Machine Learning:
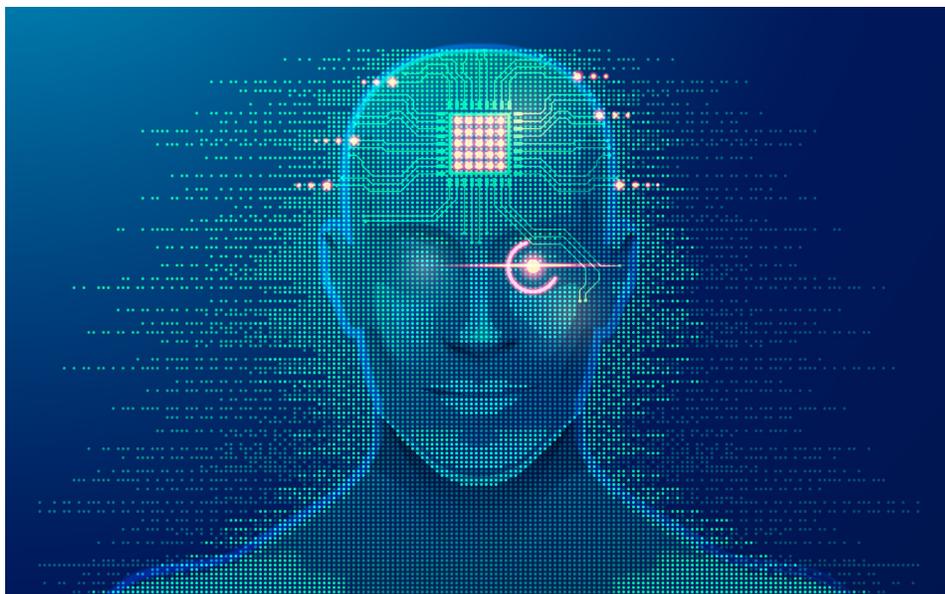## What Water Utilities Can Learn From The Power Industry

The proliferation of sensors, smart meters, and other instrumentation in the water treatment sector has led to a near inundation of data. Machine learning can interpret and utilize these massive quantities of data to produce forecasts and process models to aid utilities in long-term and short-term decision-making.

Forecasts based on machine learning are not a novel concept. Neural networks, which are algorithms designed to mimic the way the human mind makes connections between information, were introduced into the power generation industry in the 1980s. In the decades since, these technologies have been honed and refined. The lessons learned in the power industry –– and the associated benefits –– have since been translated to the gas industry and are gradually making their way into the water sector.

Modeling And Predicting Human Behavior

The power industry began leveraging machine learning and predictive modeling in order to generate forecasts about energy consumption. The challenge with electricity years ago was that it couldn't be stored. If the utility underproduced energy during high demand periods, customers could experience blackouts. Overgeneration, on the other hand, created excess costs that could result in increased rates and disgruntled customers.

To overcome this, power companies needed to have a strong sense of how much energy customers would need in a given time period. Machine learning systems take variables that affect electricity consumption and translate them into data that can be interpreted by the algorithms.

Water's Rising Need For Forecasts

Historically, water utilities lacked a need for demand forecasts; in the developed world, water used to be seen as cheap and abundant. In addition, water can be stored for use during high demand periods.

However, the combination of water scarcity and aging infrastructure has changed this. More and more water utilities are finding themselves needing to manage demand and flow rates, sometimes to preserve resources and other times to reduce pressure and stress on the system. While differences abound, the similarities between today's water industry and power industry are undeniable. Both need to ensure there is enough supply when needed and maintain a healthy distribution system. In addition, changing consumption habits mean both types of utilities need to be more flexible and adaptable.

There are several reasons why water utilities should consider incorporating machine learning systems into their operations.

Rapid adaptation to changes in consumption. When COVID restrictions first hit the U.S. in early 2020, many people either lost their jobs or began working from home. This dramatically altered the water usage patterns utilities were used to. While machine learning can't predict a pandemic, it can incorporate the sudden changes based on data from meters and other instruments to help forecast new short-term and long-term trends.

Leak/burst detection and prevention. A network with enough sensors can detect bursts or leaks after they have occurred, but as variables related to these events are entered into a machine learning system, the algorithms can begin to forecast potential problems before they occur.

Preparation for long-term changes. As populations grow, demand patterns can change. Having 10-year models of regional growth can help anticipate and prepare for not just an increase in water demand but new usage cycles.

Benefits Gained From Today's Machine Learning Technology

By adopting machine learning now, the water industry can benefit from the technology's decades of refinement in power generation. This includes:

Proven statistical approach. The mathematical principles of machine learning are based on regression analysis, which was used by Galton in 1894. Power companies continue to use it due to its proven accuracy and effectiveness. [Galton, F. (1894), *Natural Inheritance* (5th ed.), New York: Macmillan and Company.]

Elimination of manual processes. Many water utilities are already building forecasts in-house manually using Excel spreadsheets and hand-typed data. Machine learning takes over this role, producing dozens of forecasts based on different scenarios instantaneously.

No need for on-site expertise. The right machine learning solution providers also offer analytics services to help water utilities get the most out of the technology. Using such systems and interpreting the results can be a skill in itself, and having a solution provider who can aid in this process can make a big difference for those utilities that don't have or may not be able to hire someone with the necessary skillset.

Customizable models. No two water distribution systems and customer demographics are the same. Today's technology includes the ability to build models based on the nuanced specifics of the customer, while at the same time gleaning applicable insights from other utilities and water systems worldwide. ■