THE POWER PLANT OF THE (NOT TOO DISTANT) FUTURE

How semi-autonomous plants can improve fleet performance and slash operations costs

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Few would deny that the utility industry is in the midst of dramatic change. What was once a fairly predictable and stable industry has been upended by an avalanche of new technologies and trends.

The rapid and ongoing growth of increasingly cheaper renewable sources – including solar photovoltaics (PV) and wind – make it more challenging to match supply and demand on the grid.

The advent of renewables not only makes supply more challenging, but they are also challenging the economic models of the utility industry. Traditional base-loaded fossil units are subject to different operating regimes, demanding more operations and maintenance (O&M) investments and, in many markets, reduced capacity factors are lowering profits. Deploying capital for new plants is not an option, so one of the levers utilities still have to improve profitability is O&M. The growing chorus in the industry is that digital transformation could very well provide the answer to these challenges.

There is enough interest among utility executives in the promise of digital technologies – which typically includes some combination of wired and wireless sensors for monitoring, sophisticated algorithms, machine learning and artificial intelligence – that talk of digital transformation has become nearly ubiquitous.

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But the mere fact that the concept of digital transformation has become a popular topic for conferences and industry white papers does not mean that the value of adopting a suite of digital technologies is clear. “It has been a bit of a buzzword in the industry and there has been no meat around the topic,” said Doug Morris, Power Industry Director for Emerson Automation Solutions, a company that helps manufacturers and others automate and optimize their production processes. “It has encompassed talk about both little improvements and huge solutions and none of it has really stuck.”

DIGITAL TRANSFORMATION POTENTIAL,

BUT NOT YET REALITY

The lack of a concrete understanding about what digital transformation actually is, let alone how it can be implemented at the individual power plant or fleet level, helps explain the consultancy McKinsey & Company's assessment that utilities have been slow to adopt what could be genuinely beneficial technologies. A study by the McKinsey Global Institute attempted to flesh out why utilities should take digital technologies seriously. The study reported that utilities could lower their operating expenses by up to 25% and drive performance gains of 40% in the realms of customer satisfaction, reliability, regulatory compliance, and safety. Similarly, the International Energy Agency, or IEA, reports that digital data and analytics can reduce power system costs in at least four ways: by reducing operations and maintenance costs; improving power plant and network efficiency; reducing unplanned outages and downtime; and extending the operational lifetime of assets. The overall savings from these digitally enabled measures could be $80 billion per year between 2016 and 2040. That translates into about 5% of total annual power generation costs, based on the enhanced global deployment of available digital technologies to all power plants and network infrastructure.

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While there's both interest and legitimate reason for utilities to pursue some form of digital transformation, this important question remains: What exactly does the use of digital technologies involve and where can it deliver value to a utility's operations? One area that holds great promise is the use of digital technologies to operate combined cycle power plants semi-autonomously. Not only can this allow individual plants to improve their performance and lower their operating costs, but it can also enable utilities to manage their entire fleet from a central location. Think about it as a move from a multitude of control rooms at individual plants to a single utility collaboration room.

While the ability to achieve this vision of semi-autonomous combined cycle power plants depends on sensors and other technologies – more about that later – one of the most important advantages of creating a collaboration room at utility headquarters is that it provides an opportunity to tap a company's human expertise.

Indeed, the establishment of a central control room creates a place where multiple groups and disciplines can easily interface and collaborate. On a single floor of a building you might also co-locate a training facility with simulation facilities, the engineering group, an M&D Center (monitoring and diagnostics), and plant operations management. "Instead of being islands, similar power plants would be able to develop more collaboration with other shared services groups like SMEs, while readily sharing best practices and creating reliable operating models for the fleet." said Brett Benson, Director at Emerson and former engineering manager at a large utility. "So often today, power plants are operated and managed independently and lessons and ideas are not frequently shared amongst the fleet."

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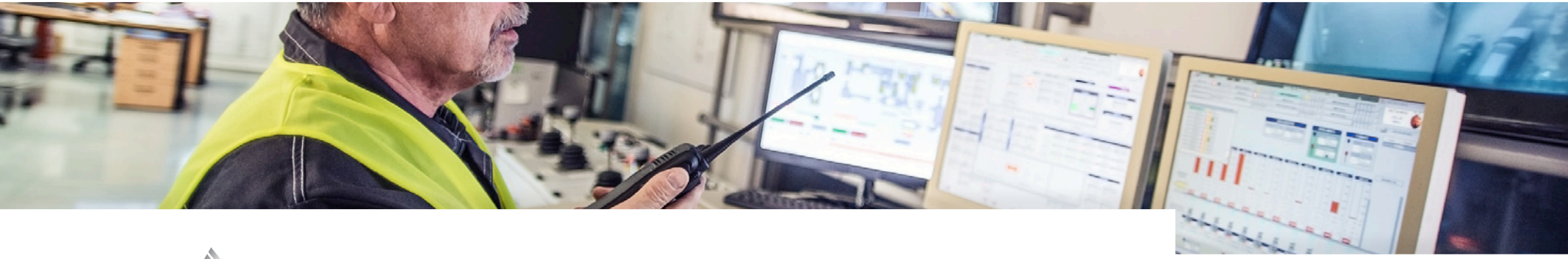
With this new centralized environment, you can not only share lessons from plant to plant nearly instantaneously, you can easily compare plant operations from one to another, try new techniques and incorporate improvements quickly across the fleet; all the while, you're constantly building up institutional knowledge.



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THE NEED TO **CHANGE**

Before diving into the details of what a semi-autonomous combined cycle power plant and a collaboration room actually look like, it's helpful to understand why digital transformation that delivers lower operating costs is so important to utilities.

The main explanation can be summed up in just one word: change. The utility industry has faced and continues to navigate an enormous amount of change over a short period of time.

The implications of the transformation in how energy is generated, distributed and consumed are wide-ranging for utilities and grid operators. They include the technical and planning challenges associated with seamlessly integrating large numbers of renewable assets onto a grid that was originally designed for large central station power plants and transmit them long distances to where businesses and consumers needed them. But for utilities, the challenges also include a fundamental shift in their business model.

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Bob Yeager, *President, Emerson Power and Water Solutions*

“The industry is changing, and renewables are putting a squeeze on all players,” said Morris. “It’s not just independent power producers; it’s also regulated utilities whose finances have been impacted because they’re building fewer new plants. Utility executives are increasingly evaluating O&M expenditures as one area that can positively impact their business.”

“Utilizing digital technologies is a compelling strategy for improving O&M and making our customers’ operations more productive,” said Bob Yeager, President of Emerson’s Power and Water Solutions business. “For the non-regulated part of the business, these new technologies can help them run their plants more efficiently, saving them significant startup fuel costs, for example.”

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APPEALING TO A
DIGITAL WORKFORCE

An increased use of digital technologies is also a way for utilities to address the rapid aging of its workforce and attract the new talent it will need to be successful in the future. According to the U.S. Department of Energy, the average age of electric power generation workers is 55. As experienced workers leave plants and take their knowledge of how to address operations and maintenance issues with them, the ability to push O&M costs lower and lower is threatened. “People are retiring and you’re starting to see a shrinking workforce for O&M. When utilities lose that expertise, they may start relying on OEMs (original equipment manufacturers) to provide it, but OEMs often know less than the senior technician you had at the plant for the last 40 years,” said Benson.

Using technology and automation provides not only an opportunity to capture and institutionalize the knowledge of workers nearing retirement. It also is a way to attract the younger workers needed to replace retirees because expansive use of technology is an expectation for younger, so-called “digital workers.”

“It’s a very competitive market now in terms of expertise and people. Engineers may not want to work in this industry,” said Morris, “The reality is that jobs in power have changed dramatically. They are more tech-oriented and what makes this semi-autonomous plant possible is that automation and technology change the functions of what people are doing to operate the plants and the skills that are required to do the work.”

So what's stopping a more widespread deployment of digital technologies to operate and maintain combined cycle power plants? A significant roadblock is simply the longstanding culture at many utilities. "Utilities have been making the same 'product' in much the same way for 50 years and it has worked. Unlike other manufacturers, the utility industry is simply not under the same competitive market pressures so the drive for innovation is not as prevalent," said Benson.

Simply put, providing safe, reliable and affordable electricity drives how plant personnel have traditionally been evaluated. Their performance metrics are about things like preventing accidents and maintaining plant uptime and there is less incentive to take risks and find new and innovative ways to reduce operating costs.

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Brett Benson, *Power Marketing Business Development Director, Emerson Power and Water Solutions*

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A BETTER WAY WITH

DIGITAL TECHNOLOGIES

Perhaps the best way to begin grasping the potential benefits of a technology-enabled semi-autonomous power plant is to look at the startup of a plant. Manual plant startups have long been the norm in the utility industry, and the process often relies on written procedures and the experience and expertise of plant operators. Because a manual startup is, by definition, dependent on the skills and abilities of operators, it is impossible to ensure absolute consistency or optimization from one startup to another.

Today, though, the manual processes involved with getting a plant up and running can be automated and optimized so that all an operator has to do is simply press a button. ”The technology and knowledge are there to startup a plant and bring it to a preselected load automatically with a press of a button. The plant profile can be built into the logic to provide a more consistent, reliable start process that allows the operator to be focused on other more critical parts of the plant,” said Yeager. “Such an automated startup can lead to predictable online times, reduced wear and tear, and less fuel usage. “

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That is particularly true today because combined cycle plants and other generators have to startup more often than ever before due to market signals and the influx of intermittent renewable energy. Having to startup more frequently means there are more opportunities to do so in ways that are either standard and efficient or inconsistent and financially draining.

Automating manual procedures at combined cycle plants can save owners and operators a significant amount of money. According to Emerson, one utility in the southern U.S. reduced its fuel use by over 50% over the course of 55 starts and 290 load transitions, which was enough to save over $1 million in a year. Another mid-Atlantic utility saved $250,000 in fuel over 50 starts.

Improved and more consistent startups are just one potential benefit of a more autonomous power plant. Better monitoring, faster and more proactive maintenance, and a unified cybersecurity strategy are others. In fact, Benson says power plants of today have undergone a similar evolution to automobiles. “In 1990, you had something like 200 sensors in your car, whereas today there are thousands. The driver doesn’t necessarily see what those sensors are doing, but the car responds automatically to them to provide a safe, efficient, and comfortable experience. Leveraging the intelligence in control systems and smart devices can provide a similar experience for a power plant operator.”

One example is the use of wireless acoustic sensors to monitor for and detect HRSG tube leaks. By detecting when a leak first starts, the plant can avoid tube bundle damage and can schedule an outage rather than having the leak force the unit offline. In the case of a collaboration center, the team can take a look at the conditions that may have lead up to the leak and ensure they are avoided in the other units being controlled and monitored.

When plants are able to run semi-autonomously and can be monitored and compared to one another in a centralized location, good things can happen. “Right now, plants with similar configurations run independently and don’t always share lessons across the fleet,” said Yeager. “In the future, we envision collaboration centers seeing how a change in operations can make a plant run better and then sharing that functionality with other plants. They’ll no longer have to wait until the next meeting of plant managers. They can push out those benefits right away.”

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