Rewriting the Rules of Modern Asset Management and Visibility

How Combining AI with Imagery Acquisition and Analysis Can Redefine Success

POSITION PAPER

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Across the utility industry, leaders are confronting a simple reality: you can no longer manage what you cannot continuously see across your asset base. Aging infrastructure, extreme weather, constrained capital and rising demand are converging, while sensor data and imagery, cloud and artificial intelligence (AI) have become more mature and affordable.

These combined market conditions require a completely new approach to asset management: an enterprise image acquisition and analysis platform that turns raw pixels into informed decisions. Utility companies need timely, complete and accurate data, which can be gleaned from readily accessible raw, remote sensing data, to maximize networks and operations.

Instead of traditional field walkdowns, scattered drone missions and one-off AI pilots, utilities today need a coordinated, cloud-native image management capability that captures, governs and analyzes imagery at scale. And they must be able to share those insights directly into core systems, such as enterprise asset management (EAM) and work and asset management (WAM) systems. Fortunately, with an innovative technology approach and strategic planning, utilities can digitally transform into a modern asset management enterprise with visibility and granularity that meet today's demands and enable tomorrow's possibilities.

Why Enterprise Asset Management and Predictive Maintenance Matter

For CTOs, CIOs and asset leaders at large utilities, proactive asset management and predictive maintenance have become paramount as grids operate beyond their original design scope.

Decades old transmission and distribution networks must today support a new era of electrification, distributed energy resources (DERs) and hyperscale data centers under heightened regulatory and public scrutiny. Traditional run to failure or calendar based maintenance models cannot keep pace with this complexity.

Modern and mature asset management provides a precise understanding of what assets utilities have, where they are, how they are configured and how they perform throughout their lifecycle. Predictive maintenance helps anticipate failures based on condition, context and risk, prioritizing precise maintenance and upgrades, not just when the schedule says it is time. Together, they enable utilities to make defensible investment decisions and demonstrate that scarce (O&M) and capital dollars are directed where they maximize resiliency.

Imagery and AI are now central to this shift. High fidelity views of poles, conductors, substations and linear assets, combined with location-based AI and computer vision, allow utilities to see deterioration, clearance violations, hot spots and encroachments long before they manifest as outages or safety incidents. When those detections are seamlessly integrated into an enterprise asset model, they fuel probabilistic planning, risk scoring and scenario analysis aligned with real world conditions.

The Challenge of Modern Asset Management

Many utilities struggle to realize the full value of grid modernization investments through effective asset management and predictive maintenance strategies. The first challenge is sheer scale: a Tier 1 utility may manage tens of thousands of miles of lines and millions of structures, making manual inspection and situational awareness unsustainable.

Inspection and maintenance activities also remain fragmented by functional area. Transmission, distribution, vegetation, gas, substations and damage assessment teams design their own inspection programs, procure imagery independently and store results in system specific silos, leading to redundant patrols and a disjointed enterprise view of risk.

Regulatory pressure is escalating faster than capabilities can keep pace. In fire prone territories, regulators increasingly expect utilities to demonstrate they understand asset condition and are taking proactive steps to reduce ignition and reliability risks. At the same time, static inventories and periodic inspections no longer meet expectations, especially in fiscally austere environments.

Many organizations have piloted AI and image analytics as point solutions for specific use cases without building the operational framework to scale them. Results often remain trapped in vendor portals or spreadsheets, so detections do not consistently drive risk based inspections or capital optimization.

Finally, internal capacity constraints persist. Utilities have limited engineering and inspection staff to review every piece of remotely sensed data or manually reconcile every discrepancy, so leaders must automate the journey from raw data to prioritized work.

Top asset management and predictive maintenance challenges include:

- Managing thousands of miles of lines and millions of assets
- Fragmented, siloed inspection programs that duplicate effort and expenses
- Regulatory expectations for evidence based risk reduction and rate justification
- AI and image analytics pilots that are disconnected from assets and workflows
- Capacity constraints that make manual inspections and review impractical

Solving the Data Problem: Turn Imagery into Enterprise Asset Intelligence

Underpinning these challenges is a fundamental data problem. Modern asset management and predictive maintenance require timely, accurate and complete data on assets, locations, configurations, conditions and performance.

Imagery and photos promise a way to close these gaps, but only if they are treated as strategic enterprise assets rather than as ancillary inspection items. Many utilities fly drones or acquire aerials for specific projects. They store images on shared drives or on vendor platforms, then move on, with sparse metadata and **limited visibility into attributes** such as asset IDs or geospatial features.

Utilities now capture a wide array of image data, but without a common ingestion, normalization and governance framework, these **rich datasets remain undiscovered, underused and costly.** Data governance is equally critical, because imagery often contains personally identifiable information (PII) that must be handled carefully to **manage privacy, security and regulatory risk** while still enabling AI and computer vision analytics to operate.

Ultimately, these issues shape the effectiveness of enterprise asset management and predictive maintenance programs; **leaders must be able to trust that imagery and related data are reconciled and up to date** to defend asset decisions to regulators, boards and the public. Governance is how trust is built and maintained.

Top asset data and imagery challenges include:

- Incomplete, inconsistent and siloed asset records
- Ad hoc imagery acquisition and storage practices
- Multi modal data streams without a unified ingestion and normalization
- Privacy, security and data access and a lack of governance
- Limited integration between imagery, analytics and work systems

Reach a New Asset Era with an Advanced Image Acquisition and Analysis Platform

Solving the modern asset management challenge requires a new way of thinking and a higher level of innovation. That's where imagery and AI change everything. Specifically, deploying an image acquisition and analysis platform gives organizations enterprise-wide capabilities and visibility that transform operations.

Taking a platform approach dramatically improves how imagery is captured, ingested, governed, analyzed and integrated, making it a foundational asset for enterprise asset management and predictive maintenance. Built on a cloud-native, standards-based architecture, it is designed to be AI-ready, partner-friendly and tightly coupled with GIS, EAM and WAM systems.

The seven core components of an advanced image acquisition and analysis platform, listed below, can change the trajectory of utility asset management across the U.S. and around the world.

1. Imagery Aquisition

The journey begins with a coordinated, multimodal imagery acquisition strategy that intentionally aligns with enterprise asset management use cases. Rather than each department contracting its own flights or drone captures, utilities define a common, comprehensive specification, including camera perspectives (terrestrial, oblique, vertical), resolutions, flight paths and cadence. By doing so, a single acquisition can serve circuit patrols, vegetation management, engineering design and post-storm assessment. Leveraging drones, ground and vehicle platforms, aerial surveys and satellite sources delivers "capture once, use many" coverage across circuits, substations and facilities.

Multi-sensor payloads (LiDAR, thermal, multispectral, radiometric and 360-degree views) are deployed where they add the most value. They identify structural defects, clearance issues, hot spots, leaks and encroachments in a single integrated mission. Precise shot maps, flight paths and oriented imagery ensure every capture is locationally accurate, maximizing downstream analytics and GIS performance. The result is a strategic imagery program that reduces redundancy, improves data quality and scales efficiently across the network.

2. Historical data inventory

Next, utilities conduct a onetime (and periodically refreshed) inventory of existing imagery and remote sensing assets. This exercise surfaces who is already collecting what, where it is stored, under what licenses and for which use cases. Many utilities today either lack the internal expertise or bandwidth to perform such an encompassing task. For these organizations, TRC can help consolidate legacy datasets from departmental silos into the enterprise image platform, normalizing formats and metadata so they become part of a coherent asset condition history.

By incorporating historical data, utilities can immediately increase the value of prior investments and strengthen change-detection capabilities. Multiyear views of circuits, substations and critical assets become available for planning, regulatory evidence and AI model training without needing to "start from zero."

3. Cloud-based platform

At the core is a cloud-native image management platform engineered for high-volume ingestion, storage and processing of imagery and sensor data. A flexible ingestion engine accepts still images, video, drone captures, terrestrial surveys, aerial photography and satellite feeds. It then normalizes them to common storage and metadata specifications. Automated, serverless pipelines perform tasks such as image orientation, quality checks, tiling, compression and tagging, keeping operational costs predictable even as volume scales.

Moreover, the platform embeds privacy and data security services. AI models detect and obscure faces, license plates and other personally identifiable elements before imagery is stored long-term or shared with analytics vendors. Security controls and audit trails are applied, enabling utilities to meet regulatory requirements. With platform-agnostic access patterns, utilities retain organizational control of their data while still enabling a diverse ecosystem of tools and analytics.

4. Remote Sensing Portal

A remote sensing portal ensures raw data becomes usable enterprise products. Built on industry geospatial standards, the portal serves as the processing hub and clearinghouse, tying every image, point cloud and scan to specific assets, spans, structures, and locations. Robust indexing and cataloging services capture metadata about who captured what, when, how and for which assets, making imagery discoverable across a variety of dimensions including feature ID, circuit, geography, or time window.

Users access imagery through intuitive web interfaces that support searching, filtering, map-based exploration and time-series views. Engineers, planners and field leaders can compare before-and-after states, review multiple sensor layers and assemble evidence for design development or regulatory reporting. This portal becomes the enterprise window into real-world asset conditions, not just another niche inspection tool.

5. AI and computer vision-based analytics

With imagery centrally accessible and contextualized, AI and computer vision unlock scalable condition assessment. Specifically, TRC's architecture supports configurable machine learning pipelines that integrate with the image store to detect features and anomalies across poles, conductors, insulators, structures, vegetation and other equipment. Best-of-breed location-based (or GeoAI) models, some built by TRC and others by specialized partners, detect and identify anomalies like bent or broken crossarms, cracked insulators, frayed conductors, overheated connectors, vegetation encroachments, substation issues and surface defects.

These visual analytics are tuned to specific operational applications like overhead circuit patrols, storm-damage triage, wildfire risk mitigation, substation inspections, vegetation management and asset mapping. As models improve, the open, AI-ready architecture allows new capabilities to be plugged in without rearchitecting the platform. The outcome is an automated first pass over massive volumes of imagery, elevating the highest-risk conditions for human review and action.

6. User interfaces and systems integration

Role-based user interfaces give engineers, inspectors and planners tools to perform remote inspections, validate or override AI detections, and initiate follow-up work. These interfaces present imagery, AI derivatives and asset context in a single, intuitive view.

Behind the scenes, integration components push enriched asset intelligence into GIS, EAM/WAM, advanced distribution management systems (ADMS), outage management systems (OMS), computer-aided design (CAD) and other systems. For example, a detected pole defect becomes an updated asset condition in the asset register, a prioritized work order in the maintenance backlog and an input to planning and risk models. Standards-based APIs and ETL patterns ensure that imagery-derived insights flow reliably into downstream processes.

7. AI-driven data enrichment and governance

Finally, the platform enables continuous data enrichment and governance. As imagery and analytics are ingested over time, AI models update asset locations, attributes and condition fields. These updates progressively close data gaps in GIS and asset systems and help to build digital twins of critical infrastructure. Governance directs how this enriched data is retained, audited and shared. The result is evidence-ready condition histories that support regulatory filings, insurance discussions and internal assurance.

TRC provides overarching stewardship of this enrichment and governance environment: curating partner ecosystems, updating reference architectures, evolving governance frameworks and aligning program roadmaps with business value. Through assessments, pilots and scaled deployments, we help utilities ensure that each incremental investment in imagery and analytics deepens and consolidates rather than fragments, building an enduring asset base for predictive, risk-driven operations.

The Benefits of an Image-Driven Asset Program

An enterprise image acquisition and analysis platform does more than automate inspections; it can reshape how utilities make decisions about risk, resilience and capital planning. By combining imagery, AI and asset systems, leaders move from periodic field insights to continuous, data-driven visibility across the network.

The top benefits include:

- **Risk-based inspections at scale:** Utility crews can focus on the assets and areas where imagery and analytics reveal real deterioration, encroachment or anomalies, thereby improving the risk reduction achieved per inspection dollar spent.
- **Reduced outages and safety incidents:** Earlier detection of structural defects, thermal anomalies and vegetation threats prevents more failures, ignitions and equipment damage. It also improves SAIDI/SAIFI metrics and public safety outcomes across service territories.multimodal data streams without a unified ingestion and normalization
- **Higher asset utilization and smarter capital:** Condition-informed plans enable utilities to defer replacements when assets remain healthy, accelerate interventions when risk is real and direct capital where it delivers the greatest lifecycle benefit.
- **Enterprise transparency and collaboration:** A single, governed imagery and analytics platform provides engineering, GIS, operations, maintenance and emergency teams with a common operational picture. It strengthens coordination and decision making during both blue-sky and storm events.
- **Faster AI adoption with controlled risk:** An open, AI-ready architecture lets utilities experiment with new models and vendors. Moreover, they can keep data, governance and integration patterns under their control, reducing vendor lock-in and accelerating prudent innovation.
- **Greater return on data Investments:** An enterprise platform approach ensures companies can exploit the compounding value of sensor data. Coordinating acquisition, data operations and analytics activities across the organization supports a high cost/benefit ratio and lowers the cost of predictive maintenance.

Start with High Value Use Cases

The value of an image acquisition and analysis platform materializes in concrete use cases that deliver better business outcomes for operations, planning and regulators. By targeting early deployments in high-impact scenarios, utilities can demonstrate measurable gains while laying the foundation for broader enterprise adoption.

High-value use cases for every utility include:

- **Overhead circuit patrols:** Replace or augment truck-based patrols with drone and aerial imagery analyzed by computer vision. This enables faster asset capture and defect detection over thousands of structures while freeing inspectors to focus on validating high-risk findings and planning targeted repairs.
- **Storm support and recovery:** Capture rapid, post-event imagery along damaged corridors to triage conditions, prioritize restoration work, route crews efficiently and document damage for regulators and insurers. This significantly accelerates time to full-service restoration after major storms.
- **Wildfire threat mitigation:** Use high resolution imagery and thermal data to identify equipment conditions, conductor clearances and vegetation encroachments that elevate ignition risk. Utilities can then perform risk-based patrols, targeted vegetation work and more defensible public safety power shutoff decisions.
- **Substation inspection and security:** Build detailed visual and 3D records of substations to detect equipment deterioration, oil leaks or structural issues; support remote inspections; and enhance physical security monitoring, reducing site visits while improving compliance and incident readiness.
- **Vegetation management:** Combine line imagery, LiDAR and analytics to quantify vegetation clearances and growth trends, enabling more precise trimming cycles, better contractor oversight and improved alignment between vegetation budgets and actual system risk profiles.

- **Asset mapping and data quality:** Leverage imagery and point clouds to correct asset locations, attributes and configurations in GIS and EAM systems, building more accurate network models that support everything from planning and design to outage management and ADMS deployments.
- **Leak detection and gas asset monitoring:** Apply thermal and multispectral analytics to detect potential gas leaks or abnormal conditions around pipelines and facilities. This facilitates earlier intervention, reduced emissions and stronger safety and environmental performance.

How TRC Helps Utilities Build Advanced Image Platforms

TRC approaches image acquisition and analysis platforms as strategic, multi-year capabilities that must be tightly aligned with each utility's business context, regulatory environment and technology roadmap.

We start by working with CIOs, CTOs, EAM directors and GIS leaders to clarify the problems they need to solve, whether wildfire risk, inspection backlogs, substation visibility or GIS data quality. We then design a platform that delivers value quickly while laying the groundwork for expansion.

Our teams bring deep experience across cloud architecture, geospatial systems, image processing, AI, user experience design and utility operations. We design and implement cloud-based ingestion engines, centralized remote sensing platforms and governance frameworks that meet strict security and compliance standards. TRC field services coordinate drone and ground-based acquisition programs, ensuring capture specifications support both human inspection and automated analytics.

We act as a systems integrator and intellectual partner. Working with a curated ecosystem of GeoAI and computer vision vendors, we design machine learning pipelines that detect high-value conditions, then connect those outputs to GIS, EAM, WAM, ADMS, OMS and CAD systems using standards-based APIs and data models. Our roadmap and assessment offerings help utilities prioritize use cases, quantify ROI, and build internal consensus across departments.

TRC stays engaged beyond initial deployment. We help mature governance practices, refresh acquisition strategies, tune analytics models and extend the platform into new asset classes and business lines. For utilities, this means a trusted partner who understands both the technical stack and the operational realities of running a complex network under increasing scrutiny.

Every Transformation Begins with a Clear View

Modern utility asset management demands a transformation in utility operations. They need enterprise asset visibility programs that provide a structured approach to ingest, govern, analyze and act on massive volumes of imagery and sensor data, enabling utilities to comply with regulations and manage risk.

Without an enterprise approach, data stays fragmented by department, making it impossible to get a complete view of system condition or to coordinate investments and maintenance priorities. An image acquisition and analysis platform provides that clarity, turning imagery into an enterprise asset that powers predictive maintenance and operations.

To explore how this approach can work in your environment, connect with TRC and start building the image-driven foundation for your next-generation asset strategy.

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