



Enriching Data, Empowering Action

*How data-powered decision-making
helps utilities reduce downtime,
increase safety, and lower costs.*

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Having access to the right data can mean the difference between uptime and downtime, customer cost savings and rate hikes, growing margins, and crippling expenses—even life and death. Knowing, in a timely manner, about damaged components, aging equipment, and vegetation encroachment gives you an opportunity to mitigate or repair the issues before they turn into big problems.

It's not difficult to get data; the real challenge is that there's simply too much information out there to separate the important from the insignificant. In 2017, there were 2.7 Zettabytes of digital data¹—and this number is predicted to grow to 175 ZB by 2025.²

Even with the plethora of information available, many of the insights that would let utility personnel take timely actions and avoid costs are hidden because the data is unavailable, inaccurate, or unactionable. Outdated and subjective collection methods like manual entry by ground crews lead to poor data quality—and even the best data is useless if it's not integrated into the right workflows.

In this whitepaper, we'll provide an overview of a solution that combines artificial intelligence and machine learning. You'll learn how such a solution can help utilities quickly turn a massive amount of data into actionable insights—and how it accelerates, automates, and amplifies data analysis to reduce human error, increase speed and efficiency, and decrease costs.

THE 3 KEYS TO BETTER BUSINESS DECISIONS



Accelerate

Speed up data collection, processing, and analysis by optimizing processes.



Automate

Improve process safety and accuracy by employing robotics and AI.



Amplify

Increase the volume and detail of the data collection by using precision tools.

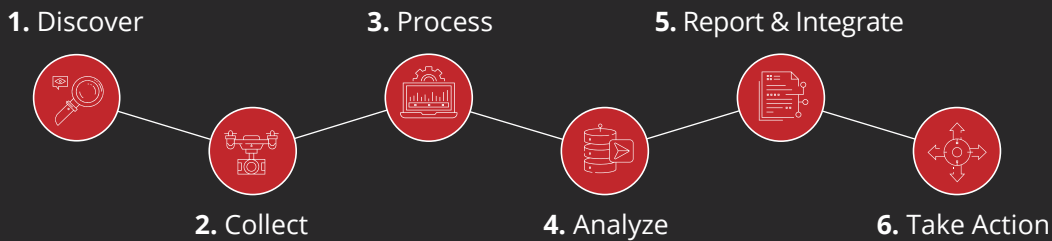
¹ <https://www.nodegraph.se/big-data-facts/>

² <https://www.seagate.com/files/www-content/our-story/trends/files/idc-seagate-dataage-whitepaper.pdf>



THE DATA VALUE CHAIN

An inspection process is a value chain, where each professional, procedure, and tool should add value to the final outcome. PrecisionHawk's data value chain is:



This data value chain is focused primarily not on the *volume* of the data, but the *quality* of the data; we need to obtain the right data during the discovery and collection phases to move forward to processing. With this data value chain, PrecisionHawk's solution is purpose-built for the entire data lifecycle.

To learn more about how the data value chain works in every facet of a utility, visit these resources:

- Distribution Asset Inspections
- Transmission Asset Inspections
- Substation Inspections
- Facility Inspections

DATA: ACCELERATED

Speed up data collection, processing,
and analysis by optimizing processes.



Speeding up the workflow of collecting, processing, and analyzing data—without sacrificing the quality of the collected data—helps utilities make fast, accurate decisions on time-sensitive issues.

THE SAFE, COST-EFFECTIVE WAY TO SPEED UP COLLECTION

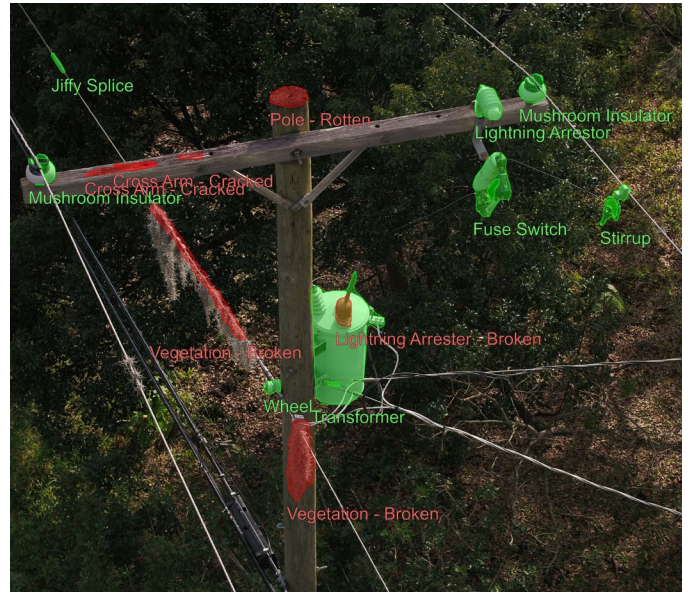
PrecisionHawk is a collection-neutral solution—meaning it can process and analyze data no matter where it originates from, from manual methods to satellites. For this reason, PrecisionHawk recommends the data collection modality that best fits the mission based on the timeline, required resolution, safety risks, and cost per unit (for example, per structure, per mile, or per acre).

UNLOCKING INSIGHTS THROUGH DATA PROCESSING

Many utilities have vast amounts of existing asset data, and few effective means to process it—meaning all the key insights are locked away inside the database.

If the data wasn't collected well or is corrupted, the only solution may be to recollect. As you'll see in the storm hardening case study, PrecisionHawk has led recollections for utilities whose data was low quality. However, if the data is clean and accurate, PrecisionHawk can develop software scripts and workflows that will automate the processing.

This creates efficiencies that speed up analysis and lower costs. Software scripts handle repetitive tasks that don't require subject matter experts,



allowing utilities to reallocate their human resources to more valuable tasks. Now, instead of having a team of analysts scrolling through, say, 10,000 images to pinpoint potential issues, the utility can train a few analysts to analyze the 500 images that are flagged for review.

FASTER ANALYSIS AND HIGHER ACCURACY THROUGH MACHINE LEARNING MODELS

Speeding up analysis without compromising accuracy may seem like an impossibility—but because PrecisionHawk's machine learning models quickly narrow down the number of images to be reviewed, analysts are able to focus on only the most relevant images.

Not only that, machine learning algorithms are self-learning, meaning they become more accurate the more data they're exposed to. And their standards are not biased by human error or perspective, making them even more precise.

The speed and accuracy of machine learning and the expertise of trained analysts combine to create the fastest, most precise data processing workflow.

HOW MUCH TIME CAN YOU SAVE?

With the right solution, a utility can take advantage of accurate data almost instantly rather than having to wait weeks for processing. The ideal is to mobilize a collection team, identify problems, issue an emergency work order for time-sensitive repairs, and have the repair team in the field—all in the same day.

For example, a small, agile drone team can be easily deployed to any location with minimal requirements. In most cases, this is a much faster process than relying on ground teams or workers in bucket trucks.

If you've collected a lot of data—say an entire distribution line's worth—manual processing can take anywhere from one week to more than four weeks. Human analysts must slowly and carefully rectify the data, look for component issues, and compare the data to existing information in the system so that it's usable and actionable.

With PrecisionAnalytics, a highly secure web-based asset management solution for utility asset data, you can receive images straight off the line directly from the remote sensor—or through an air dump, which is the process of transferring the data via WiFi or a telecom server—into a system that's already aware of where your assets are located.

It takes PrecisionAnalytics only about one minute and 15 seconds to process each image. PrecisionHawk's machine learning model then pushes only those images that need subject matter review to experts.

PrecisionAnalytics can also integrate into current workflows and enterprise systems, determine which work orders are already out, and act as a middle analytical layer to streamline the entire process.

These capabilities bring the usual one- to four-week turnaround—from collection to action—down to a day, an hour, or even just minutes.

CUTTING LOSSES, SAVING TIME

While machine learning and trained analysts can speed up the processing of vast amounts of data, utilities need to be cognizant of the point of diminishing returns. PrecisionHawk conducts continual process reviews to be sure utilities don't hit that point: the team reviews past projects, creates a process workflow, monitors successes and challenges during projects, collects feedback from clients and analysts, and makes improvements based on all these inputs and results.

In some cases, PrecisionHawk discovers that it will take more time to optimize or upgrade a segment of a utility's workflow than it will save the analyst in the long run. When this happens, in the interest of efficiency, the team instead focuses on an area of the workflow where they're more likely to attain measurable improvements.

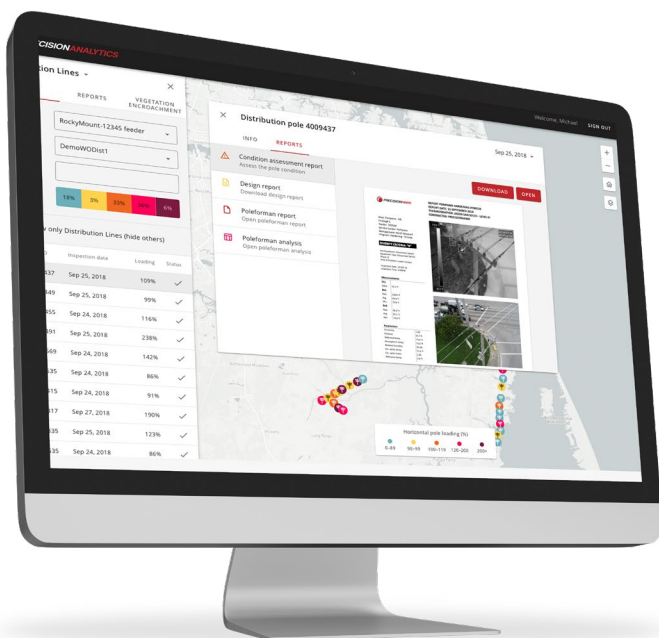
CASE STUDY:

SOUTHEASTERN UTILITY SPEEDS UP MODERNIZATION EFFORTS WITH ACCELERATED DATA

What took ground teams 6 months to inspect, took PrecisionHawk's drone operators and data analysts just 6 weeks.

In early 2019, a Southeastern electric utility that covers over 100,000 square miles scheduled an inventory of assets before implementing IVVC activation, an implementation that reduces energy demand.

After realizing that their incumbent provider's manual methods of data collection, processing, and analysis were too slow—and that the data it provided was lacking in quality—the utility partnered with PrecisionHawk to increase the accuracy of its asset data and speed the time to IVVC activation.



PrecisionHawk was tasked with updating the utility's inventory and phasing of more than 275,000 structures. Since the project was already a few months in, it was crucial that PrecisionHawk build a solution that could collect accurate data at a very fast pace.

Based on the requirements and timeline, PrecisionHawk designed a solution that would streamline each aspect of the asset management lifecycle, from data collection through reporting and action:

1. PrecisionHawk's credentialed drone pilots executed flights tailored to the project specifications, and captured the required images and data with RGB cameras; in the meantime, the pilots also served as ground teams, using a tablet app created by PrecisionHawk that streamlines manual data entry.
2. The drone pilots captured images of each pole from various angles as well as the next pole down the line, plus images of complicated equipment like capacitors and reclosers for future inspection purposes.
3. The collected data—over a million images was uploaded into PrecisionAnalytics, to apply machine vision, conduct change detection, and identify areas of concern.
4. Utility stakeholders received, via PrecisionAnalytics, reports and images showing the location of each asset and the phasing of each overhead conductor. This was served up in a view that allowed the utility to see all the poles inspected, the associated images, and any changes PrecisionHawk made to the utility's database.

(Case Study continued from page 08)

The utility now had an accurate representation of their inventory, plus data on the phasing of their circuits. Using the data collected and analyzed by PrecisionHawk, just six months into the project the client determined that:



There were more than **17,000** pieces of inaccurate data in the utility's database.



Eight percent of pole tags were incorrect, and **26%** of poles were missing tags.



In **234 cases**, there were no poles where the utility thought it had one.

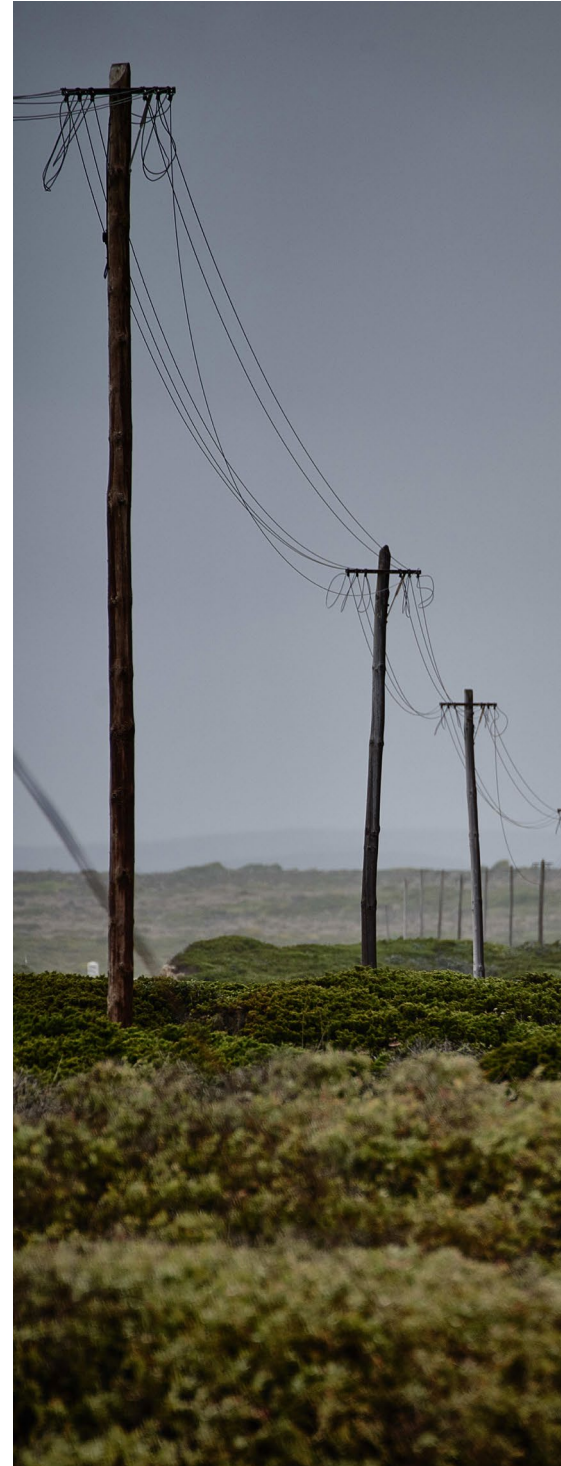


The utility had over **500 poles** that were not in its database at all.



There were **1,500** updates to pole class and height data.

Using PrecisionHawk's solution for data collection, processing, analysis, and reporting, the utility sped up the inventory process, gained unprecedented insight into the type and location of its assets, gathered needed data on phasing—and made incredible headway in its modernization program.



DATA: AUTOMATED

Improve process safety and accuracy by
employing robotics and AI.



Automating data is the process of generating the desired outputs from a set of provided inputs with little to no human intervention. This requires finding the optimal mix of human and machines that requires the least amount of human interaction while still meeting the quality standards of the utility.

In the PrecisionHawk solution, artificial intelligence combines with human skills to create a streamlined end-to-end data workflow that increases accuracy and efficiency without incurring unreasonable costs.

Humans are involved at the beginning and end of this workflow. At the beginning, data engineers research, design, and implement the machine learning models. At the end, data analysts analyze the outputs of the model for quality control before sending them along to the client. Artificial intelligence and machine learning handle the middle phases to create a manageable dataset that includes only the most relevant information.

BUILDING, TESTING, AND IMPROVING THE MODELS

PrecisionHawk uses three metrics to score the performance of its machine learning models:



Recall is a measure of how well the model performed in finding all of the true targets in the data. This metric takes into account the number of true positives and false negatives; in other words, did the model find everything it was supposed to find? Recall is important when missing something comes with a high cost; for example, when looking for anomalies that might cause damage or downtime.

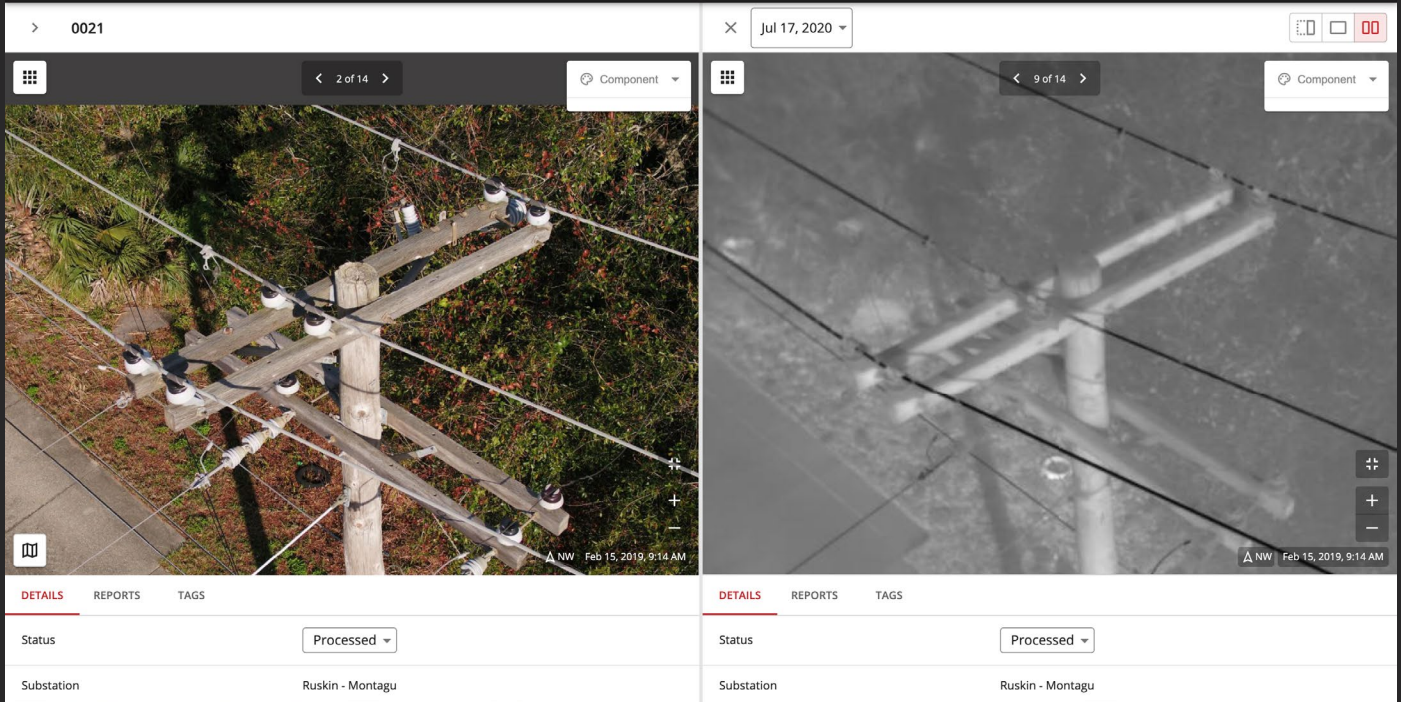


Precision takes into account the number of true positives and false positives, but it also takes the measure of all of the targets that the model detected. How many of them were correct? Precision is important when a high level of insight is needed, for example when identifying types of equipment.



The F1 Score is a combination of Precision and Recall, which is useful for comparing a model with other models. F1 is very important when you're trying to find the right balance between precision and recall.

While all three of these metrics are important for different needs, Recall is the key metric for PrecisionHawk's utilities clients since utilities are looking to identify anomalies that could lead to equipment failure, network outages, fires, or permanent damage to the network.



HOW AI POWERS THERMAL TAGGING TO PREVENT OVERHEATING

During the summer of 2020, in the middle of the COVID-19 pandemic, electric utilities faced scorching weather as well as increased and unpredictable demand—which heightened the risk of overheating components.

One solution: PrecisionHawk’s inspection process that incorporates AI to help utilities identify overheating parts before they fail.

1. Once thermal images of electrical equipment are collected, a model in PrecisionAnalytics reviews the images and detects items of concern, from connection points to insulators.
2. The ML algorithm produces anomaly reports, selecting only those images that show potential damage.
3. Thermographers review the subset of images for thermal issues.
4. The utility company quickly identifies thermal issues and ranks them by severity so they can be pushed to work orders and repaired.

Since the machine learning algorithm culls through the data to pull out only the most relevant images, it enables the utility to collect massive amounts of data—increasing accuracy and decreasing the risk of thermal issues.

HOW ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING COMBINE IN THE PRECISIONHAWK SOLUTION

WHAT IS ARTIFICIAL INTELLIGENCE?	WHAT IS MACHINE LEARNING?	HOW DO AI AND ML WORK TOGETHER IN PRECISIONANALYTICS?
<p>While there's some debate over the exact definition, Artificial Intelligence (AI) can be thought of as smart machines performing tasks that a human has to apply intelligence to perform. These might involve planning, problem solving, or manipulation.³</p> <p>When Siri gives you driving directions, your favorite online store suggests a product you might like to buy, or you get a text from your bank that they detected a fraudulent charge—AI is at work.</p>	<p>Machine Learning (ML) is a subset of AI. ML is the process of feeding data to a machine and letting the machine learn how to accomplish that task. As the algorithms adapt to new data, they're able to learn through experience and eventually make predictions or decisions.</p> <p>For example, some grocery stores are now using ML to develop touch-free self-checkout stations. Data engineers train the model with images of, for example, oranges until the ML can recognize an orange when a customer puts one on a scale. The model becomes more and more accurate as more data is fed into it in real-world use.</p>	<p>PrecisionAnalytics is an AI platform that leverages ML object recognition models to recognize objects like, say, blown fuses on distribution poles.</p> <p>To train the model, the team annotates images of blown fuses and feeds them into the model so it learns how to identify blown fuses on different backgrounds, in varying types of light, and from different angles.</p> <p>Over time, the data engineer will be able to input any image and the model will be able to tell them if the image contains a blown fuse. The model continues to refine its abilities as more data is fed into it in real-life situations.</p>

³ What is AI? Everything you need to know about Artificial Intelligence, ZDNet, [zdnet.com/article/what-is-ai-everything-you-need-to-know-about-artificial-intelligence/](https://www.zdnet.com/article/what-is-ai-everything-you-need-to-know-about-artificial-intelligence/)

DATA: AMPLIFIED

Increase the volume and detail of the data collection by using precision tools.



Utilities need the right data to make smart business decisions—but there also needs to be enough of it. Collecting enough good, real-life data to ensure positive business outcomes can result in datasets in the millions of images; when you have this amount of data, processing it is a time- and resource-intensive task. That's why PrecisionHawk hands this task off to its machine learning model.

Rather than training a model on every single image in a large dataset—for example, five images each of the 275,000 distribution poles in a utility's network—PrecisionHawk's data engineers train the model on a small subset of the data and monitor the performance early on. This allows the data engineers to quickly assess where improvements are needed. The model learns the easier, more repetitive tasks first, freeing the data team to focus on edge cases and outliers to ensure the robustness of the model.

In addition, the machine learning model employs filters to separate the noise from the valuable data, resulting in a more manageable amount of data. This reduces processing time and storage costs while providing the most accurate results.

MORE THAN IMAGE VOLUME

There's more to amplifying data than increasing the number of images. A large volume of images is important, but these other aspects need to be amplified as well:



The right angles. When the application calls for it, PrecisionHawk's team can use drones to capture images of interior angles inaccessible to ground crews and manned aircraft.



A high level of detail and focus. Ultra-high-resolution cameras, LiDAR models, and image analytic algorithms ensure that even the smallest issues are easily visible.



The proper tags. Humans need high quality, real-life imagery, not just data models—but for machines to be able to process these images, they need tags that, for example, indicate the location of the asset. The PrecisionHawk solution offers both.



High temporal resolution. This is the amount of time between revisits to acquire data for the exact same location. The high temporal resolution of drones allows for the rapid and cost-effective capture of essential decision-support data.

BREAKING DOWN DATA SILOS

Good data is amplified further by being shareable. PrecisionHawk's open API layer allows PrecisionAnalytics to push information into not just one system, but into the many various systems commonly used by enterprise clients.

This means the solution can identify issues before they become emergencies and add them directly to the maintenance plan. For example, let's say a utility needs to monitor a substation defense for security issues. If PrecisionHawk's visual detection

system reveals a hole, PrecisionAnalytics can automatically push the information into the utility's security system, and the utility can then have the problem addressed immediately.

Not only that, PrecisionAnalytics creates easily understood reports that can be shared among stakeholders, enabling the data to be used across the organization to refine capital budgets, fuel network engineering strategy, apply for permits, prove regulatory compliance, and more.

KEEPING DATA SECURE

With all this data being created and shared, how can you ensure it's secure?

It's crucial that software systems creating and handling utility data are designed with security in mind for today and tomorrow. "While there are major weaknesses in the distribution system, which are vulnerable to exploitation [...] there are myriad new attack vectors being added every day," report Reza Arghandeh and Yuxun Zhou in their book *Big Data Application in Power Systems*.⁴

When sensitive data resides in multiple stakeholders' systems, that risk is multiplied. The more places data is stored, the more opportunities there are for bad actors to find vulnerabilities.

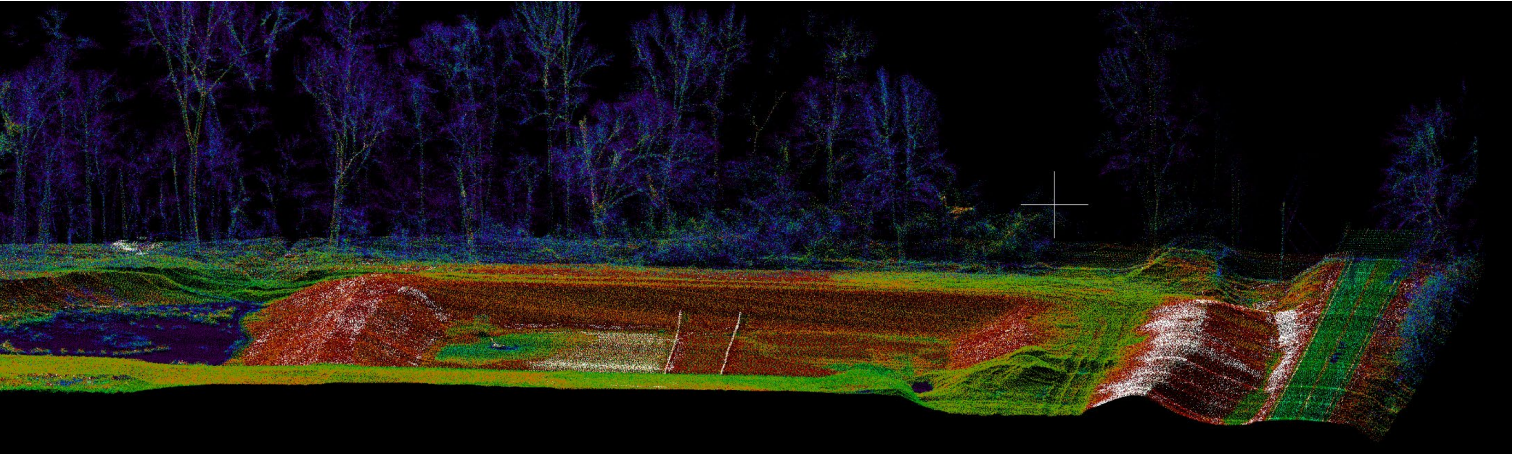
PrecisionHawk provides a multi-tenant, cloud-based experience—which means each tenant's data is isolated and invisible to other tenants.

Code scans, third-party audits, and automated testing ensure that new vulnerabilities or threats are not introduced.

Mobile security is also important since data might be transferred directly from the field via a WiFi or cellular connection to enhance speed. PrecisionHawk's Flight Operations and Data Services branches are vetted and go through annual training to ensure proper safety measures are in place. Secure pipelines and systems are used when transferring data, and PrecisionHawk's data engineers are diligent with data cleanup. Data cards are always re-encrypted to make sure no trailing information is left behind.

PrecisionHawk holds ISO certification, meaning its processes meet all the quality, safety, and efficiency requirements of the International Organization for Standardization.

⁴Reza Arghandeh and Yuxun Zhou (editors), *Big Data Application in Power Systems*: www.sciencedirect.com/book/9780128119686/big-data-application-in-power-systems



CASE STUDY:

AMPLIFIED DATA HELPS LEADING UTILITY MEET ITS STORM-HARDENING DEADLINE

After two-thirds of Florida lost power during Hurricane Irma in 2017, the state government introduced storm-hardening regulations to help prevent massive outages in the future.⁵ These regulations require inspections to determine the condition of electricity distribution poles and their components, wind-loading analyses to make sure the poles can withstand hurricane-force winds, and hardening of the system where needed.

To comply with storm-hardening regulations, utilities typically rely on ground-based inspections. But if the utility did this, it would risk not completing the storm hardening by the government deadline of 2025, since it can take weeks to inspect each feeder. Manual inspection methods can also produce insufficient and inaccurate data on inventory and the condition of poles.

That's why the utility partnered with PrecisionHawk to amplify its asset data. PrecisionHawk developed a customized, fully integrated data value chain solution that included:

1. A flight plan and technology portfolio; since the utility had been using manual inspection methods for years, PrecisionHawk couldn't rely on the company's records and needed to recollect.
2. A vegetation encroachment warning system.
3. Data captured using drones outfitted with RGB cameras and LiDAR sensors.
4. Machine vision technology for change detection and to identify areas of concern.
5. A wind-loading analysis using PoleForeman.
6. Actionable reports and images from PrecisionAnalytics showing the location and condition of each asset.

⁵ <https://www.heraldtribune.com/news/20190417/storm-hardening-bill-could-hike-florida-electric-rates>

(Case Study continued from page 17)

The high-resolution imagery was used to produce a model of every pole that was so ultra-high fidelity that PrecisionHawk was able to identify cracks and holes and calculate their impact on pole integrity. Using the data collected and analyzed by PrecisionHawk, the utility determined that:

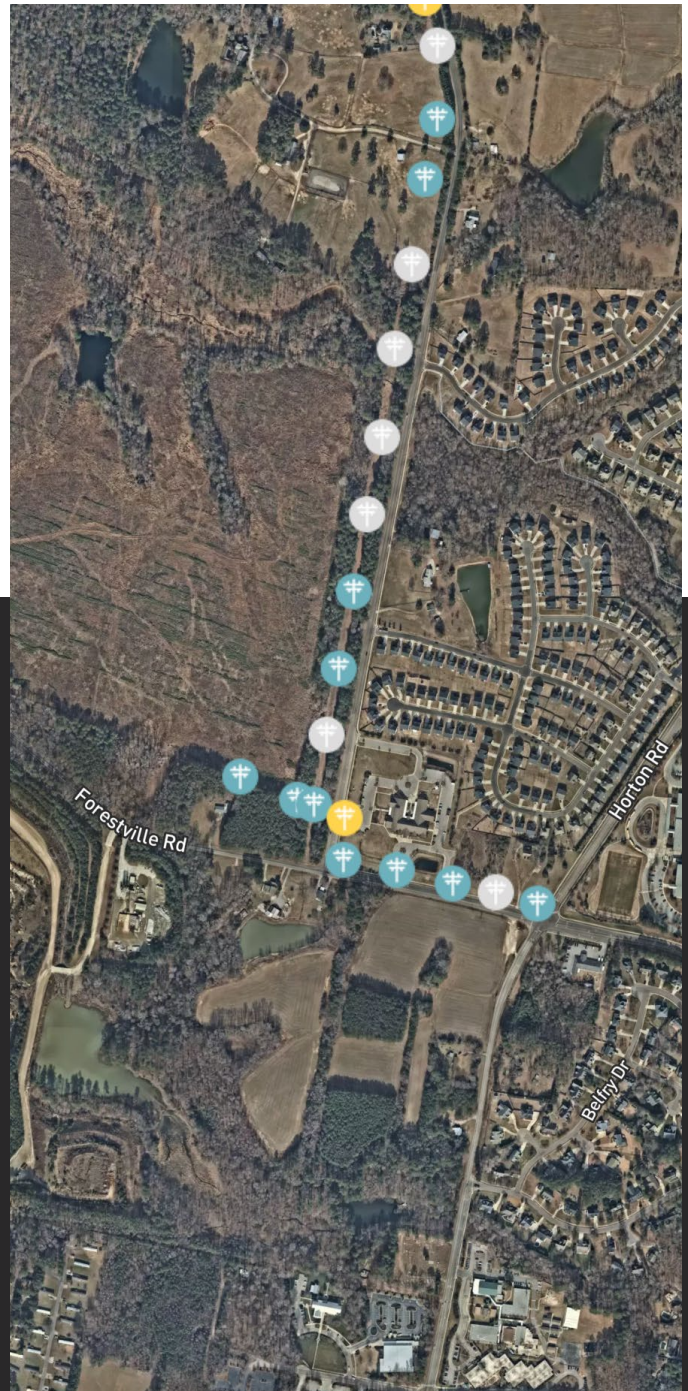
- Seven percent of the assets the utility thought were in the field were not in the field.
- Ten percent of the assets the utility thought were removed had not been removed.
- Forty percent of poles were located more than five feet away from where the utility's database had them located.
- Some poles were as far away as 50 feet or more from the utility's database record.

DATA THAT DRIVES RESULTS

Accelerating, automating, and amplifying data helps utilities collect the vast amounts of data needed to ensure accuracy and usefulness, because AI and machine learning can filter that data down to the most relevant information. The balance of automation and human intervention makes the process cost effective, as well.

With the right data, utility personnel can now make the best decisions to increase safety, customer satisfaction, and cost savings—decisions that will benefit the utility today and tomorrow.

Thanks to PrecisionHawk's end-to-end data solution, the utility has been able to quickly address imminent issues, and now has an accurate record of their distribution assets—which will speed up the utility's storm hardening initiative and streamline future inspections and repairs.



WHY PRECISIONHAWK?

PrecisionHawk has the experience, expertise, and technology to help utilities understand their assets, predict and prevent problems, and comply with regulations.



Experience — We specialize in serving major enterprises, counting among our clientele top 50 utilities, oil and gas supermajors, Fortune 100s, and federal and state agencies. Our staff includes experts in business, policy, geographic information systems, and technology.



Regulatory Leadership — We've partnered with NASA and the FAA to help define practices in Beyond Visual Line of Sight (BVLOS) operations and universal traffic management, among other regulatory areas.



Machine Intelligence — PrecisionAnalytics Energy runs on the latest artificial intelligence platforms.



Cutting-edge Geospatial Science — Our industry-leading team of PhD-holding and remote sensing-accredited geospatial scientists help ensure the quality and accuracy of our systems.



Safety and Operational Excellence — Our flight operations are founded on Naval aviation principles, earning an A-rating from ISNet.

THE BOTTOM LINE:

By deploying PrecisionHawk's data solution, enterprises can improve every step of their inspection process—from collecting data to deploying repair crews.

And through it all, we're with you every step of the way.



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To speak with one of our experts about our portfolio of geospatial data analytics services and tools, contact us.

