PowerX

Data Crisis in the Tower Industry

Why Operational AI and Data Integrity Now Define Competitive Advantage in Tower Networks

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Executive Summary

PowerX completed an AI-readiness assessment of live telemetry from mobile tower sites operating in different regions across Africa throughout 2025, sampling and processing tens of millions of time-series records.

Broken and missing data is silently eroding tower network performance.

The findings echo challenges that are representative of what tower companies, MNOs and ESCOs face in every part of the world where passive infrastructure telemetry is essential to deliver insights into network performance. The findings illuminate a structural issue across tower portfolios globally:

- Eight out of ten sites recorded readings above expected operating ranges and one in four below them
- Two out of three sites showed erratic or inconsistent fuel sensor profiles
- A third discharged batteries while grid supply was available
- One in five experienced solar system failures
- A quarter breached battery autonomy thresholds
- One in five showed unaccounted-for fuel, averaging 150+ litres per site per month

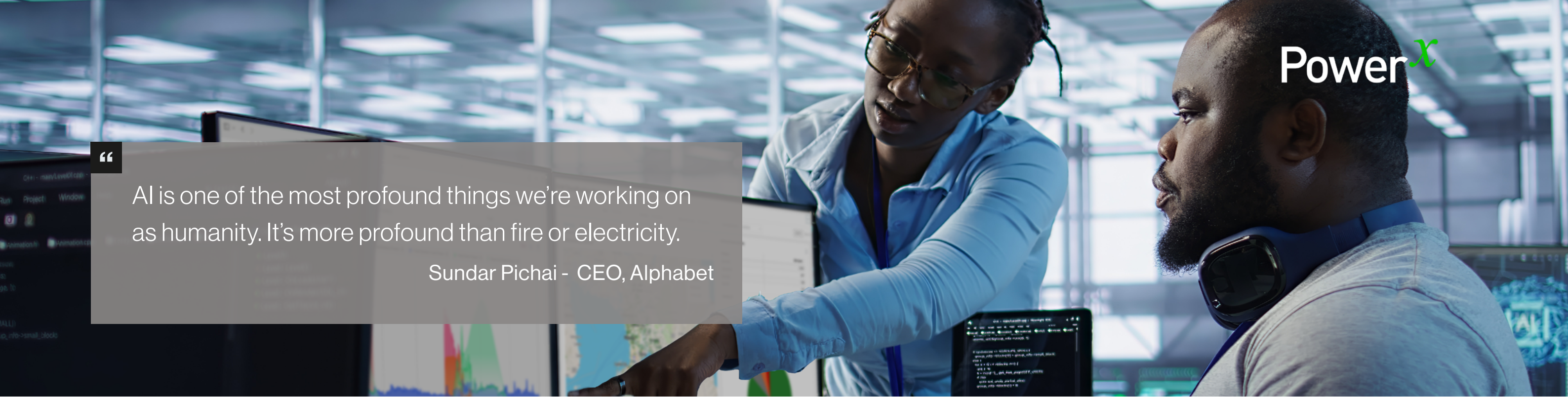
These are not isolated inefficiencies. They are systemic visibility failures.

At the same time, Artificial Intelligence (AI) has crossed the threshold from experimental to operational. Globally, nearly eight in ten organisations have deployed GenAI in some form, and of those, over 80% report no material bottom-line impact . The 5% of organisations that confirm successful results are those who applied AI to deep vertical use-cases and fully embedded automation at the heart of their business workflows. This is the “AI paradox.”

The lesson is clear: AI only transforms businesses when embedded into core workflows. For tower networks, this means:

- Operational AI is transforming infrastructure management
- Digitalisation is the essential gateway to this transformation
- Digitalisation fails without data quality integrity
- Even absent an AI strategy, fixing data unlocks immediate measurable value
- Late adoption does not mean slower progress - it means structural disadvantage

PowerX is uniquely positioned at this intersection. No organisation globally analyses tower telemetry at this depth, across this range of use cases, with this level of applied data science.



Introduction

The telecom tower industry stands at a strategic inflection point. Networks are expanding, energy costs are volatile, sustainability expectations are rising, and uptime requirements are tightening. At the same time, infrastructure portfolios are becoming more complex - hybrid power systems, distributed renewables, battery storage, grid dependencies, and multi-tenant commercial models all interacting across thousands of sites. The next wave of digital services will intensify these pressures further. 5G and emerging 6G architectures demand denser networks, while edge computing and edge data centres are pushing processing and storage closer to the network. Together these trends will significantly increase energy demand across tower infrastructure, potentially doubling power requirements compared with earlier 4G networks. In this environment, operational precision is no longer optional. It is existential.

Over the past decade, the industry has invested heavily in Remote Monitoring Systems (RMS), Internet of Things (IoT) devices, dashboards, and reporting layers. On paper, tower networks are digital. In practice, however, telemetry is inconsistent, incomplete, and frequently unreliable. Measurements drift outside expected ranges. Sensors behave erratically. Critical variables are missing. Precision in operations depends on reliable data embedded directly into operational processes - data that can be trusted. Yet in many networks, poor data quality reduces true operational visibility and weakens the precision of both operational decisions and strategic planning.

This whitepaper argues that the tower industry is facing a structural data crisis. The issue is not a lack of technology, but a lack of data integrity and system coherence. Without trustworthy inputs, optimisation becomes guesswork, renewable investments underperform, hybrid systems misbehave, and inefficiencies compound silently across portfolios. The problem is systemic, not anecdotal, and results in higher OpEx and CapEx, slower growth, and reduced revenue opportunities.

Operational AI now offers the ability to detect, predict, and optimise infrastructure performance at unprecedented scale. But AI cannot compensate for fractured data foundations. Digitalisation without data integrity leads to stalled transformation and stranded investment. This paper examines the evidence, quantifies the impact, and sets out why fixing the data layer is the first and most urgent step toward competitive survival in the AI era.

The Purpose of this whitepaper is threefold

- Expose the scale and impact of the tower industry's hidden data integrity crisis.
- Demonstrate why digitalisation and Operational AI depend on fixing foundational telemetry weaknesses.
- Show that immediate performance gains - and long-term competitive advantage - begin with data quality.

Data Overview

PowerX analysed **tens of millions of time-series telemetry records** from a representative sample of tower sites, spanning multiple energy configurations including grid, diesel, battery, and solar. The intent was not to audit assets, but to assess whether the data itself was fit to support modern operations and agentic AI workflows.

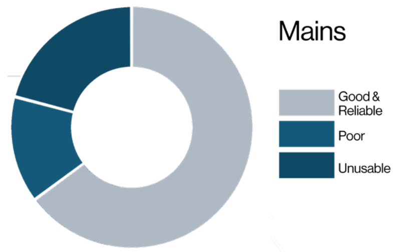
The majority of sites recorded sensor values that fell outside expected or viable physical operating ranges. Some metrics were persistently too high, others implausibly low, and many oscillated between extremes, all indicative of material data flaws. In practical terms, this means that even basic questions like 'How much energy was consumed?', 'How long do batteries actually last?', 'Are generators being used efficiently?' cannot be answered with confidence.

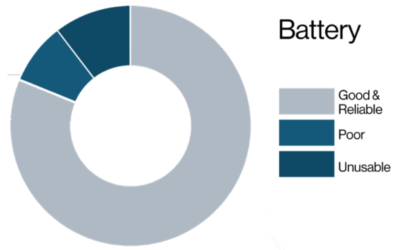
Fuel and genset data illustrates the problem clearly. In many tower networks - particularly in regions such as Africa where diesel generator use remains common - fuel represents one of the largest components of operational expenditure. Having a reliable picture of fuel usage is therefore fundamental. Yet across many sites the recorded fuel levels fluctuate erratically, rising and falling without any correlation to generator runtime - even after considering the impacts of fuel loss/theft. When this happens, operators cannot accurately measure consumption, detect potential losses, or reconcile fuel deliveries. In the worst cases, the distortion is so severe that fuel-related KPIs become effectively meaningless.

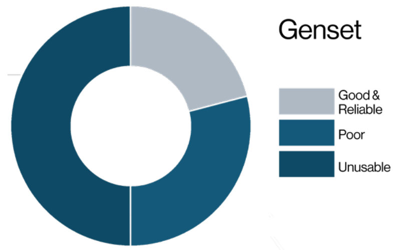
Similar patterns appear across power systems. Some reflect data integrity issues - for example, sites showing grid voltage with no corresponding current or power. In these cases, the telemetry cannot be trusted, and the problem is **loss of visibility rather than inefficiency**.

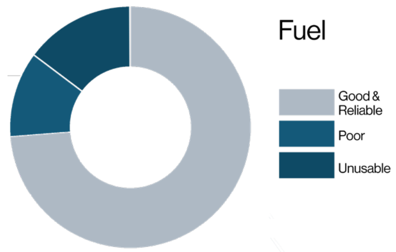
Alongside this, the assessment identified **genuine operational inefficiencies visible within the data**, such as batteries discharging while grid is available or generators running at low load. These are real behaviours that increase cost and reduce performance.

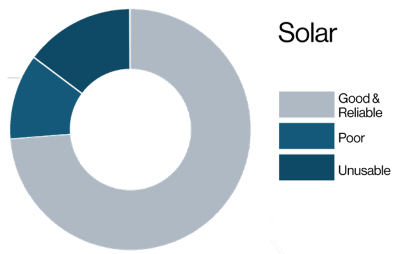
Crucially, both often coexist. Without validating the data, faults can mask inefficiencies - and apparent issues may simply be measurement errors - leading to decisions based on unreliable signals.

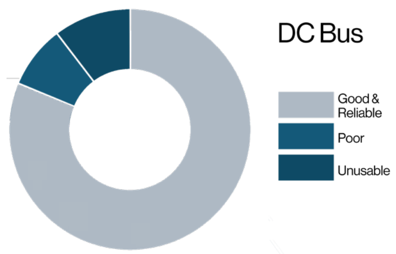












The Compounding Effect of Poor Data

Poor data quality does not just affect individual metrics. **It cascades.**

Derived indicators such as battery state of health, autonomy, rectifier efficiency, or renewable contribution depend on multiple upstream signals being accurate and consistent. When those inputs are unreliable, higher-level analytics become distorted or misleading.

The assessment across multiple networks of sites found widespread inconsistencies between battery voltage and reported state of charge, frequent breaches of assumed autonomy thresholds, and operating conditions that would normally trigger protection mechanisms but did not. In many cases, it was impossible to determine whether the underlying issue was asset behaviour or measurement error - and that distinction matters operationally.

This creates a dangerous feedback loop. Operators lose trust in the analytics, fall back on manual heuristics, and deprioritise further digital investment. Meanwhile, inefficiencies persist unchecked.

Confident Decisions, Compromised Inputs

Based on the PowerX assessment, this modus operandi is commonplace. Eight out of ten sites recorded readings above expected operating ranges and one in four below. Fuel sensor profiles were reliable and consistent at only one third of sites, limiting reliable assessment of fuel consumption and/or loss. In parallel, two out of three battery sites lacked sufficient data integrity to support robust State of Health or end-of-life modelling.

In other words, decisions about refuelling, battery replacement, autonomy risk, and generator optimisation may appear data-driven - but are in fact being made on unstable measurement foundations. The danger is not visible failure. It is confident optimisation built on compromised inputs.

The Trust Erosion Effect Data is Binary - and so is Trust

Once confidence drops below a certain threshold, behaviour changes. Engineers stop relying on dashboards. Alerts are second-guessed. Field teams revert to experience and instinct. Decision cycles slow down.

This is not just a technical issue - it is an organisational one.

When analytics are perceived as unreliable, three things happen

- Proactive maintenance reverts to reactive intervention
- Investment cases weaken because baseline savings cannot be proven
- Digital programmes lose executive momentum

The cost of poor data therefore extends beyond inefficiency. It undermines institutional confidence in digital transformation itself.

Telemetry Analysis: The hidden opportunity cost

Hybrid System Misconfiguration
Configuration Without Intelligence

Hybrid configuration drift is when a tower's power system gradually stops operating the way it was originally designed.

Hybrid sites combine grid power, generators, batteries, and often solar. These are configured to work in a specific order to minimise cost and maximise efficiency. Over time, settings change, sensors drift, equipment ages, or maintenance alters how systems behave.

The site still runs, but the control logic no longer works as intended - for example batteries continue to discharge or generators continue to run even when grid power is on (not for grid peak shaving purposes). In short, the system keeps working, but less efficiently, because its configuration has slowly drifted from the original design.

1/3

sites showed generator run-time while grid was on, indicating system faults

1/3

sites ran on batteries while grid was available

These patterns directly increase generator runtime, battery cycling, fuel consumption, and maintenance events.

This is not always an asset failure problem. It is often a control logic and configuration intelligence gap - precisely the type of pattern operational AI is designed to detect and correct.

Renewable Under-performance
Stranded CapEx

Renewable energy under-performance means a site's solar system produces less useful energy than it should.

Panels may fail, become dirty or shaded, or generate power that the system cannot store or use. Sometimes the control settings prioritise the wrong power source at the wrong time, impacting the ability to optimise solar yield and leading to unnecessary grid or generator usage grid or generator usage.

The result is stranded investment - solar equipment is installed, but the expected yield and savings are never realised. Reliable, timely data enables the ability to correctly and dynamically optimise power source selection and resultant costs.

1/5

sites experienced solar system failures

1/4

recorded wasted solar energy

1/5

experienced losses due to shading

This is measurable, stranded, free, low emission energy. Without dependable telemetry, AI cannot deliver insights, so solar under-performance is detected late, shading patterns remain invisible, and system mis-sizing persists.

Battery Degradation
Invisible Risk

Battery degradation is the gradual loss of a battery's ability to store and deliver energy. Over time, heat, deep discharge cycles, high charging rates, and poor operating conditions wear down the internal chemistry of the battery. As this happens, the battery holds less energy and its performance becomes less predictable.

For tower sites that rely on batteries to maintain uptime during outages, this creates a hidden risk. When degraded batteries can no longer provide the expected backup power, sites may lose autonomy or rely more heavily on generators. Without reliable data on how batteries are actually operating, this decline is difficult to detect until performance problems appear.

- **1/4**
  batteries breached required autonomy
- **2/3**
  showed inefficient charge/ discharge conditions
- **2/3**
  lacked sufficient data for reliable SOH modelling

Battery life modelling is impossible without reliable inputs. AI-driven asset life optimisation requires digital truth to ensure the hundreds of millions of dollars invested in modern, Li-ion technology yields expected returns.

Fuel Anomalies
Immediate Financial Leakage

Fuel management is one of the most persistent operational challenges in tower networks, particularly in developing economies where grid supply is unreliable or absent.

Many sites rely on diesel generators as a primary or backup power source, often in remote locations that are difficult and costly to reach. Fuel must be transported, stored, and monitored across widely dispersed sites, sometimes over poor infrastructure and long supply chains. In these conditions, even small discrepancies in fuel data can quickly translate into significant operational cost, making accurate monitoring and accountability critical to efficient network operations. Fuel losses/theft is also a recurring problem and reliable data is essential to enable reconciliation, detection and rapid response.

- **1/5**
  sites showed unaccounted-for fuel
- **150+ litres**
  of fuel discrepancy on avg per site, per month
- **2/3**
  of sites recorded erratic fuel sensor data, distorting consumption monitoring

Fixing data and telemetry foundations enables AI-driven optimisations, predictions and forecasts to deliver measurable OpEx recovery.

Financial Impact

Systemic Impact
from poor data

To illustrate the operational consequences of poor telemetry integrity, PowerX translates the impact into indicative energy and fuel losses across the sites*. The financial impact is quantified by identifying measurable anomalies in renewable generation, fuel consumption, power conversion efficiency, and hybrid system behaviour. Where possible, losses are calculated directly from the observed operational metrics; where the underlying telemetry does not allow precise measurement, impacts are presented directionally based on the frequency of identified conditions.

Hybrid grid–diesel–battery systems, intermittent renewable generation, and limited operational visibility are the norm in tower estates across the African continent, MENA, Asia, and parts of Latin America. The type of operational inefficiencies and anomalies we see across different types of site configuration, energy topologies, and operational constraints are commonly found in these markets.

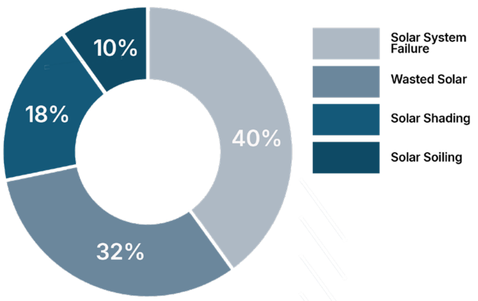
For this reason, this assessment is not isolated. Rather, it illustrates systemic patterns that are likely to appear across comparable tower portfolios operating under similar economic, infrastructure, and energy conditions.

*Cost estimates are typically calculated using the average local electricity rates and diesel fuel prices.

Renewable Energy Loss
Directly Quantified

The analysis identifies several distinct types of solar energy loss, each reflecting a different operational failure within the renewable power chain. Some losses occur when solar systems fail outright, preventing generation from reaching the site load.

Others arise when solar energy is generated but not utilised, typically because of misconfigured hybrid controls, battery limitations, or system logic that prioritises other power sources. A third category results from physical constraints such as panel soiling or shading, where installed solar capacity cannot achieve its expected output due to environmental or installation conditions. Together these categories capture different points where renewable energy contribution can break down - from asset failure, to system configuration, to physical deployment conditions - all resulting in installed solar capacity that delivers less energy than intended.



If these losses are mapped onto a modestly-sized 1,000 tower network, the annual losses amount to:

Solar system failures (~1/5 of sites)	1,100 MWh
Wasted solar energy (~1/4 sites)	850 MWh
Solar shading impact (~1/5 sites)	490 MWh
Solar soiling impact (~1/5 sites)	300 MWh
Total identifiable solar loss	2,740 MWh

This is real energy that was installed, available, but not converted into usable power. If grid or diesel backfilled that shortfall, the corresponding cost estimates determine the financial impact and inform prioritisation and investment decisions.

Fuel Loss & Consumption Anomalies
Directly Quantified

Fuel consumption represents one of the largest operating costs for tower networks in markets where diesel generators remain a primary or backup energy source. As a result, even relatively small deviations between expected and observed fuel usage can translate into significant financial impact.

Unaccounted-for fuel events are a typical driver for high fuel costs - situations where fuel levels, consumption patterns, and generator runtime do not reconcile with expected operational behaviour. These anomalies may arise from factors such as measurement inaccuracies, delivery discrepancies, or physical fuel loss, but regardless of cause they represent real energy expenditure that cannot be explained by normal site operation. Because fuel levels and generator activity are directly observable in telemetry, these discrepancies can be quantified, allowing a conservative estimate of the total fuel loss across the analysed portfolio.

Fuel sensors can be prone to vandalism to mask fuel theft, but rapid response to fuel sensor issues (incorrect or missing data) can help identify and address such instances more quickly, along with correlating other data sets such as site access information, including camera inputs where available.

Across 1,000 sites, fully loaded fuel cost losses amount to over

$125,000 p.a.

without any detected anomalies.

The typical annual fuel discrepancy sized above is equivalent to around four full mid-size fuel tanker deliveries (often to remote tower sites), or approximately 6,000 hours of generator runtime (depending on load conditions).

Digitalisation is the Gateway to AI Advantage

The Illusion of Digital Maturity: Dashboards Don't Equal Digital Readiness

Digital maturity is not about how much data you collect. It is about how much of it you can trust, and how you ultimately use it.

Many tower portfolios appear digitally advanced. There are dashboards, alarms, KPIs, and monthly reports. Sites stream telemetry continuously. From a boardroom perspective, the estate looks "instrumented."

But instrumentation is not the same as intelligence. True digital maturity requires three conditions:

- Measurements that are internally consistent across systems
- Signals that align with physical reality
- Data pipelines that improve over time rather than degrade

Without these, organisations sit in a dangerous middle ground - confident enough to automate, but not disciplined enough to validate.

The risk is subtle. Capital is allocated, workflows are redesigned, and performance targets are set on the assumption that the data layer is stable. If that assumption is wrong, optimisation efforts stall, accountability blurs, and transformation fatigue sets in.

AI cannot operate in darkness. It requires structured, trustworthy, and context-aware data. Operational AI - whether for optimisation, predictive maintenance, or automated control - depends on consistent, high-integrity inputs. Models do not fail gracefully when fed inaccurate data. They amplify errors at scale. Before advanced digitalisation can succeed, foundational data quality must be addressed.

Telemetry analysis (p.8-9) demonstrates that most tower portfolios remain partially digitalised, but not truly data-ready. Under such conditions, automated optimisation becomes unreliable. Predictive models cannot distinguish between genuine asset degradation and measurement drift. Decision-support systems may recommend interventions based on distorted inputs. AI cannot optimise what it cannot reliably measure.

But poor data can no longer be used as an excuse for delaying operational AI. Platforms capable of validating telemetry, correlating signals across systems, and identifying sensor faults in context are already available. What has historically been missing is not technology, but the operational discipline required to treat data integrity as a core infrastructure layer rather than an afterthought.

Digitalisation is not simply the deployment of monitoring tools. It is the establishment of a trustworthy measurement foundation. Achieving this requires leadership and deliberate action - embedding continuous data validation, contextual analytics, and operational accountability into how networks are run. The organisations that do this will unlock optimisation, automation, and AI-led operations. Those that do not will face a widening gap in efficiency, cost structure, and operational resilience. Inaction is no longer neutral; it inevitably results in the loss of competitive advantage.

Crossing the Threshold:
AI Becomes Core Enterprise Capability

AI is no longer a frontier experiment. It is becoming a baseline enterprise capability - like cloud, mobile, or the internet before it. The question is no longer whether organisations will adopt AI, but how quickly they embed it into core workflows and begin compounding its advantages.

The macro signals are clear. Over 78% of companies now use generative AI in at least one business function, up from 55% the year prior, yet more than 80% report no material earnings impact from their initiatives - the so-called "GenAI paradox."[1] AI is already widespread, but value is concentrated among the minority that have moved from experimentation into workflow integration. The next stage of this shift is agentic AI - systems that do not simply generate content or insights, but autonomously interpret signals, prioritise actions, and execute decisions across complex operational environments. Industry leaders increasingly view this as the real transformation layer of AI. Rather than assisting humans in isolated tasks, agentic systems operate continuously within workflows, coordinating decisions across multiple systems and time horizons.

The economic stakes are enormous. McKinsey estimates $11T–$18T in potential value from analytical AI, with $2.6T–$4.4T more from generative AI[2]. Separate research estimates $4.4T in additional productivity growth from enterprise AI use cases[3]. This is not incremental efficiency - it is operating model transformation at global scale.

Yet investment is racing ahead of execution maturity. 92% of organisations plan to increase AI investment over the next three years[4], but only 1% consider themselves "AI mature,"[5] meaning the technology is fully embedded into workflows. Meanwhile, the MIT NANDA State of AI in Business report cites $30–40B in enterprise GenAI investment, yet 95% of organisations see no return[6], and only ~5% of AI pilots reach successful production deployment[7].

The lesson emerging across industries is simple: AI creates value only when embedded into real workflows[7]. For tower networks, that means embedding intelligence directly into operational systems. And in infrastructure environments, that operational fabric is telemetry - the data layer where measurement becomes decision, and decision becomes action. No data, no transformation.

The AI Paradox
Investment Surging,
Execution Lagging

AI is rapidly becoming a foundational enterprise capability, with adoption and investment accelerating across industries. The scale is significant, with trillions in projected value and the majority of organisations increasing spend.

However, capability is not keeping pace. Only a small minority have embedded AI across operations, while most remain fragmented, with isolated use cases and limited integration.

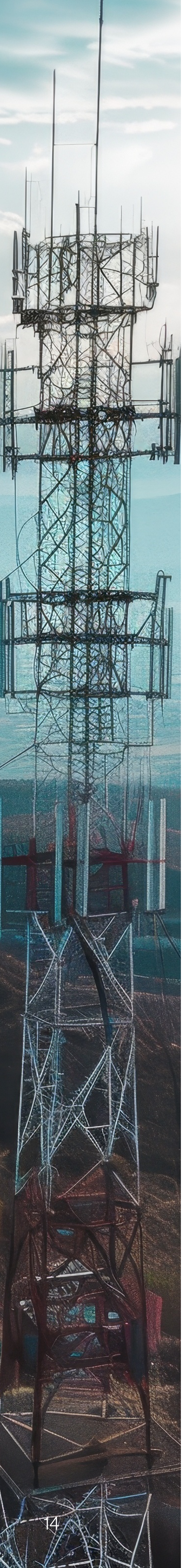
This creates a growing divide between using AI and operating with AI. The next phase will be defined not by access to models, but by the ability to orchestrate systems, data, and decisions at scale.

In infrastructure environments, this means embedding intelligence directly into operational systems - where AI becomes part of how the network runs, not an overlay.

employees in 90% of companies report using AI tools for work[9]

only 1% of organisations describe themselves as 'mature' in AI - i.e. fully integrated into workflows and delivering material outcomes[10]

(1)(2) McKinsey & Company (2023) The economic potential of generative AI: The next productivity frontier. Available at: https://www.mckinsey.com (Accessed: 8 March 2026).
(3)(4)(5)(9)(10) Mayer, H., Yee, L., Chui, M. and Roberts, R. (2025) Superagency in the workplace: Empowering people to unlock AI's full potential. McKinsey & Company.
(6)(7) Nanda Project (2025) State of AI in Business 2025: The GenAI Divide. MIT / Project NANDA.
(8) Yee, L., Chui, M. and Roberts, R. (2025) One year of agentic AI: Six lessons from the people doing the work. McKinsey & Company.



Immediate Value Exists Even Before AI

Fix the Data Now Recover the Value

Even in the absence of a formal AI strategy, establishing a reliable data foundation unlocks immediate operational and financial value. Before optimisation, automation, or advanced analytics can deliver results, operators must be able to **trust what they are measuring**. Where telemetry is inaccurate, incomplete, or inconsistent, inefficiencies cannot be reliably identified, and energy consumption cannot be reconciled against expected behaviour. Restoring data integrity is therefore not an optimisation step — it is a **precondition for effective decision-making.**

Once that foundation is in place, the impact becomes rapidly visible. The analysis identified rectifier efficiency drops at one in six sites, indicating measurable power conversion losses that increase both grid consumption and generator runtime. It also highlighted unaccounted-for fuel at one fifth of the sites, with an average discrepancy of 150+ litres per affected site per month. With reliable data, these are no longer ambiguous signals — they become **actionable operational issues**, allowing operators to isolate root causes, correct system behaviour, and regain control over energy spend.

At portfolio scale, even modest inefficiencies translate into significant cost exposure. Applied across a 1,000-site network, these patterns represent millions of dollars in recoverable fuel expenditure, alongside avoidable generator runtime and unnecessary carbon output.

Reliable data also enables earlier identification of battery stress and suboptimal operating conditions, supporting better maintenance decisions, longer asset life, and improved SLA performance.

The critical shift is from **uncertainty to control**. With trustworthy telemetry, operators can validate site behaviour, prioritise interventions, and enforce consistent operating standards across the network. Decisions that were previously based on assumption or experience can instead be grounded in verifiable evidence, reducing variability and improving execution at scale.

None of this requires autonomous AI or complex predictive modelling. The initial value comes from establishing visibility and acting on it. In many cases, the fastest route to improvement is not adding more intelligence, but **removing ambiguity from the data that already exists**.

Digital hygiene is therefore a direct source of ROI. It enables operators to recover wasted energy, reconcile costs with confidence, and stabilise the operational environment. With that foundation in place, AI becomes the next stage — extending these gains through prediction, optimisation, and automation, and compounding value over time.

The Compounding Advantage
as AI Systems Learn

AI Advantage Accumulates Over Time
Widening the Operational Gap

AI advantage compounds over time. Unlike traditional software, AI systems learn continuously from operational data. Each decision cycle improves accuracy, each anomaly detected refines the models, and each month of learning widens the performance gap between organisations that have embedded AI into their workflows and those that have not.

This is why timing matters. Late adoption does not simply mean starting later **- it means competing against systems that may already have accumulated years of operational learning.**

In distributed infrastructure environments such as tower networks, where thousands of sites generate millions of signals every day, this learning advantage compounds quickly.

Global research reflects this divide. Around 78% of companies now use AI in at least one business function, yet more than 80% fail to generate measurable financial returns from that AI usage. The difference lies in execution: organisations capturing value are embedding AI into operational workflows rather than treating it as a standalone analytics layer.

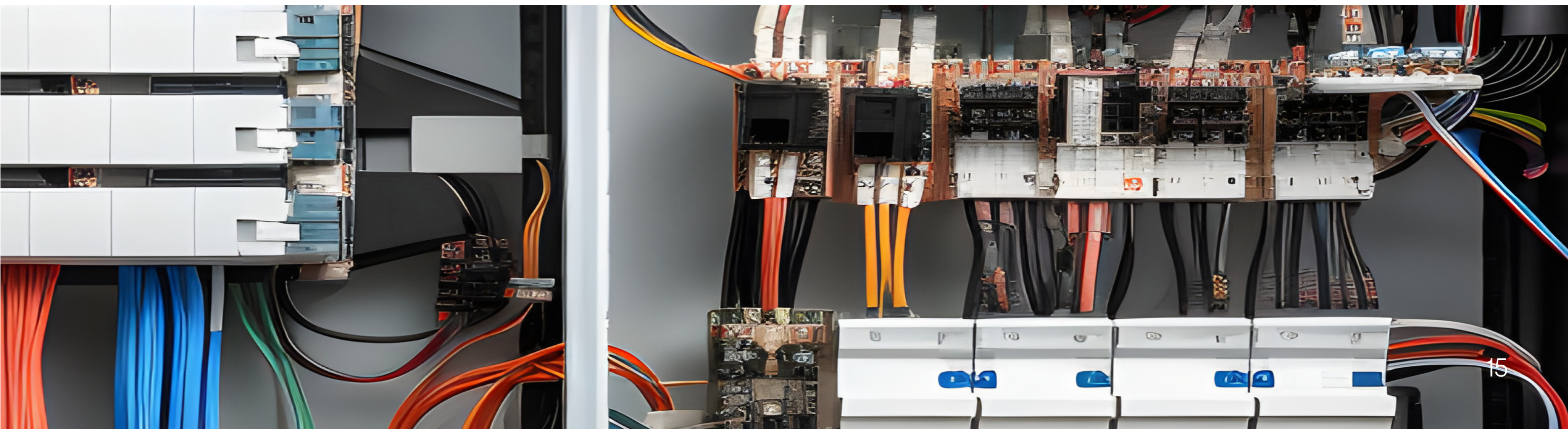
Tower operators that address data quality now position themselves to unlock progressively advancing capabilities such as:

- Predictive maintenance before failures occur
- Continuous optimisation of hybrid energy systems
- Dynamic modelling of asset life
- Automated anomaly detection
- Reduced NOC workload and faster decision cycles

Those that delay risk a widening operational gap:

- Higher operating costs from persistent inefficiencies
- Less predictable uptime and performance
- Stranded digital investments
- Compressed margins and lower asset valuations

Over time, this becomes a structural disadvantage. In infrastructure businesses where efficiency and uptime define competitiveness, delayed AI adoption compounds into competitive decline.



Why PowerX?

At its core, PowerX is a data company operating in the infrastructure domain. Our focus is not simply monitoring towers or collecting telemetry. It is transforming fragmented operational signals into a reliable data foundation and delivering actionable insights that operators can use to run their networks more efficiently.

Across many tower portfolios, the biggest barrier to optimisation is not technology but unreliable data. Measurements drift, sensors behave inconsistently, and energy systems operate in ways that cannot easily be reconciled. When the data layer is unstable, even basic operational decisions become difficult to validate. Fixing this foundation is therefore the first step toward meaningful digitalisation.

PowerX assessments of site telemetry - tens of millions of telemetry records across large, representative samples of tower sites - identify operational inefficiencies that conventional monitoring systems struggle to detect. The objective is not simply reporting, but converting raw telemetry into decisions that operators can act on immediately.

Within this framework, PowerX analyses telemetry across key operational conditions, including:

- RMS/IoT faults and sensor inconsistencies
- Hybrid system misconfiguration
- Fuel anomalies and delivery reconciliation issues
- Solar under-performance and renewable inefficiency
- Battery degradation and autonomy risks
- Energy system design mismatches and asset allocation opportunities

In many cases, the first value PowerX delivers does not require AI automation. It begins with data hygiene - restoring integrity to the measurement layer so operators can trust the signals coming from their networks. Once telemetry is consistent and contextualised, operators can detect inefficiencies earlier and recover wasted energy.

AI and advanced optimisation build on this foundation. Once telemetry is reliable and contextualised, intelligence can move from dashboards into operational workflows. Models detect inefficiencies earlier, predict asset degradation, and optimise how power systems run. Each cycle of better data and decisions compounds operational gains.

This enables agentic AI workflows across monitoring, optimisation, maintenance, and planning. Systems can not only interpret data but increasingly act on it, coordinating decisions across the network. The result is a compounding sequence of efficiency and cost benefits built on a trustworthy data foundation.

Turning Telemetry Into Trusted Data

Traditional RMS platforms focus on collecting and displaying telemetry. They generate alarms, dashboards, and reports, but they rarely resolve the underlying inconsistencies in the data itself. As a result, operators often find themselves managing noise rather than insight.

PowerX takes a different approach. Before optimisation begins, the platform focuses on reconciling the data layer - validating signals, cross-checking measurements, and identifying inconsistencies between sensors, systems, and site topology.

This process turns fragmented telemetry into operationally reliable data.

Once that foundation exists, the system can:

- Detect inefficiencies hidden within normal operating signals
- Identify anomalies that conventional monitoring misses
- Prioritise the operational actions that deliver the greatest impact
- Manage through to resolution to ensure the benefits are realised

The first step toward intelligent operations is not more dashboards.

It is data you can trust - and data that supports advanced Operational and Agentic AI.

From Data Integrity to Operational Control

How Reliable Telemetry Enables **Scalable Tower Operations**

Establishing a trustworthy data foundation is only the first step. Once telemetry is validated and contextualised, the next challenge is applying that intelligence across an entire tower estate. In networks that may span thousands of sites, manual analysis does not scale. Identifying issues, prioritising interventions, and maintaining data integrity must therefore be automated.

PowerX addresses this through continuous data quality assessment. Telemetry streams are evaluated against expected operating ranges, system topology, and historical behaviour. Each signal, asset, and site receives a data quality score reflecting the reliability and completeness of the information being produced. Rather than assuming incoming telemetry is correct, data integrity becomes a measurable operational attribute that can be monitored and improved.

With data quality quantified, the system can detect operational issues at scale. Analytics continuously scan telemetry across the estate, identifying patterns such as hybrid system misconfiguration, fuel anomalies, renewable under-performance, and battery degradation. Instead of manually reviewing sites, operators are automatically alerted to locations where behaviour deviates from expected operating conditions.

Not all anomalies require immediate action. PowerX therefore applies impact-based prioritisation, ranking issues by operational and financial significance. Factors such as energy loss, fuel cost exposure, service risk, and asset health determine which interventions will deliver the greatest benefit, allowing engineering resources to focus on the highest-impact sites.

Where telemetry is incomplete or inconsistent, the platform can apply synthetic data techniques to maintain analytical continuity. Synthetic data refers to signals inferred from reliable measurements elsewhere in the system. For example, generator runtime, battery current, and site load can be used to estimate expected behaviour when a sensor temporarily fails. This prevents short-term data gaps from disrupting analysis while underlying issues are resolved.

Once the data layer is stabilised, telemetry can be enriched with advanced machine learning. These models analyse large volumes of operational data to detect patterns that are difficult to identify manually. Machine learning can highlight early indicators of battery degradation, detect hybrid system control drift, or identify when solar production diverges from expected performance.

This intelligence operates within a hardware-agnostic, vendor-neutral architecture. Tower estates typically contain equipment from multiple manufacturers and generations of hardware. PowerX standardises telemetry across these devices, normalising metrics into a unified operational model that allows consistent analysis across the entire network.

Finally, the platform is built with an integration-oriented architecture. Cleansed and contextualised data is made available to other operational systems such as NOCs, maintenance platforms, planning tools, and financial analytics. By exposing reliable telemetry through APIs and integrations, the platform ensures that the benefits of trustworthy data extend across the entire operational ecosystem.

In effect, raw telemetry is transformed into operational intelligence - validated, interpreted, prioritised, and shared across the organisation - creating the foundation on which optimisation and AI-driven operations can reliably run.

Conclusion

The telecom tower industry is entering a new operational era. Artificial intelligence is rapidly becoming a core enterprise capability, and infrastructure sectors are beginning to embed intelligent systems directly into the management of complex, distributed assets. For tower networks, this shift has profound implications. Operational AI has the potential to transform how energy systems are managed, how failures are predicted, and how performance is optimised across thousands of sites.

Yet the assessment presented in this paper highlights a critical constraint: data integrity. Digitalisation alone does not guarantee operational intelligence. If the underlying telemetry layer is inconsistent or unreliable, even the most advanced optimisation tools cannot deliver their full value. In many tower portfolios today, the barrier to progress is not the absence of AI but the weakness of the data foundation on which AI depends.

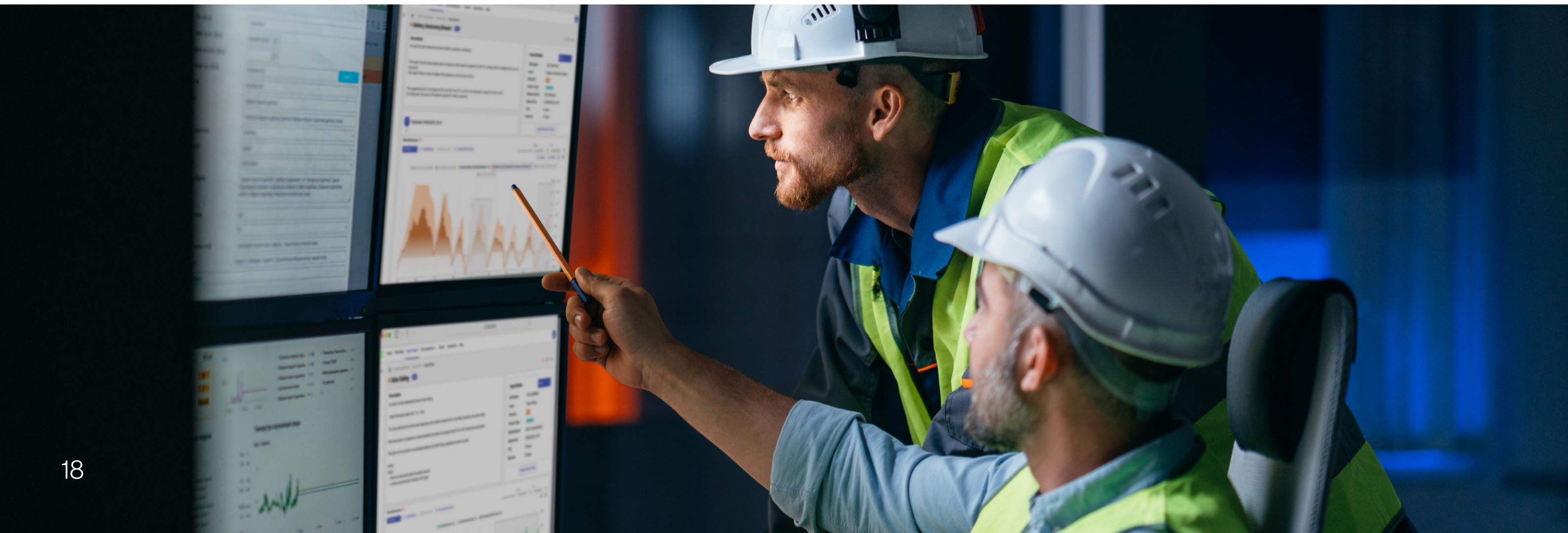
Encouragingly, the same assessment shows that meaningful gains can be realised even before advanced AI systems are deployed. Restoring trust in the data layer allows operators to identify inefficiencies, reconcile energy consumption, and recover wasted resources across their networks. Improvements in telemetry integrity can reduce fuel losses, optimise hybrid energy behaviour, and extend the life of critical infrastructure assets. Fixing the data pipeline delivers immediate operational and financial returns.

Once that foundation exists, the benefits compound. AI systems learn continuously from operational data, improving their ability to predict failures, optimise energy flows, and automate anomaly detection. Operators who establish reliable data environments today position themselves to capture these advantages sooner and at greater scale.

The industry stands at a clear inflection point. The technology required to transform tower operations already exists. The remaining challenge is operational readiness: building the data integrity and digital discipline required to support intelligent infrastructure.

Those who move early will accumulate learning, efficiency, and resilience across their networks. Those who delay risk competing against systems that have already spent years improving themselves. In an environment where performance, cost, and uptime define competitiveness, the transition to data-driven operations is no longer optional.

PowerX was built for this transition. By transforming fragmented telemetry into reliable operational intelligence, it enables tower operators to stabilise their data foundation today and unlock the compounding advantages of AI tomorrow.



The PowerX **Platform**

As telecom infrastructure grows and demand increases, ensuring uninterrupted, cost-efficient and sustainable power is more critical than ever. PowerX helps deliver OpEx, CapEx, revenue and sustainability benefits by optimising energy-related assets at scale in multi-site environments. Our suite of advanced AI-driven tools improves the visibility and performance of power assets across telecom tower networks, enabling a resilient and sustainable infrastructure fit for data usage growth.

Peak Power Cost Reduction
Significantly lower the cost of energy per GB of data by leveraging AI to dynamically tailor power provision options, reducing peak utility charges and maintaining peak performance.

Sustainable Growth
Support your expansion plans with renewable energy and optimisation solutions, making a stronger case for green investments with reduced CO_2 emissions and targeted, prioritised CapEx.

Reduced Power Backup Failures
Minimise the risk of backup system failures, reducing penalties, costly outages and site downtime by automating remote monitoring and diagnostics.

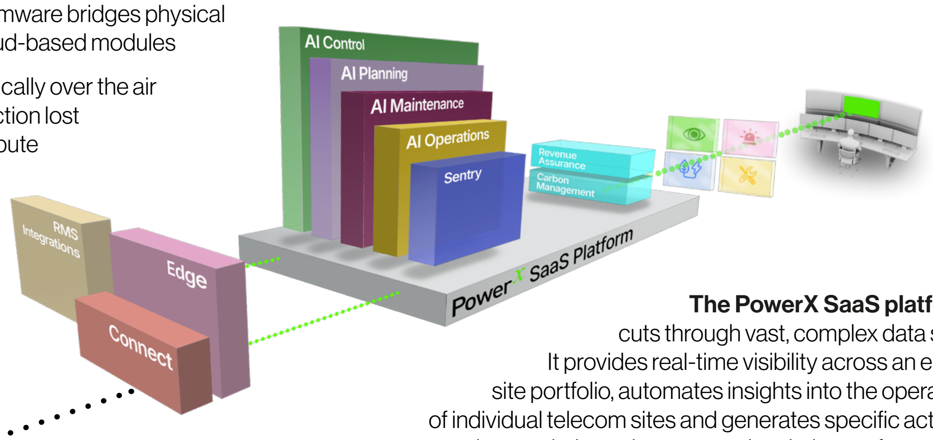
Improved Visibility & Control
Manage your entire infrastructure with a single, intuitive dashboard, minimising site visits & ensuring every tower is optimised for peak performance with PowerX's network-wide real-time visibility of assets.

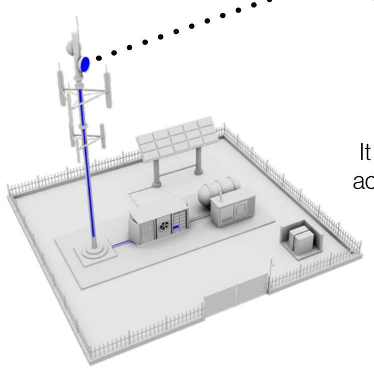
More Resilient Networks
Ensure your network remains strong in the face of extreme weather and growing energy demands with PowerX's predictive analytics and autonomous controls.

- PowerX **Edge** or **Connect** + Hardware

For sites without existing RTU / RMS for data capture, PowerX Connect proprietary firmware bridges physical site assets with the PowerX cloud-based modules

- Firmware updated automatically over the air
- Data stored locally if connection lost
- Optional: on-site edge compute





The PowerX SaaS platform cuts through vast, complex data sets. It provides real-time visibility across an entire site portfolio, automates insights into the operation of individual telecom sites and generates specific actions managed to resolution to improve and optimise performance.

Highly scalable and enterprise-wide, the platform combines advanced data science tools and automated workflows integrated into business processes. It leverages unused or underutilised operational data and assets that are within reach across your enterprise. It enables operational teams to automate at scale detect-and-repair of issues which impact efficiency, profitability, and growth.

The Power of **Integration**

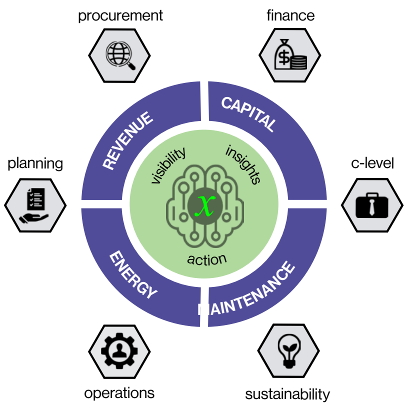
Increase Revenue & Reduce Risk

enable **99.99%+**
SLA achievement, resilience, autonomy & revenue assurance

Reduce Energy Costs & CO_2

20%-30%+
lower energy cost, fuel usage & CO_2 emissions

15%-25%+
improvement in solar yield & asset efficiency



10x
team productivity improvement

Optimise Capital Expenditure

10%-20%+
asset utilisation, redeployment & capex optimisation benefits

Reduce Cost of Maintenance

80%+
reduction in alarms

15%-25%+
lower maintenance cost

10%-30%+
decrease in mean time to repair (MTTR)

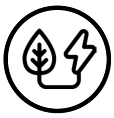
- Highly scalable
- Extensive integrations
- Hardware agnostic
- ISO 27001 certified
- Rapid deployment
- Secure, public cloud (AWS)

Increase Revenue

Optimise CapEx

Minimise OpEx

Reduce Fuel & CO_2



Real Time **Visibility**

- Real-time cross-functional dashboards
- Asset and site health, benchmarking
- Reduced analytics time & cost
- Improved data quality, auditable datasets

Granular **Insights**

- Issue triage and diagnostics
- Prioritisation and impact
- CapEx planning

Prioritised **Actions**

- Integrated workflows
- Managed to resolution
- Autonomous AI Control

The PowerX platform employs advanced data science tools (AI/ML) to provide intelligent site monitoring and energy management solutions for cell tower networks.

- Intelligent remote monitoring with triaged and prioritised alarms at scale for macro and small cell sites
- Power dimensioning and performance management for efficient investment in sustainable energy at sites
- Asset health, PMM and anomaly detection with diagnostics at scale for energy resilience and efficiency

PowerX delivers OpEx, CapEx and revenue benefits with real-time visibility, automated granular insights and prioritised actions to resolution across vast, complex data sets.

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