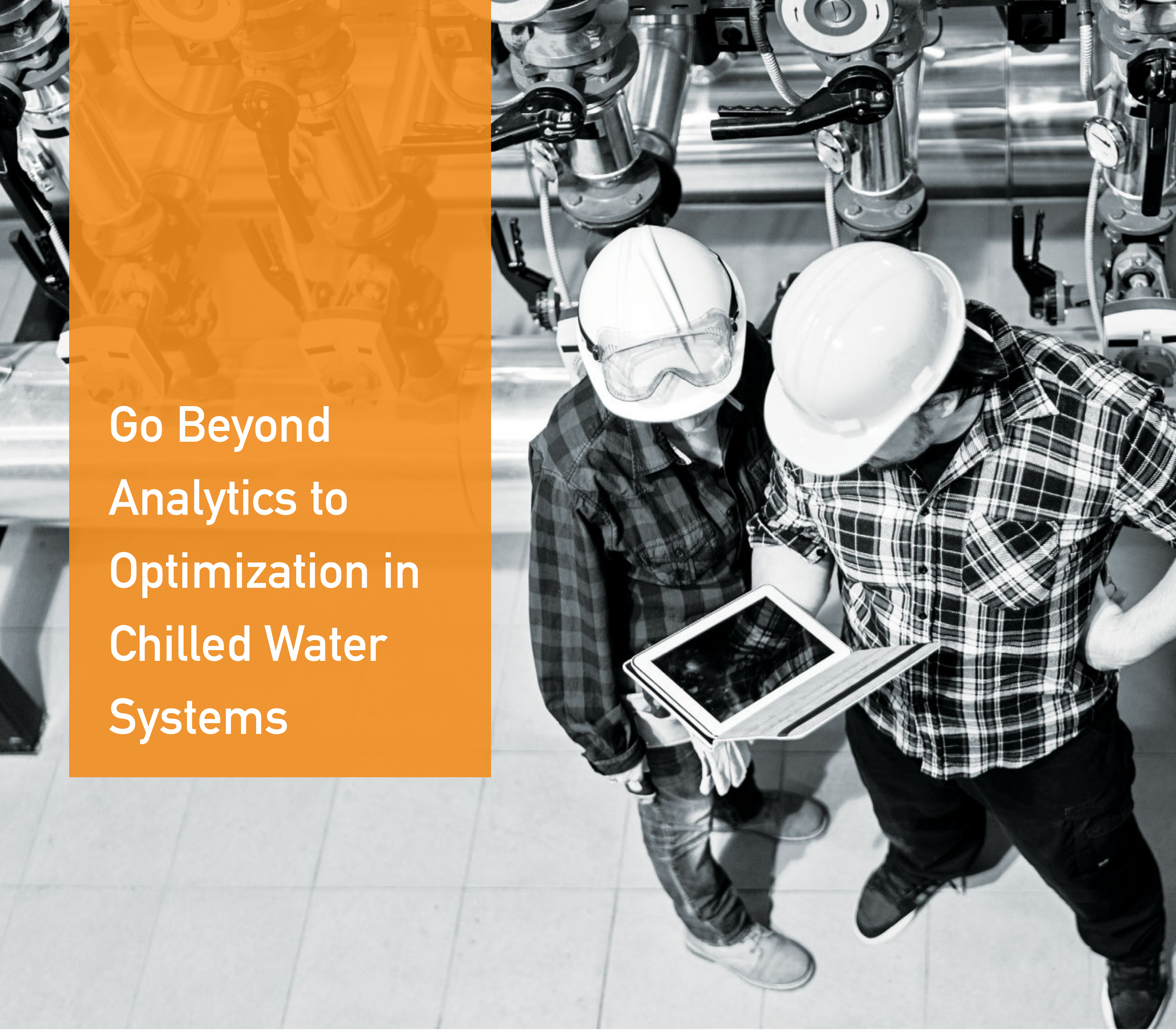


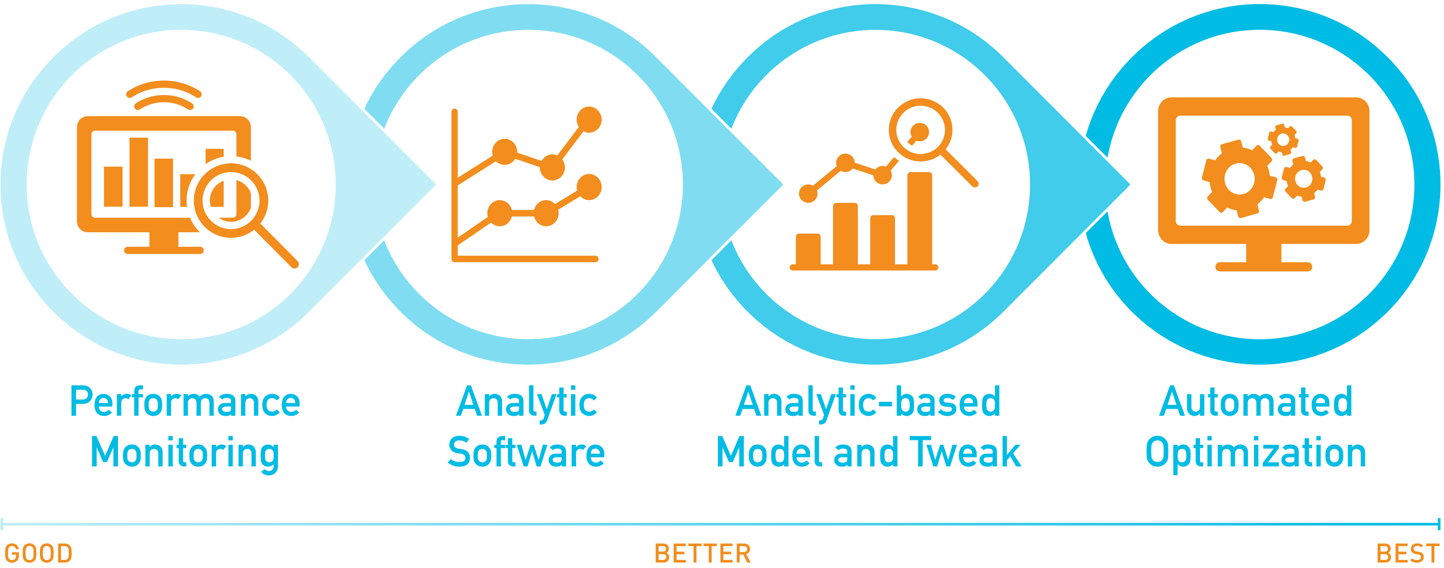
Go Beyond Analytics to Optimization in Chilled Water Systems

tekWorx

Analytic dashboards seem to be in every facet of our lives, giving us information, diagnostics and recommendations. Unfortunately, analytics as an actual cost reduction tool in chilled water systems are limited unless a human takes action on this information to adjust operations. Optimizing the efficiency of dynamic systems, such as a chilled water plant requires action, ideally continuous action, that does not rely on manual intervention.

Chilled water plant optimization has mostly been limited to analytic and model-based strategies. While these approaches may appear to deliver optimized efficiency, analytics simply suggest edits, not action. A plant's efficiency then rests on the frequency of human interaction, the individual's skills and diligence.

This white paper will show why going beyond analytic packages is the key to truly optimizing your chilled water plant. You'll learn the differences between the varying levels of efficiency improvements:



Performance Monitoring – A Good Start

Monitoring key process variables and performance data is the foundation of energy improvement. Any process must be measured, be it manually or automatically, before it can be effectively amended. Monitoring and visualization dashboards, whether local or remote, allow energy managers and operators to determine system efficiency and glean information from trend data to improve efficiency. The next step is up to the operators.

The Next Step: Analytic Software

Analytics go beyond graphics and commissioning reports to identify correlations or trends in the data, visualize this information and make specific recommendations for operational changes. However, reducing chilled water plant energy requires acting on the data through control parameter adjustment. Furthermore, it requires someone with knowledge of the system taking the time to set up the variables and parameters that you want monitored on the dashboard. In an attempt to get operators to act rather than simply observe, some analytics packages monetize the impact of corrective action.

Two general optimization strategies have evolved to attempt to satisfy this action requirement: analytic-modeled optimization and automated optimization.

Even Further: Analytic-based Model and Tweak

Analytic-based modeling approaches are clearly preferable to pure analytic recommendations and alerts. These models at least involve action, albeit manual and irregular.

This approach starts with pre-project modeling of the expected range of the load on the chiller plant, ambient conditions and power consumption data sheets to create a set of "recipes." The recipes contain operating sequence instructions that theoretically will operate the plant at the highest efficiency over the full range of conditions. These static recipes are usually stored in the cloud with access to the site's chiller plant control system. As conditions change during daily operations, the control system looks up the corresponding recipe and uses its values to control the plant operation.

While this methodology can help, it has two significant limitations. First, the pre-project model is unable to account for common issues, including:

- Equipment spec variation due to equipment age and condition
- Unknown system idiosyncrasies or maintenance problems
- Installation and construction mistakes
- Drawings and plans that are inaccurate or out of date

To compensate for this limitation, optimization system supplier technicians periodically collect actual operating data, re-run the model, tweak the recipes according to their best judgement, and download them so the plant control system has new values to improve the efficiency. The entire operate-collect-analyze-tweak process repeats itself periodically with operator intervention.

This process exposes the second major limitation of the analytic-based model and tweak optimization strategy. It relies on many technical limitations and human behavior inconsistencies:

- Frequency and timing of model and tweak sessions are unreliable
- Revised recipes are static, remaining in use until the next model and tweak session

At Last:
Automated Optimization Delivers Real Results

Real-time optimization automatically closes the loop. Model and tweak analytic packages rely on manual, intermittent intervention that misses critical opportunities.

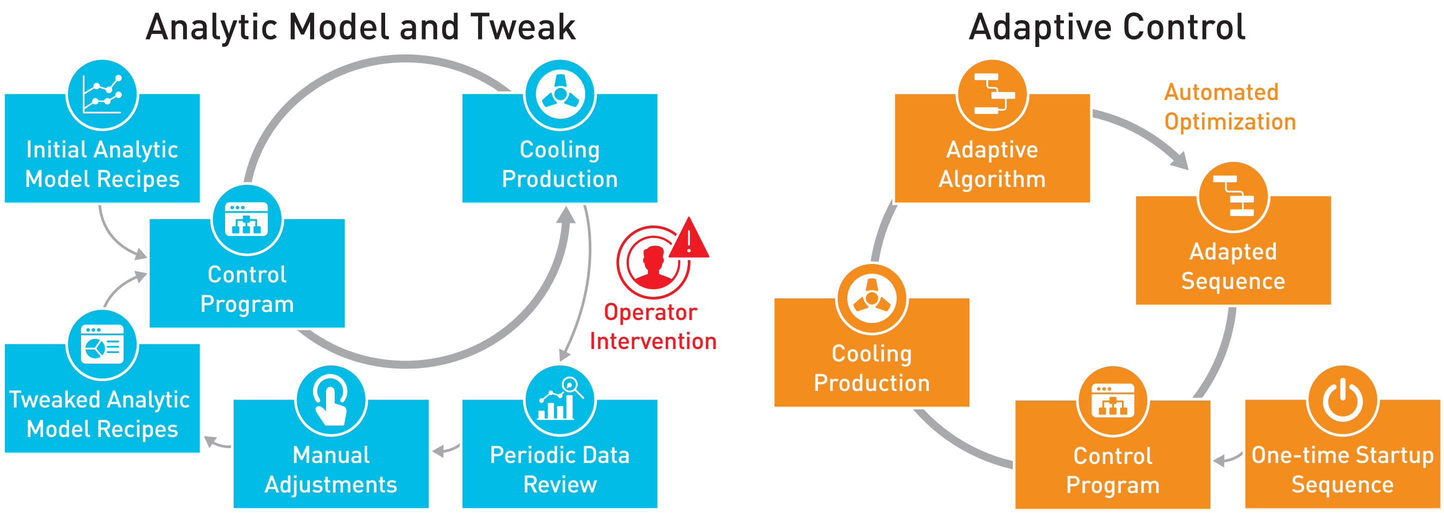
One particularly effective approach is based on adaptive control algorithms that continuously analyze process variables to determine the most efficient combination of equipment sequences and setpoints. The algorithms then automatically adjust corresponding control parameters in real-time.

The automated optimization approach starts with a set of initial sequence parameters derived from power models and practical experience. The adaptive control algorithms set these values only during start-up and early operation. The algorithms analyze the energy efficiency and gradually "adapts" the parameters in real-time without human intervention. It's like having a really great operator, who never takes a break or gets tired, constantly making efficiency adjustments to minimize the total plant kW over time.

The major benefits of this approach include:

- Real-time operating data automatically accommodates any piping idiosyncrasies, spec deviations and maintenance issues that cannot be modeled in the pre-project phase
- Automation is continuous and does not rely on if/when a model and tweak session occurs
- Automation eliminates technician judgment and skill errors and applies consistency in the way changes are made
- Automatic adjustments immediately impact efficiency with no delay, dealing with real-time conditions

Closing the Optimization Loop



A Real-World Scenario

Let's take a look at how a common chilled water system issue would be handled by the intermittent, analytic-based model and tweak approach compared to the continuous, automated optimization strategy.

Imagine your chiller's condenser approach starts to increase. Both potential solutions would:

- Identify the problem: high condenser approach temperature
- Identify possible causes: fouled tubes or low refrigerant
- Recommend corrective action: tube cleaning or refrigerant addition
- Monetize cost impact: efficiency lost multiplied by the utility cost projected over the course of annual operation

Under the analytics model, operational data would be fed into the controller for consideration during the model and tweak session. However, the sequence order with the inefficient chiller in the lead would remain unchanged unless an operator manually intervened to change it.

Furthermore, even if an analytic-based model and tweak solution were to show relative efficiency of each chiller and/or make a suggested recommendation, someone must manually override the recipe to realize the savings.

In contrast, an automated optimization solution would use approach temperature to not only identify the problem, but it would calculate the reduced efficiency and then automatically adjust the sequence and run more efficient chillers. This is the essence of the most effective optimization strategy: measure, calculate, decide, act.

Summing It Up:
The Role of Optimization vs. Analytics

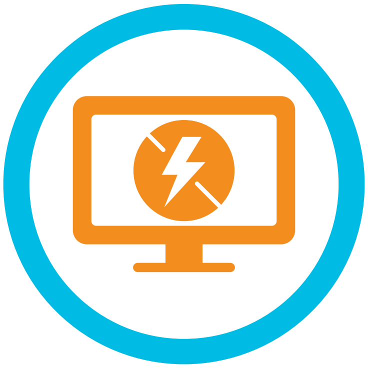
Optimization and analytics are complementary, but they are not the same.

Truly effective optimization solutions evaluate real-time values to determine the most efficient sequence, and then continuously adjust parameters, such as proportional-integral-derivative (PID) setpoints and sequencing parameters, without manual intervention. Critical plant efficiency-related functions that should be considered are:

- Chiller sequencing
- Pump sequencing and speed
- Water temperature optimization, chiller and condenser
- AHU valve optimization
- Free cooling transition
- CT fan sequencing and speed

Analytic software packages support optimization solutions, but they alone are not an effective substitute. Without automation, analytic software cannot optimize dynamic settings like a chilled water plant. Analytics alone can be effective when used for baseline generation, data gathering and collection and multi-site comparison. Analytic services provide:

- Historical data logging/trending for local export and external review
- Energy dashboard (real-time display)
- Equipment performance monitoring
- Operator activity log
- Revision control and records



If analytic software only displays values via images and makes suggestions, nothing gets done.

Put tekWorx Approachable Expertise® to Work for You

Since 2000, tekWorx has offered a unique blend of Approachable Expertise®, providing innovative, yet pragmatic, cost-saving analytics and optimization solutions for central energy plant performance, reducing costs and providing superior customer service.

The CEO® family of solutions from tekWorx, based on the industry standard Niagara 4® platform, utilizes adaptive algorithms to continuously analyze real-time process variables and then automatically adjust key control parameters for operator-free optimization. All solution suites easily integrate with any BAS, any mechanical configuration and any equipment make/model.

tekWatch® is the perfect analytic tool to complement the CEO® algorithms. The Niagara 4® architecture enables tekWatch® to easily integrate with any other chiller plant control system to gather operational insights and improve plant energy performance.

For more information

To learn more about the CEO® family of automated optimization and performance solutions, contact the Approachable Experts at tekWorx.

Learn More

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