supply system to pinpoint what upgrades were necessary to maintain service. They assessed three contingency alternatives and, ultimately, decided to construct a pipeline to connect the two production systems.

Image 3:



Caption: Engineers use models and digital twins to reliably assess a variety of operational scenarios on a water system without impacting service to the people who depend upon that infrastructure. Not only is this financially pragmatic, but it is also socially responsible.