Smart industry

TECHNOLOGY REPORT

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Energy has always been a critical factor in manufacturers' processes. It is often their greatest expense and a huge determinant in the success or failure of new industrial programs. And energy—as you are surely aware—is costly, particularly as global events continue to disrupt energy channels. As such, efficient energy use has never been more critical. And insights on using energy as smartly as possible have never been more valuable.

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A FLEXIBLE FOUNDATION FOR DATA-DRIVEN INTELLIGENT OPERATIONS IN MANUFACTURING

Maximize value from all manufacturing data in any format – including real-time data to achieve operational excellence, increase yield and accelerate business results

The Data Lifecycle Architecture to Enable Intelligent Operations Use Cases

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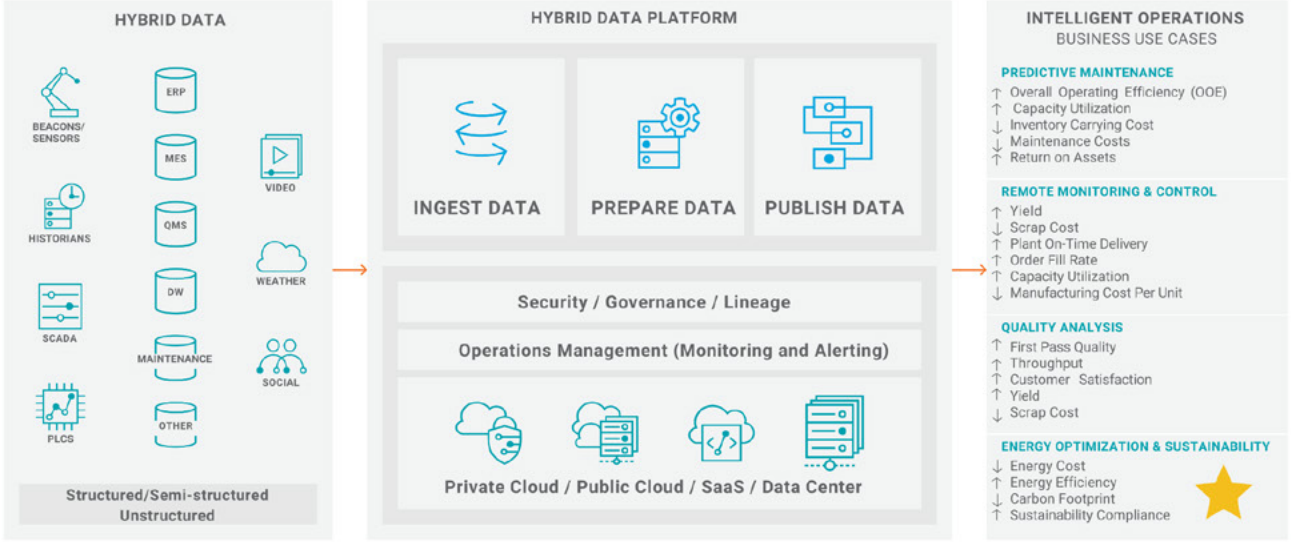
Manage the Data Lifecycle on Cloudera's Data Platform



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What Is "Digital Energy" And How Can We Twin It?

By Chris McNamara, Smart Industry editor in chief

Digital twins are trending. A recent Research And Markets study predicts that up to 89% of all IoT platforms will include digital twins by 2025, which will alter how facility and IT managers collaborate as they transform industrial facilities and the processes within them. (Perhaps you're already experiencing these changes.)

This trend, while hardly surprising, includes many facets and applications. Consider the use of digital twins in the energy space, which is the focus of Luis D'Acosta, executive vice president of Schneider Electric's Digital Energy Division, who shares his perspective on digital energy and new capabilities with twinning it here...

Smart Industry: What differentiates digital energy from traditional energy? How does this affect energy consumers?

Luis: The main differentiator between digital energy from traditional energy is how we automate, monitor, control, and optimize using digital technologies. Digital innovation makes energy smart. Thanks to this the invisible becomes visible, eliminating waste and driving efficiency. Electricity is the most efficient energy, proven to be 3-5x more efficient and it is also the best vector for decarbonization. Digital solutions such as "optimizing procurement," which tracks and analyzes energy performance to obtain the most accurate energy and carbon portfolio, enable us to gain key insights into the building's landscape and identify different patterns of how consumers are using facilities and energy.

Additionally, the ability to unlock data potential in buildings helps prioritize the highest energy consumption, enabling facility managers to have complete control over a building's carbon profile via visibility over operations of energy distribution. Adding to this, open-secure and centralized platform for real-time control and management can be used to assess the health and efficiency of HVAC systems, and power diagnostics can be automated once patterns are established to enable data transmission to optimize efficiency and make sustainability visible to managers.

The ability to unlock data in buildings helps prioritize the highest energy consumption.

Taking it a step further, the magic really happens when we can measure what's happening in the physical world and correlate those sensors with behaviors. This allows users to witness first-hand how their actions have a direct impact on the building operations and its carbon footprint. The key solution for a more sustainable and resilient world requires all digital and all electric net-zero buildings. This

approach, which entails buildings becoming self-generating assets, is a formidable path to net-zero operations and has the potential to improve energy efficiency by 40%.

Smart Industry: What role do digital twins play here?

Luis: The digital twin is an "evolving" digital profile of the end product or the overall composite system that brings together traditional simulation models with intelligent data and analytics. Digital twins are allowing us to build deeper into the realm of the possible. What if you could validate design before you build, reduce the risk of equipment failure, improve factory operations and energy efficiency?

A digital twin is the enabler. When based on reliable, high-quality data, digital twins enable a range of real-time insights that makes design, commissioning, and implementation easier, while improving productivity and operations across the digital value chain, including the digital customer service experience.

One main role of digital twins is to design sustainability and efficiency upfront. Digital-twin technology enables facility managers to generate virtual representations that can evaluate the anticipated carbon footprint of the building during the design phase. This approach not only creates a baseline that tracks and updates the building's design to achieve energy and operational efficiencies, but allows the opportunity to design for flexibility and ensure continuous improvement as technology evolves or as the building becomes utilized in new ways. Having the opportunity to adjust your building design ahead of time allows facility managers to really understand all the possibilities and construct against an already pre-optimized building strategy.

With a digital twin framework, you can also:

- Boost efficiency and safety through increased productivity and improved product design / quality, while distinguishing potential operator mistakes.
- Revolutionize the customer experience through streamlined product innovation, remote troubleshooting with context, and new digital business models (e.g., services).
- Streamline processes and data reliability through a digital thread that enables data continuity and provenance to track and explain data and a real-time continuum across otherwise disconnected CapEx and OpEx phases.
- Enhance enterprise digital culture through collaborations across many stakeholders from historical silos and a new way to upskill workforce for digital and attract digital natives.

With a successful digital twin-based platform, companies can reduce annual energy costs by 20%, with digital retrofits seeing an average playback in just 1-3 years. Incorporating digital twins as part of your environment can be used before and during any building-construction process for organizations looking to bring their data to life for better performance. It's best to keep in mind that there is no one-size-fits-all approach. Start small and prioritize your business objectives to be achieved, while also being mindful that in the practical environment, there will be the need to integrate and possibly digital twins from multiple domains and vendors.

Smart Industry: What are the unique challenges in the energy space in this digital era?

Luis: The challenges we're seeing within the digital energy space are not necessarily around new buildings themselves, but around "responsibility beyond compliance." It's not enough to just comply with the building code; we need to do better. The building codes are typically lagging in what we need as a society to achieve sustainability and fight climate change. We can't wait to take these sustainable steps;

we must go beyond compliance to ensure productivity, efficiency and improve energy efficiency.

To do this, we must educate facility managers on the digital technologies that are widely available to modernize building management systems to improve sustainability and efficiency. Investing in digital-building solutions upfront will provide great payback not only financially, but for the planet. For example, building upon and enabling improvements of an old infrastructure building through digital simulations vs. demolishing buildings and starting from stretch.

Construction costs a lot of money, and the cost would be monumental if we tore down old buildings to make way for new ones. We expect 50% of today's buildings still be in use in 2050 and for that reason achieving a net-zero emissions scenario by the middle of this century requires 85% of the existing building stock to be retrofitted over the next three decades, along with all new buildings to be net zero-carbon from 2030 onwards.

This is where the power of digital technology is the enabler to simulate attributes of a retrofitted building. On top of a retrofit building approach providing a cost savings of 43-65%, digital models can be used to predict occupancy usages, energy demands and key building operations to show how the ROI on sustainable investment can take place.

The synchronization between the physical product and its digital representation will unlock major opportunities for the future of digital energy.

Lastly, how do we modernize existing building infrastructure? We're seeing a lack of education with existing buildings in need of retrofitting and modernized building-management systems that have different constraints due to older building-management systems. Instead of designing and building from scratch, we must salvage our existing building installations by implementing the tools, hardware, software and services to complement what already exists.

Today, we have technologies such as wireless, IoT, and connectivity directly to the cloud that allow us to modernize existing building infrastructures encompassing digitally driven energy-management initiatives.

Smart Industry: What most excites you about the near future of digital energy?

Luis: The continuous synchronization between the physical product and its digital representation provided by digital twins is very exciting and will unlock major opportunities for the future of digital energy. Built on reliable, continuous, and intelligent IT and OT data, the "digital thread" establishes the continuity across the product lifecycle and provides a "single source of truth"—the lifeline for accelerating outcome-driven ways to capture IoT's business value.

Additionally, the integration of new building technologies that pair "all digital" with "all electric" is the recipe for a more sustainable and resilient world to accelerate the path to net zero and emission reduction. Being able to bridge the silos between mechanical and electrical processes to building-management systems, including EV charging infrastructures and microgrids and connectivity to the grid, is truly exciting because we now have the technology to really orchestrate all these assets to make the most of energy efficiency, resiliency and sustainability. ◻

Use Case: Food-Packaging Company Reduces Energy Use & Cuts Compressed Air Costs

By James Figy, senior content specialist with Beckhoff Automation LLC

While many companies claim their products or services pay for themselves, iZ Systems proves it. Based in Macon, Georgia, the company provides clients across a range of industries with energy auditing services and control systems that quickly deliver a complete ROI from the resulting energy reductions.

"Almost every system upgrade we complete is based on green initiatives to reduce energy consumption at plants," said Dean Smith, general manager and technical manager for iZ Systems. "We guarantee these savings, and our technology platform proves that significant energy reductions are maintained in the long term."

Since Smith founded iZ Systems in 1990, the company has continued to expand its product offerings and client base, gaining customers internationally as a division of its parent company Blake & Pendleton. iZ Systems has long performed audits and upgrades of compressed air and industrial vacuum systems, and it now offers these services for cooling water systems as well. With its standard control cabinets that include built-in HMI displays, iZ Systems supplies eco-friendly technologies that measure efficiencies, support remote data acquisition and deliver insightful energy usage information to customers.

For seven years, iZ Systems has provided these services to food packaging manufacturer Pactiv at its Macon facility, which focuses on molded fiber egg cartons. The partnership began with a project to replace the compressed air systems supplying low-pressure blowers, according to David Powell, maintenance manager for Pactiv. "With every blower we tested, the pressures would change too much even if a single nozzle was adjusted," Powell said. "The iZ Systems team promised a blower system that would not change in pressure, even if you shut off all but one nozzle, and their system has worked flawlessly."

OPEN, TRANSPARENT TECHNOLOGIES HAVE UNIVERSAL APPEAL

The system improvements for Pactiv resulted in unique technical specifications, highlighting the fact that greater system openness is increasing in importance across all industries. To guarantee that customers' systems achieve peak performance, iZ Systems must be able to monitor data remotely and make adjustments whenever necessary. However, connecting to clients' diverse networks can be difficult, according to Allen King Jr., inside application project manager for iZ Systems. "The ability to access and analyze performance data with ease is very important,"

Greater system openness is increasing in importance across all industries.

King said. "To this end, we access data from systems across the globe using a common source and format."

In addition to its thorough audits, the company accomplishes these goals through its turnkey iZ Compressed Air Automation and Data Acquisition System, which combines the automation controller, I/O and HMI in a single control cabinet and utilizes custom software. This system must support an increasing number of connected devices—50 compressors across a factory, for example – while reducing footprint, complexity for users, cost and, most importantly, unplanned downtime. "Improved reliability is an ever-present demand from industrial clients," Smith said. "A compressed air system that is not reliable has the ability to cost hundreds of thousands of dollars in lost production and energy costs. A reliable and well-managed compressed air system has the ability to save those dollars. Our iZ Compressed Air Automation and Data Acquisition System has the ability to assist in maintaining those savings."

OPEN CONTROLS MAINTAIN PERFORMANCE UNDER PRESSURE

The engineering team at iZ Systems accomplished its mission at Pactiv using PC-based solutions from Beckhoff Automation. Beckhoff and iZ Systems first partnered on projects about 15 years ago, because TwinCAT automation software helped the company establish remote monitoring of its compressed air automation and data acquisition systems. Smith explains that interfacing horizontally via Modbus TCP to diverse compressor control systems within plants and vertically via OPC UA are important features that exemplify the system openness of PC-based control technology. "The TwinCAT software platform provides tremendous flexibility to the process of applying our iZ Compressed Air Automation and Data Acquisition System software to any system," he said.

Visualizing the numerous compressors and equipment spread throughout entire plants can easily clutter HMIs, so iZ Systems has standardized on the Beckhoff CP2924 multi-touch Control Panel. The 24-inch widescreen panel, which was implemented at Pactiv, is mounted into a control cabinet cutout to enable easy identification of field components, according to King. "Our trending screens use the multi-touch zooming function, allowing operators to draw a square around the area they want to see in greater detail," he said. "However, we know there is the capability to implement much more multi-touch functionality, and we hope to add interesting features, such as pinch to zoom, in the near future."

Visualizing the numerous compressors and equipment spread throughout plants can clutter HMIs.

As with other iZ Systems projects, EtherCAT industrial Ethernet technology enabled real-time communication across the Pactiv production facility. EtherCAT and TwinCAT allow the automation system to identify any new compressor or other industrial

Open systems that support multi-vendor architectures create energy-saving solutions from one industry to another.

component automatically, and BACnet/IP enables direct integration of building automation controls in the iZ Systems solution. In addition to a range of standard digital and analog I/O terminals, iZ Systems also uses EK1501 and EK1541 fiber-optic EtherCAT Couplers along with EK1521 and EK1561 fiber optic junctions in most compressed air applications to communicate with field devices. "Fiber-optic wire provides absolute isolation between our system, the processor, the machine and the compressor," Smith said. "Fiber-optics by nature provide excellent immunity to electrical noise and interference, and the EtherCAT I/O hardware offered us a big step forward in this regard."

STRATOSPHERIC ENERGY SAVINGS, GUARANTEED

By implementing open, PC-based solutions, iZ Systems kept its promise to Pactiv. As a result of the blower equipment upgrades, Pactiv reduced its energy consumption for compressed air by 45%. "By using blower air, we replaced nearly 400 horsepower of compressed air with 50 horsepower. This amounts to a cost savings of nearly $250,000 each year," Powell said. "The improvements to our air compressor design have stabilized our pressure, and the remote monitoring has given us peace of mind."

The results are impressive by any standard, but they are not unusual for iZ Systems, Smith explained, "For some clients, we have reduced compressed air energy costs by more than 50%, and we can prove that we have maintained those savings ever since." Secure communication with customer machinery via OPC UA allows iZ Systems to monitor any changes in performance that could require maintenance. Powell said this, along with excellent support, has been crucial for Pactiv: "The system alerts me when there are any abnormalities with the compressors, but iZ gets the warnings as well and their engineers are usually working to address the issue before I call them."

By creating open systems that support multi-vendor architectures, iZ Systems has the unique opportunity to apply energy-saving solutions from one industry to another. For example, the blower solution implemented at Pactiv has also worked for clients in the steel casting industry, among others. "In many facilities, we installed these low-pressure blower systems to provide cooling or control of fluids and coolants, and it basically produced a 25-to-one reduction in energy," Smith said. "We try to make the initial acquisition cost attractive to the client while guaranteeing major energy reductions, and the Beckhoff platform has made a huge difference in our ability to meet these goals." □

Increasing The Energy Efficiency Of The Manufacturing Industry With Data And Analytics

By Louisa Lu, senior industry marketing manager at Cloudera

While the manufacturing and production sectors are key drivers for economic growth, comprising 16% of global GDP per The World Bank, the energy consumption from these sectors used over half of the world's energy resources.

Today's manufacturers are under increasing pressure to report on their environmental, social and governance (ESG) impacts while facing limitations in data collection and analytics to generate real-time insights. Manufacturers often monitor *specific* assets and facilities for energy usage, and adjust manually when energy availability or energy usage changes significantly. However, little strategic coordination is available. There is a major opportunity to improve data collection, analytics, and insight to reduce energy consumption.

Much of the challenge is due to the rapid evolution of new and connected data sources and the massive volume of data created. In the latest Enterprise Data Maturity Research Report, almost six in ten (56%) IT decision-makers in manufacturing report challenges in growing data volume, and more than 90% of surveyed IT decision-makers in manufacturing agree that there is value in delivering real-time business insights.

Using data to find, generate and share real-time insights can be particularly useful for operations and tracking energy consumption. Collecting and analyzing data can help detect signs of mechanical wear and degradation, so it can be addressed proactively before a failure occurs, impacting production and energy consumption.

THE VALUE OF COLLECTING DATA FOR REAL-TIME ENERGY INSIGHTS

While many manufacturers understand the potential of data, it can be difficult to collect and manage datasets from many sources. In many organizations, data is in an individual system or in siloes. Without visibility across these siloes, there is no operational visibility to overall energy consumption—and no way to use data to improve machinery performance. The datasets can also be quite challenging. The data is often in different formats and is created rapidly, leading to massive volumes.

Manufacturers are turning to data platforms that are optimized to handle greater velocity of data.

That's why more manufacturers are turning to data platforms that are optimized to handle large volumes, variety, and greater velocity of data. Today, these platforms are often known as "data lakehouses," which combine the capabilities of a data warehouse, designed for analytics, and a data lake, designed for large volumes and many varieties of data.

The first step is unifying data, then building analytics and machine learning to find deeper insights.

However, not all data lakehouses are the same. Manufacturers should look at platforms that include capabilities for easy data collection and ingestion. It's also helpful to look for an "open" data lakehouse, which is typically easier to integrate with other systems.

Using an open data lakehouse as the foundation can make data ingestion and analytics easier. Manufacturers should prioritize the ability to leverage both OT and IT data in structured and unstructured formats, and look for platforms that make it easy to collect data across factories, plants, data centers, and multi-cloud.

Collecting and unifying all of this data is a challenge—but the payoff is worth it. By ingesting and processing data from multiple sources, combining and correlating IoT sensor data streams with activity logs, historian data, ERP and MES data, customer data, external data, and much more, and publishing data with management tools and analytics engines such as ML and AI, manufacturers can:

- Identify equipment that is using excessive energy
- Identify sustainability and energy efficiency
- Trigger energy maintenance workflow automatically

HOW CAN YOU GET STARTED?

The first step is unifying data, then building analytics and machine learning to find deeper insights. Look for open data lakehouses, platforms, and solutions capable of supporting the following:

- Easy data collection from any source: Data comes in different formats from multiple, often disparate, sources. Many will need near-real-time capabilities. Can the solution handle both OT and IT data?
- Flexibility to run across clouds: Consider platforms that are hybrid and make it easy to run in a data center or the public cloud. This helps manufacturers be agile, reduce costs and improve flexibility.
- Embedded analytics and machine learning capabilities: Evaluate the platform's capabilities to deliver actionable insights. Does it support a variety of different analytics engines? Can it easily connect with other analytics tools?
- Proven success at major manufacturers: Look for companies that have successfully delivered for other manufacturers, and offer reference architectures for a head start. Is your data platform provider experienced with developing energy-efficiency projects using ML models that lead to a reduction of costs and carbon emissions?

Unifying data in this manner will reduce defects, optimize energy usage and implement predictive maintenance in months, making a fast financial impact. ◻

Case Study: Pinpointing Industrial Energy-Saving Opportunities

By Adrian Guggisberg, president of motion services at ABB Motion

Industrial electric motors are a major opportunity for energy savings. According to the International Energy Agency (IEA), around 70% of all electricity consumed by industry is used by millions of motors that power machines, pumps, conveyors and other applications. Many of these operate inefficiently, drawing more power than they really need.

However, when we surveyed industrial leaders this year, we found that relatively few businesses are actively pursuing this opportunity. Although 90% of respondents saw energy prices as a threat to the profitability, only 51% were planning to use an energy appraisal to identify poorly performing motors.

It's likely that the high cost and low coverage of traditional energy appraisals are a barrier. Because these are labor-intensive, they typically focus on just the biggest and most powerful motors, which are perceived as offering the biggest potential for savings. However, many operators have realized that major energy savings can also be found by combining efficiency improvements from many smaller motors.

Modern technology has lowered the barrier to gathering data from a fleet of motors and evaluating their efficiency. It is now inexpensive and straightforward to gather digital data to see which electric motors are using more energy than they should. Expert analysis can also show how to boost efficiency with a known return on investment.

In turn, operations managers can make informed decisions to reduce energy consumption for the lowest-efficiency motors. Solutions to boost efficiency include altering operational schedules, installing a variable-speed drive (VSD) and upgrading to high-efficiency technology.

Generally, operators will take action when the return on investment is two years or less. Therefore, today's high energy prices are making it viable to upgrade many more motors than in the past and operators can achieve big energy savings from the sum of many small improvements.

Operations managers can make informed decisions to reduce energy consumption for the lowest-efficiency motors.

CERN TAKING ACTION

The approach is being adopted by particle-physics laboratory CERN in Switzerland. The facility wants to cut energy consumption from its cooling system, which is critical to the success of its experimental program. Motors use around 20% of the facility's total energy consumption in a network of pumps, fans, compressors and cooling towers, equivalent to 260 gigawatt-hours (GWh) every year.

Demand for electricity is likely to double over the coming 20 years, as businesses switch from fossil-fuel plants to electrical motion to meet net-zero targets.

CERN is now working with ABB with the goal of cutting this energy consumption by 15% and is harvesting data from connected motors to identify where most energy can be saved.

Data from the same sources is also providing the laboratory technical team with insight into the condition of equipment. Constant monitoring identifies changes in operational parameters such as temperature and vibration that show when components in motors and other equipment are approaching the end of their life. As a result, operators can replace systems before they fail and avoid unplanned outages, which protects the continuity and success of the experiments. An unplanned outage lasting 30 minutes could stop an experiment for 48 hours.

"Our innovation partnerships help us to enable positive societal impact from our work pushing the limits of science and engineering at CERN," said Han Dols, head of business development and entrepreneurship from CERN. "We have partnered with ABB to generate insights to help reduce our own electricity footprint, as we continue to test the extremes at such a large facility. We also hope to inspire other big science facilities and industry to do the same and, as such, have agreed with ABB to share the learnings of this project publicly."

ELECTRICITY AS A PRECIOUS RESOURCE

The data-driven approach to energy efficiency has a lot of merit today due to the energy crisis. However, demand for electricity is likely to double over the coming 15-20 years as businesses switch from fossil-fuel plants to electrical motion to meet net-zero targets.

This trend for electrification will create more incentive for industrial operators to invest in better energy efficiency. It will help them control electricity demand in the short term, keeping bills and CO_2 emissions under control. However, it will also free up energy resources for other consumers over the long run.

Over time, it's likely that the data-driven approach to energy appraisals and condition monitoring will evolve into a new business model. This will see partners taking on operational risk and using data and expertise to deliver specific outcomes such as minimizing energy consumption or maximizing process continuity. ◻