TRANSFORMATION IN THE TOWER INDUSTRY

HOW DATA SCIENCE ADOPTION AT SCALE FUTURE-PROOFS YOUR BUSINESS

A Practical Guide to Machine, Human, and Process Integration for Unlocking Efficiency, Sustainability, and Growth

PowerX

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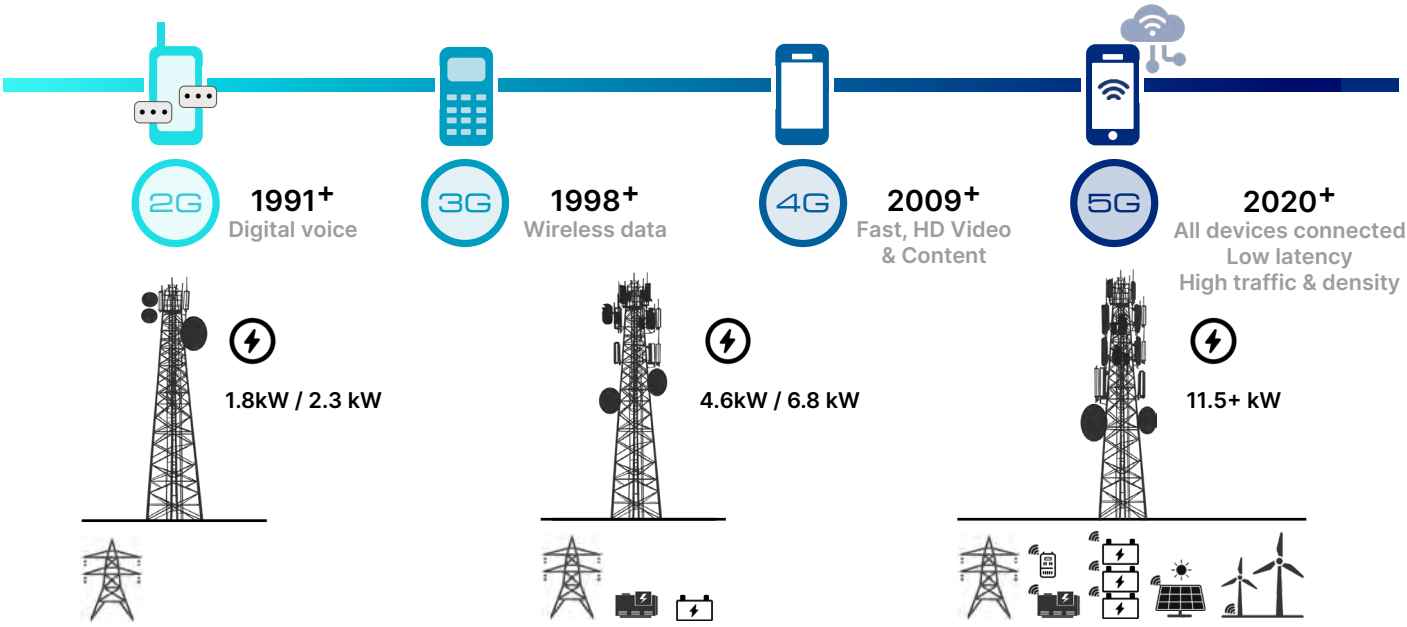
EXECUTIVE SUMMARY

Mobile connectivity has revolutionised our lives. Each generation - 3G, 4G, 5G - has delivered increasingly sophisticated services, a trend that 6G will continue. However, the underlying infrastructure that supports and delivers mobile connectivity faces immense pressure.

The shift to 4G and 5G has dramatically increased demands for power, resilience and 'five-nines' service level agreements (SLAs). At the same time, they have been the catalyst for fundamental changes in the business models governing the tower infrastructure ownership. Over the last decade, Mobile Network Operators (MNOs) have been divesting their mobile towers to Tower Companies (TowerCos) – organisations solely focused on the operational efficiency of the tower infrastructure.

This model has gained traction because TowerCos have effectively responded to the needs of MNOs, using Sales and Leaseback Transactions (SLBs) and colocation models to assist MNOs in divesting their towers. This helps MNOs raise capital for expensive spectrum licenses and reduce the overhead of infrastructure operations. While TowerCos are well positioned to manage operations efficiently, they encounter challenges specific to the industry.

For TowerCos, the passive tower infrastructure and all its related assets are revenue-generating. This requires tight, efficient operations and adherence to strict availability SLAs for multi-tenants. TowerCos must also meet ESG and NetZero commitments despite challenges such as unreliable grid infrastructure, rising energy costs, and



MNO only tenant	Multi-tenant key for growth
Active asset only focus	Complex active RAN & passive legacy assets
25+ year MNO – TowerCo REIT contracts	Shorter MNO – TowerCo contracts
No energy responsibility or pass-through only	Complex Power-as-a-Service / ESCOs
SLB driven SLAs	Stringent SLAs
No ESG	Stringent ESG / NetZero targets
No data traffic	Exponentially high data traffic
Low energy needs	Exponential rise in energy costs; grid at capacity
Lower efficiency focus	Stringent efficiency needs

environmental deterioration. Continuous efficiency gains are imperative. Maintaining healthy margins under these pressures is untenable, and demands a radical shift in network management.

The key to success? Informed, derisked decisions and agile execution – possible only though adoption, at scale, of innovative technologies including new data science, ML/AI-enabled automations. Digital transformation has already revolutionised other industries: sectors like banking, manufacturing, and retail leverage data and digital transformation for competitive advantage. This transformation is today achievable for the tower infrastructure sector.

Innovation Now

The time for innovation is now. Data is readily available from an explosion of IoT adoption. Computing power - currently doubling in speed at a dizzying rate of once every 3.4 months - allows application of new technologies such as data science, including machine learning (ML) and artificial intelligence (AI), to interpret and analyse vast amounts of telemetry in real-time. Longstanding lease agreements between MNOs and TowerCos are expiring or opening up for renegotiation. These factors are aligning, enabling real-time data analytics, granular insights, and the automation of actions - all managed to resolution at scale to leapfrog and transform the operational efficiencies and resilience at the heart of the TowerCos business model.

The Current Landscape & Opportunity

- Expiring MNO leases are creating opportunities for renegotiation and ownership changes.
- IoT devices generate massive datasets offering unprecedented insights into network assets.
- Advanced computing power enables sophisticated data analysis at scale.

Data science empowers TowerCos to move from reactive to proactive infrastructure management. This is achieved through:

- **Data-Driven Decision-Making:** Extracting actionable insights from complex datasets to optimise operations, reduce costs, and enhance revenue.
- **Predictive Maintenance:** Utilising algorithms to anticipate equipment failures and minimise downtime.
- **Renewable Energy Optimisation:** Leveraging data for efficient power management and reduction of energy cost.
- **Improved Asset Management:** Pinpointing equipment failures and allocating resources effectively.

Key Steps to Successful Implementation

- **Machine Integration:** Establishing standardised naming conventions and data frequencies for seamless data collection and analysis.
- **Human Integration:** Implementing comprehensive training and communication strategies to alleviate employee concerns and facilitate adoption of new technologies.
- **Process Integration:** Redesigning business processes to embed data-driven decision-making and optimise operational efficiency.

Benefits of Data-Driven Transformation

- **Reduced OpEx and CapEx:** Streamlined operations, lower energy costs, and minimised maintenance expenditures.
- **Increased Revenue:** Improved service reliability and enhanced network uptime, leading to higher MNO tenant satisfaction and potential revenue increase.
- **Enhanced Competitiveness:** Gaining a decisive edge through proactive asset management and data-driven insights.
- **Sustainable Growth:** Reduced CO_2 emissions, alignment with environmental initiatives, and support for long-term sustainability efforts.

The adoption of data science and AI is not optional but essential for TowerCos to thrive in this rapidly evolving industry. Companies that embrace these technologies will secure a competitive advantage, achieve sustainable growth, and establish themselves as market leaders. PowerX offers the tools and expertise to guide this crucial transformation.

WHAT IS DATA SCIENCE?

Data science is an interdisciplinary field that uses scientific methods, algorithms, and systems to extract insights and knowledge from structured and unstructured data. It combines techniques from statistics, computer science, and domain expertise to analyse data and solve complex problems.

Data Collection

This initial step deals with gathering relevant data from various sources, such as metered and/or Internet of Things (IoT) assets systems, databases, and sensors, via various protocols such as MQTT or APIs. This is followed by data cleaning, where inaccuracies and inconsistencies are resolved to prepare the dataset for analysis. Once the data is ready, exploratory data analysis (EDA) is performed to uncover initial patterns, trends, and insights using statistical techniques and visualisations.

Data science-led platforms will then apply modelling techniques, utilising algorithms that use correlations across various data points to build, for example, predictive models that can forecast future outcomes based on existing data. This is often further advanced by machine learning, where models are trained - either supervised or unsupervised - on historical data to improve accuracy over time. Finally, the results are returned to the organisation and employed in a variety of ways. This could be communication through data visualisation and reporting tools to ensure that stakeholders can interpret the findings easily and use them to inform strategy and decision-making, seamlessly fed into workflows and trouble ticket systems to streamline operations or used to automatically update configurations in the field without the need for manual interventions. This comprehensive approach allows organisations to harness the full potential of their data - enabling them to make informed, data-driven decisions.

Data Science for TowerCos

By deploying a comprehensive network of sensors and IoT devices across their sites, tower operators now gather enormous quantities of granular, real-time data on a wide range of aspects of their infrastructure. But the widespread adoption of IoT and site telemetry isn't - in and of itself - inherently transformative.

Data is a tool, but its effectiveness depends entirely on how it is used. Collecting more data does not automatically lead to better outcomes.

In some cases, it may have the opposite effect - overwhelming organisations with too many issues and alarms, providing poor context, pushing technology to its limits, exposing skills gaps, offering few actionable insights, generating false positives, and increasing workload. True transformation comes from how data is interpreted, analysed, and acted upon.

Data science, including ML/AI automation, empowers TowerCos to extract invaluable operational insights from a wealth of previously scattered, siloed, or impenetrable information. This drives efficiency, cost management, and asset optimisation improvements. It enables operators to shift from reactive to proactive infrastructure management, optimising maintenance schedules, minimising downtime, and reducing operational costs. Data-driven power management, renewable energy optimisation, and overall consumption reduction lower energy expenses.

In the field, data science pinpoints equipment failure root causes, ensuring the right field engineers with proper tools are dispatched, reducing repair times and repeat visits. These operational efficiencies and cost savings are just the beginning – true digital transformation holds vast potential for TowerCos. Streamlined operations enhance efficiency, reduce costs, and de-risk capital expenditure decisions, ultimately improving margins and reducing revenue loss.

But the real power of digitalisation and data science lies in true business transformation, beyond simply OpEx and CapEx rewards.

GLOBAL DATA SCIENCE MARKET BY SHARE, BY INDUSTRY[1]

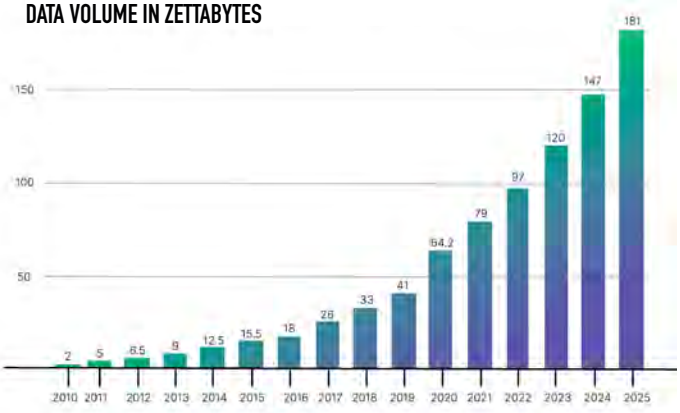
94% of enterprises use cloud services - with cloud-based data science platforms on the rise[2]

59% of business leaders say their companies are using data analytics to drive business innovation[3]

72% of industrial businesses rely on advanced data analytics to boost productivity[4]

GLOBAL DATA GROWTH: 2010 – 2025[5]

DATA VOLUME IN ZETTABYTES



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WHY NOW?

The potential for industry transformation is driven by three key factors - expiring long-term MNO leases opening opportunities for change of ownership and lease renegotiation; an explosion of IoT data providing detail on network assets; and the growth in computing power enabling sophisticated data analysis.

Data has long informed decision-making across industries, from financial analysis to market research. But this traditional approach is evolving as organisations harness the power of emerging technologies. The reliance on structured data is giving way to a new paradigm fuelled by the convergence of increasing computing power and widespread IoT adoption.

Massive datasets

Not only does the tower industry generate massive, complex datasets from diverse sources, but it must reconcile this data with cell tower environments that are increasingly multi-tenant.

This volume and complexity typically overwhelms users of traditional Remote Monitoring Systems (RMS), who are left to make sense of the data available: correlate, track, analyse and interpret basic metrics reported from the site using analogue analytics methodologies. In a world where they need to act fast, this can overwhelm.

Data science technologies such as pattern identification, advanced analytics, and predictive modelling are now not only feasible, but also affordable and accessible.

The risk of failure

Organisations failing to embrace advanced technologies risk falling behind in today's competitive landscape. Neglecting cutting-edge computing and data analytics not only hinders operational efficiencies, but also compromises a company's market position.

Competitors investing in these transformative capabilities will gain a decisive edge - optimising operations, anticipating equipment failures, and swiftly responding to market changes. Without these tools, TowerCos may struggle to make informed decisions, merely reacting to problems rather than proactively managing their assets.

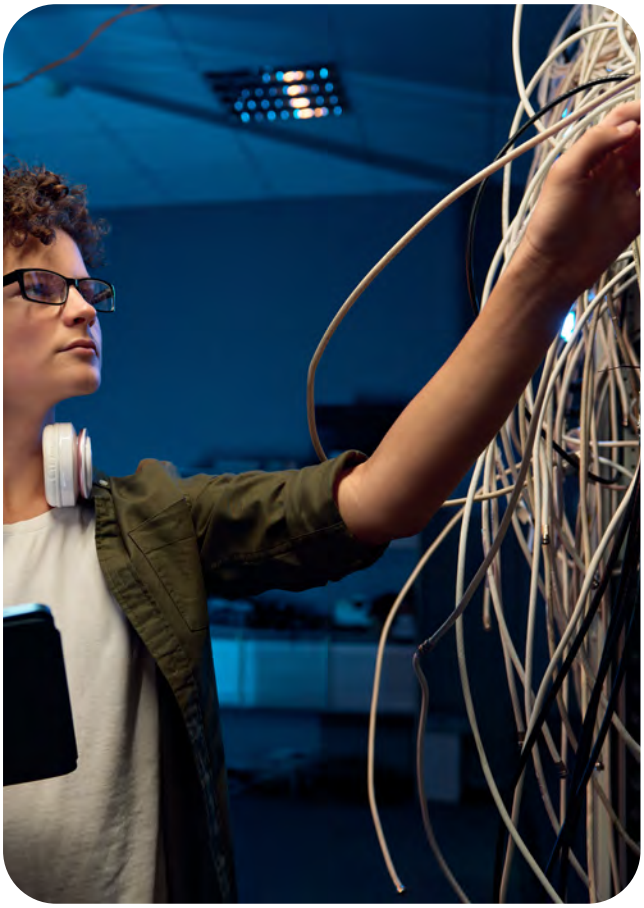
Inaction has serious consequences. As customer expectations rise, companies clinging to outdated practices will struggle to remain relevant. Failing to leverage real-time data insights can lead to poor service, driving clients to more tech-savvy providers. In an age of agility and precision, reliance on traditional methods risks losing clients and long-term sustainability. The urgency to adopt new technologies has never been greater.

In a data-driven world, those left behind face an insurmountable competitive decline.

The sudden acceleration of data science adoption comes from a confluence of technology and market forces.

Exponential Growth in Computing Power: Moore's Law has long predicted a doubling of transistors on microchips every two years, implying exponential growth in computing power and falling costs per transistor. However, AI computing power has far outpaced this trend since 2012, doubling approximately every 3.4 months. This rapid acceleration results from advancements in specialised hardware like GPUs (Graphics Processing Units) and TPUs (Tensor Processing Units), which facilitate the processing of massive datasets.

Proliferation of IoT Devices: The extensive adoption of IoT devices on cell towers - ranging from environmental sensors to power management systems - generates a continuous stream of previously untapped data. IoT devices are expected to generate nearly 80 zettabytes of data in 2025, representing a compound annual growth rate (CAGR) of 28.7% from 2018 to 2025[1]. This explosion of data points offers invaluable insights for optimising tower operations and predicting potential disruptions.



HOW MUCH DATA IS 'A LOT'?

The widespread adoption of IoT devices on cell towers (environmental sensors, power monitoring systems, security cameras, etc.) generates a constant stream of data points. A single tower will have dozens of sensors measuring temperature, humidity, diesel usage, power consumption, battery voltage etc. - all sending data multiple times per minute.

A typical tower delivering 4G and 5G service, with grid access, generator back-up, solar arrays and lithium-ion batteries, might generate around 8,000 data points in a 24-hour period.

Scale this up to a common network size of 10,000 towers, and the network operator faces the overwhelming task of ingesting, managing, and prioritising over 80 million data points a day.

Without the right tools to correlate, interpret, predict fast – that i.e. without leveraging the data science tools and technologies widely available to automate these processes, this gold mine of insight and actionable optimisations remains inaccessible - hiding in plain sight yet requiring too much human resource to leverage effectively.

Accessibility of Data Management Services: The emergence of cloud-based data management services, such as Amazon Web Services, has democratised the applications and large-scale use of data, including data science and the technologies built around it. These technology platforms provide the tools and infrastructure to process and analyse large datasets more efficiently. This lowered barrier-to-entry allows even smaller telecom players to leverage advanced data analysis techniques.

The global cloud infrastructure service spending grew by 23% year-over-year in Q3 2024, reaching over $84 billion. Amazon Web Services - with 100 data centres worldwide, each with up to 50,000 servers - generated over $90 billion in net sales revenue in 2023[2].

Connecting the Data Dots: Enhanced computing power enables seamless integration and analysis of diverse data. This reveals hidden correlations and patterns that were once difficult or impossible for humans to discern. By connecting these data points, organisations unlock predictive capabilities that drive proactive, data-driven decision-making.

1 Gonzalez, Villali, J, & Lee, S. (Dec 2024). DC MarketScape: Worldwide Industrial Internet of Things Platforms and Applications 2024 Vendor Assessment. IDC Corporate, Needham USA. Retrieved from https://www.idc.com/getdoc.jsp?containerId=US51560324
2 (2024) Amazon Web Services: Statista. Retrieved from https://www.statista.com/study/46913/amazon-web-services/

WHAT DOES TRANSFORMATION LOOK LIKE?

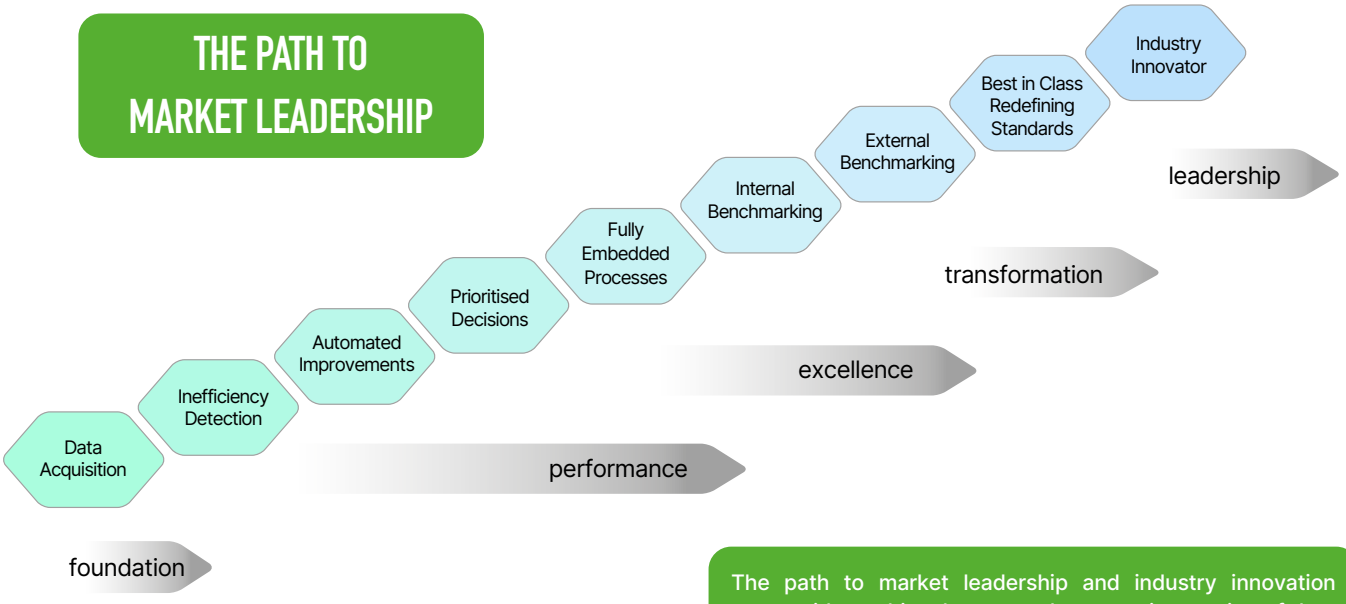
The journey of data-driven transformation unfolds in nine distinct stages, beginning with the foundational step of comprehensive data acquisition. For many organisations (often locked into an RMS model), the journey stops there, with data collated, organised and visualised - but lacking actionable analysis or insights available at the fingertips.

The application of authentic data science tools opens up the way for the next step on the path - identification of operational inefficiencies and automated improvements at large scale. As data science integration deepens, decision-making becomes increasingly informed, leading to fully embedded data-driven processes that optimise performance and profitability.

This enhanced performance facilitates internal and external benchmarking, showcasing excellence and attracting investor interest, ultimately culminating in industry leadership defined by best-in-class standards.

TowerCos that are early adopters of these technologies - and get ahead on this transformative journey - become better positioned to take advantage of the growth opportunities within the dynamic and competitive telecoms market. Increased resilience and lower operating costs instils credibility and trust with MNOs - enhancing competitiveness and drawing in more tenants.

Interestingly, MNOs that haven't divested all their towers often find themselves with a mixed portfolio, encompassing sites managed by different TowerCos, each with varying operational practices. When MNOs see the improvements in resilience and uptime from sites managed by fully digitised operations, they are more likely to seek out similar service providers.



The path to market leadership and industry innovation starts with machine, human and process integration of data science - unleashing hidden potential in your organisation and establishing benchmarks that continually drive-up performance, efficiency and innovation.

WHAT'S THE DIFFERENCE BETWEEN 'DIGITISATION' AND 'DIGITALISATION'?

While the terms 'digitisation' and 'digitalisation' are often used interchangeably, there's a subtle but important distinction:

Digitisation is the process of converting information from analogue to digital format. It's about transformation of format. Think of scanning a paper document into a PDF, converting a vinyl record into an MP3, or taking a photograph with a digital camera. The core focus is on representing something already existing in a new, digital form.

Digitalisation, on the other hand, is a broader, strategic transformation of business processes and models using digital technologies. It's about transformation of processes. This encompasses digitisation (as a component), but it also includes the adoption of new technologies, the redesign of workflows, and the creation of entirely new business models enabled by digital tools.

Think of a company moving from paper-based record-keeping to a fully digital system, integrating customer relationship management (CRM) software, or automating their supply chain using AI. The focus is on leveraging digital technologies to fundamentally change how an organisation operates.

Digitisation is about converting information; digitalisation is about transforming processes and business models using digital technology. Digitalisation includes digitisation as one of its many steps, but it's much more comprehensive and strategic in scope.

The contrast between TowerCos that have invested solely in infrastructure and those that have also invested in digitalisation is stark: the latter achieve far greater efficiency and long-term strategic advantages. Investing in renewable energy sources for example, including energy storage solutions like lithium-ion batteries, requires not only substantial capital but also considerable manpower for installation and ongoing management to fully realise the return on investment.

Without digitalisation, identifying and addressing asset degradation is hampered, leading to higher operational costs, lost revenue from renewable energy production, and an inability to meet mandated sustainability targets.

Successful implementation of these technologies requires a complete overhaul of business processes and operational workflows. This transformation demands new skills, team structures, workflows, and business objectives.

TowerCos that undergo this transition become more competitive and attractive to MNOs. As a result, when new sites and towers come to market, MNOs are increasingly likely to partner with fully digitalised TowerCos that can guarantee higher quality assets and more resilient service.

> **"What we've done since 2024 is try and get more and more of the data managed by AI. Predictability is something we wouldn't have been able to achieve without a 30 to 40 man team, which was impossible for us"**
>
> **TowerCo CEO, Philippines**

TowerCos that adapt their infrastructure, business model, and operations within 12 months of transactions are more compelling to MNOs than those stuck in traditional models. Agility is key to gaining a competitive edge.

Digitalising infrastructure yields profound benefits. Proven success in other sectors, combined with enabling technologies, allows TowerCos to overcome past growth hurdles and reach new heights.

CHALLENGES IN INTEGRATING DATA SCIENCE

The initial benefits of applying data science technology are invariably operational. Actionable insights gained from artificial intelligence and machine learning analysis deliver immediate OpEx and CapEx benefits, revealing inefficiencies at scale that would otherwise have remained hidden in the volume of data generated by the organisation or its customers. But in order to drive the business forward, these insights need to be integrated into the core of an organisation's business practises. This can, however, present challenges (technical and organisational) that many companies struggle with during transition.

LACK OF DATA SCIENCE LITERACY

A major barrier to integrating data science is often a lack of concept literacy across an organisation. Employees, especially at management and operational levels, may not fully understand data science concepts or how to leverage them in decision-making. Without foundational knowledge, employees might resist data-driven initiatives or misuse insights, leading to poor decisions and missed opportunities.

DATA SILOS

Many organisations have data stored in disparate systems or departments, creating silos that make it difficult to access and integrate information. Legacy systems or fragmented IT infrastructure exacerbate this issue. Without unified data, it is challenging to conduct comprehensive analyses or generate insights that span across business functions.

CULTURAL RESISTANCE TO CHANGE

Resistance from leadership or employees can slow down or prevent the adoption of data-driven practices. Some employees may fear that data science will replace their jobs, while others may distrust automated insights over human judgment. Without cultural buy-in, even the most advanced data science tools and insights may be ignored, leading to poor adoption and wasted investments.

DATA QUALITY AND AVAILABILITY

Poor data quality, incomplete datasets, or inconsistent data collection practices can hinder the effectiveness of data science initiatives. Inaccurate, outdated, or irrelevant data can lead to flawed models and unreliable insights, eroding trust in data science solutions.

COMPLEXITY OF IMPLEMENTATION

Developing and deploying machine learning models or advanced analytics tools can be complex, requiring specialised infrastructure, cloud computing resources, and expertise in model deployment. Without proper implementation and ongoing model maintenance, data science projects may fail to deliver reliable insights or scale effectively. An easier path for many is to employ a data science organisation, which can deliver the insights and visibility your organisation needs using specialist skills and services.

MISALIGNMENT OF GOALS

Data science initiatives may not be aligned with an organisation's strategic objectives. Data scientists may work in isolation, focusing on technically interesting projects that don't directly impact key business goals. Resources can be wasted on projects that don't provide tangible business value, leading to frustration and a lack of support from leadership.

LACK OF LEADERSHIP SUPPORT

For data science initiatives to succeed, they require buy-in from leadership. However, some leaders may not fully understand the potential of data science or may be hesitant to invest in long-term data projects that don't yield immediate results. Without executive sponsorship, data science projects may struggle to secure funding, resources, or visibility within an organisation.

TALENT SHORTAGE

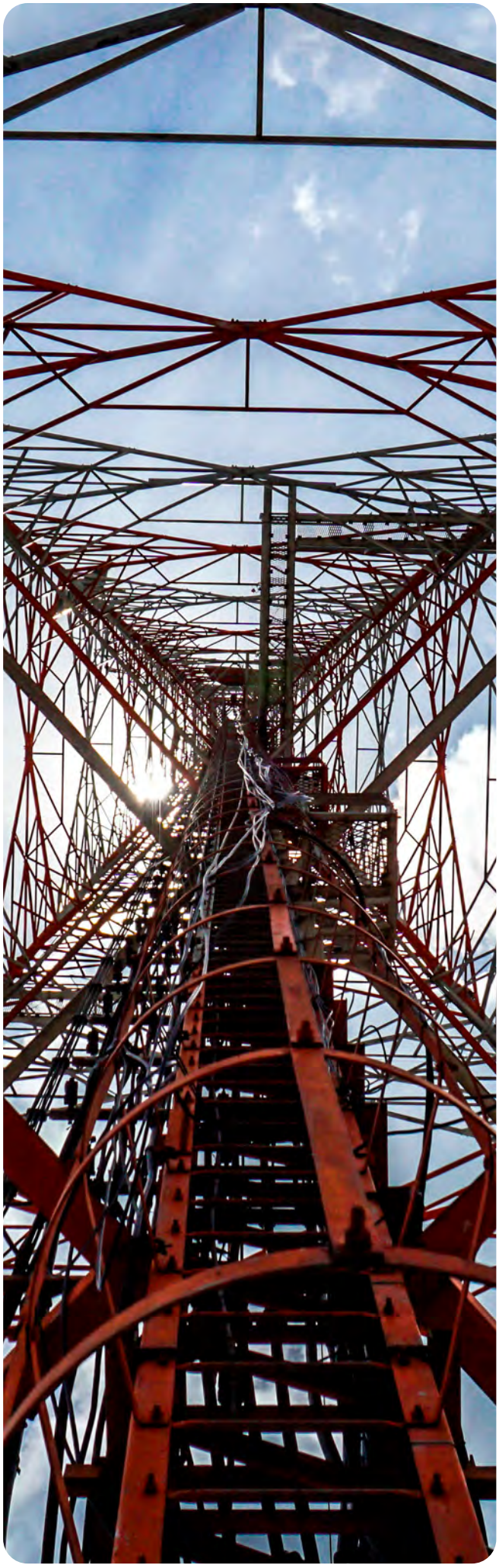
There is a high demand for skilled data scientists, and organisations often face difficulty attracting, hiring, and retaining top talent. Data scientists require a mix of technical expertise, business acumen, and communication skills, which can be challenging to find.

ETHICAL & REGULATORY CONCERNS

Organisations are increasingly concerned about the ethical implications of data science, such as data privacy, algorithmic, and compliance with regulations like GDPR. Missteps in handling sensitive data or deploying biased algorithms can lead to reputational damage, legal penalties, and a loss of trust among customers and employees.

SCALABILITY CHALLENGES

Many organisations face difficulties in scaling data science solutions from pilot projects to enterprise-wide deployment. What works on a small scale may not perform well when applied across multiple business units or data sources.



THE HUMAN ELEMENT

Adaptability is a crucial feature of organisations who successfully embark on a program of business reprocessing. Understanding human inertia and resistance to change is therefore integral in formulating strategies that ensure the buy-in and active contribution of employees into the change process.

Humans are often resistant to changing work practices due to a variety of psychological, social, and organisational factors. People are more comfortable with established routines and practices, yet change introduces uncertainty - and with it, discomfort and anxiety.

While individual factors like fear of the unknown and perceived loss of competence play a role, it's an organisation's culture that ultimately determines the success or failure of change initiatives. A culture that fosters open communication, transparency, and employee empowerment significantly increases the likelihood of buy-in and active participation in the transformation process.

One reason for resistance to embracing data science and advanced technologies, such as generative AI, is the negative portrayal these tools have received in certain sectors of the media. Often depicted as a threat to employment, generative AI raises fears among employees that their jobs may be at risk due to automation. This narrative can create anxiety and mistrust in adopting data-driven approaches.

Yet, when AI is thoughtfully integrated into business processes, it actually enhances productivity by enabling employees to concentrate on higher-level decision-making and creative tasks, rather than mundane activities. By highlighting the ways in which this technology can augment human capabilities rather than replace them, organisations can alleviate concerns and encourage a culture of innovation and collaboration.

CULTURAL RESISTANCE

Organisational culture and social norms play a significant role in resistance. If the existing culture values stability and tradition, changes to work practices may be viewed negatively or as a threat to established norms.

COMFORT WITH FAMILIARITY

People are generally more comfortable with established routines and practices. Change introduces uncertainty, which can create discomfort and anxiety.

TRUST ISSUES

If employees do not trust leadership or the motives behind the change, they are more likely to resist. Building trust and involving employees in the change process can alleviate this concern.

LOSS OF CONTROL

Change can make employees feel like they are losing control over their work environment. A shift in practices often implies that decisions are being made for them, which can lead to resistance.

PAST EXPERIENCES

Employees who have experienced poorly executed changes in the past may be sceptical or even fearful about new initiatives, concerned that they will lead to disruptions or failures.

LACK OF UNDERSTANDING OR COMMUNICATION

Poor communication about why change is necessary or how it will benefit individuals and the organisation can fuel resistance. If employees do not fully understand the rationale, they may feel the change is unnecessary or misguided.

FEAR OF THE UNKNOWN

New work practices may bring ambiguity regarding roles, responsibilities, or future outcomes. This uncertainty can cause fear, particularly if people are unsure how the change will affect their job security or performance.

PERCEIVED LOSS OF COMPETENCE

Learning new ways of working may make employees feel less competent, especially if they have mastered existing processes. Fear of losing expertise can lead to reluctance in adopting new practices.

FEAR OF INCREASED WORKLOAD OR COMPLEXITY

New processes and technologies can seem overwhelming, particularly if employees feel they will have to learn new skills or work harder during the transition.

THE PSYCHOLOGY OF CHANGE MANAGEMENT

Resistance to change in the workplace has been extensively studied, with various theories explaining the psychological, social, and organisational factors involved. Kurt Lewin's **Change Model** (1947) identifies resistance as a natural part of the "unfreezing" stage, where individuals are reluctant to move away from established practices. Similarly, John Kotter's **Eight-Step Model** (1996) highlights emotional barriers, such as a lack of urgency or vision, which can be mitigated through transparent communication and leadership involvement. The Kubler-Ross **Change Curve**, adapted from the grief model, maps out the emotional stages employees experience during change - including denial, anger, and acceptance.

Other models focus on individual resistance to change. The Prosci **ADKAR** model breaks down change into five stages, emphasizing that a lack of awareness or desire often fuels resistance. **Psychological Contract Theory** (Rousseau, 1989) explains how changes can violate employees' expectations, leading to distrust, while **Social Identity Theory** (Tajfel & Turner, 1986) suggests that shifts in work practices may threaten established group identities, causing individuals to resist changes that could disrupt social cohesion.

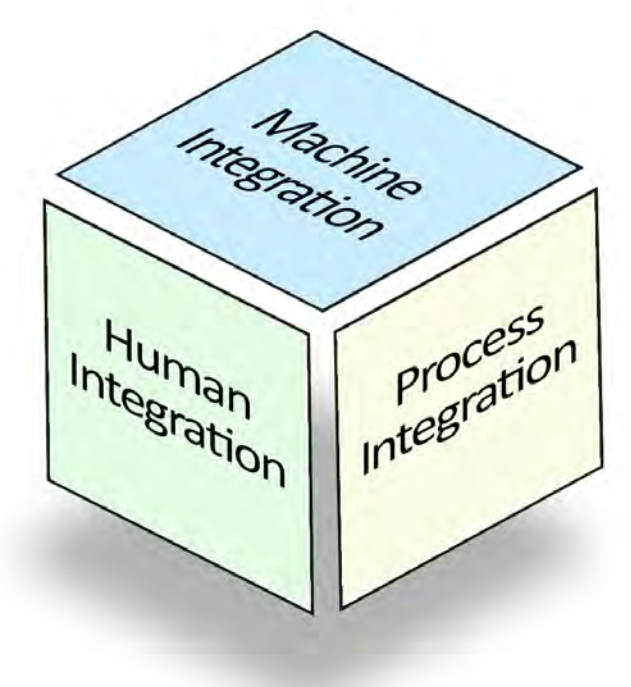
Finally, cognitive and motivational theories provide further insight into resistance. Festinger's **Cognitive Dissonance Theory** (1957) argues that employees resist changes that conflict with their beliefs, while Deci and Ryan's **Self-Determination Theory** (1985) highlights the importance of autonomy and competence. Edgar Schein's **Organizational Culture and Leadership** (2004) adds that deeply rooted cultural norms play a significant role in resistance, and successful change management must address these cultural factors to be effective.

STRATEGIES FOR SUCCESSFUL IMPLEMENTATION

Data science represents the latest evolution in a long history of business transformations driven by technological advancements. From the early days of automation to the rise of internet-based solutions, each technological leap has reshaped how organisations operate, make decisions, and engage with customers.

Many decision-making processes for the telecoms industry (such as creating a Bill of Materials for new sites, dimensioning site power backups/ renewables, selecting vendors and suppliers, or allocating Network Operations Centre [NOC] resources) are informed by the insights made available to the teams responsible for these processes. These decisions are only as good as and as timely as the data available to them. That's why the advent of data science and its adoption in the telecom industry will drive the next technological leap defining the pace of growth for this sector.

Successfully navigating the challenges of organisational change requires a strategic focus on three key areas: machine integration, human integration, and process integration. With each component considered critical to the re-engineering process, organisations can ensure that data science becomes a seamless part of their operation, fostering a data-driven culture that enhances decision-making, improves efficiency, and drives sustainable competitive advantage.



MACHINE INTEGRATION STRATEGIES

CREATE NAMING CONVENTIONS

When legacy protocols were initially designed, they were intended to monitor individual units, often in single locations, and human operators could easily interpret alternative names for the same data points (e.g., 'office temperature', or 'room temp', or 'space temperature 1'). However, as organisations scale and manage fleets of devices, inconsistent naming complicates data interpretation and hinders the automation of data-driven insights.

Naming conventions allow operators to work with consistent sets of data, reducing complexity and future-proofing network upgrades and expansion. While individual customers might have their preferred aliases for certain data points, standardised backend tags allow models and algorithms to operate seamlessly across different environments.

This standardisation should be carried out non-destructively. In large, complex systems – often built up over a number of years and interconnected across many different functions of the organisation - replacing core telemetry labels can have unforeseen (and occasionally catastrophic) consequences. Instead, data science teams should add new naming conventions as tags, preserving the original label in case of interoperability issues Industry standard protocols such as COBie (Construction Operations Building Information Exchange) and Project Haystack have emerged to address these challenges by promoting the use of common data tags and schemas. These protocols enable the integration and analysis of data from diverse systems, facilitating improved decision-making and operational efficiencies across various platforms and sectors. By adhering to these standards, organisations can ensure more reliable and scalable system interoperability.

CALIBRATE FREQUENCIES

Managing data from devices that report at different frequencies is not inherently problematic, but it does require monitoring to ensure data completeness and communication reliability. For example, data expected every five minutes equates to 12 data points per hour or 288 per day. Setting a threshold - such as raising an alert if fewer than 200 readings are received daily - helps identify communication issues or failure which often occur silently in downstream devices. Such failures may stem from severed cables, maintenance errors, or equipment turned off unintentionally.

By implementing 'controller offline' strategies that flag devices with unusual data gaps, operators can diagnose potential issues, from intermittent connectivity problems to complete device failures,

thereby maintaining data integrity across millions of daily data points.

In some instances, the hardware-programmed cadence of data points could be unsuitable for the fidelity required for comprehensive power asset monitoring and optimisation (either too many or, more commonly, too few). This may require collaboration with hardware suppliers to recalibrate the frequency of data delivery.

MANAGING TIME

When edge devices collect data from downstream equipment, a timestamp is assigned to each reading, derived from either the gateway or the connected device's internal clock. However, these clocks can drift over time, including those in computers. To address this issue, the Network Time Protocol (NTP) is employed. NTP serves as an authoritative time source, allowing devices to synchronise their internal clocks to maintain accuracy.

If sites and networks do not incorporate time synchronisation capabilities, there is a likelihood of data being assigned incorrect timestamps. When connections occur through a central access point, providers may address these discrepancies centrally. However, with complex integrations, accurate time management becomes increasingly critical.

UNDERSTAND DATA TYPES

Misinterpreting data can lead to serious errors. Systems differentiate data types as strings, integers, or floats. For example, the number '30' could be a text string ('thirty'), a simple integer or a float with added precision, like '30.00'. This distinction becomes critical in scenarios where slight variations matter, such as in battery cell monitoring, where a small difference (e.g., 0.04 volts) could indicate a shift from normal function to a potential failure.

PRIORITISE DATA

Transmitting data to a NOC consumes bandwidth, and in many markets tower operators work under strict bandwidth limits - either data caps, or overrun cost penalties. This makes data prioritisation essential to ensure that critical telemetry is transmitted at the right frequency, whilst less critical (or more stable) data points are paced appropriately.

For instance, the ambient air temperature in a tower cabinet would not require reporting every five minutes, since ambient temperature takes some time to change appreciably, whereas generator load – a mission-critical asset insight for cell towers – may require data dispatch at three minute intervals.

STANDARDISE UNITS

Values without units ('naked numbers') are meaningless without the context of their data label.

A reading of '45' could signify voltage, pressure, or any number of measurements, making it crucial to know the unit for accurate interpretation. This issue is compounded in environments with mixed unit systems, such as °C and °F for temperature, common in international deployments.

A centralised system such as the PowerX platform stores all measurements in standard units (e.g., SI units like Celsius), with automatic conversions applied as needed to meet user preferences. This approach ensures consistency, allowing for accurate cross-site benchmarking and peer analysis, while still accommodating various measurement formats.

Proper data management lays the groundwork for advanced analytics, such as real-time alerts, predictive analytics, and condition-based maintenance. Without reliable, normalised, and accurately tagged data, these higher-level functions are impossible to achieve. Successful machine integration provides a trusted and stable foundation for these advanced, data-driven approaches.

APPLY QUALITY CONTROL

Quality control ensures data is both usable and reliable. For example, temperature readings arriving on time and without transmission errors may still be flawed if they are out of plausible range, like a temperature reading of 9000°. Technology such as PowerX Connect uses high and low flags to identify values outside expected ranges (e.g., temperatures above 50° in a UK setting). This mechanism allows issues to be caught and addressed in real time.

Unlike traditional Remote Monitoring Systems (RMS) providers, whose responsibility to the data often ends after installation of the monitoring device, data science providers like PowerX are committed, and reliant upon, ongoing data accuracy. Poor-quality data at the source compromises downstream calculations, affecting the enterprise value. Ensuring data integrity from installation onward is essential to a data science value proposition, and tools are specifically designed to maintain this high standard.

SWEAT THE DETAIL

Effort invested in refining systems and processes will yield significant long-term benefits. While there may not always be quick fixes or automatic solutions, the meticulous work pays off by amplifying downstream business advantages.

This diligence offers deeper insights into asset conditions, helps understand equipment interdependencies, and reveals how assets degrade over time. Beyond operational benefits, conscientious machine integration can also contribute to non-operational insights, such as understanding the company's asset value, health and economic return.

MACHINE INTEGRATION CASE STUDY

Contrary to common belief, perfect data across all assets is not a prerequisite for driving automation and efficiency. However, understanding potential data gaps and ensuring the availability of distinguishable telemetry is critical. This data must encompass various applications, such as diesel generators, solar arrays, and standard grid, and power train metrics (current, voltage, power). Only by reconciling this full spectrum of data can a tower operator build an accurate and actionable model for operational improvements.

A CASE OF MISSING DATA?

In a recent engagement with a client in Southeast Asia, PowerX conducted an analysis of a data stream delivered through a Remote Monitoring System (RMS) integration. This dataset comprised various objects representing controllers responsible for transmitting data points from multiple sites. After reviewing the data, we identified an issue with the solar array information - specifically no data being received from the solar controllers. The client confirmed that while solar panels were installed, they were not connected to any controllers, hence no solar data was available.

NOT MISSING - MISLABELLED

However, a deeper analysis of the data revealed an anomaly within the power usage stream. One controller, labelled DCEM1, was sending data from four channels, despite the site only having three tenants. Upon further investigation, PowerX uncovered that the fourth channel was erroneously capturing data from the solar arrays, which had been wired into the tenant power usage controller and had never been returning data to the NOC.

This discovery allowed PowerX to disaggregate the data streams for the tenants and the solar arrays without requiring any on-site adjustments to the hardware. By simply reassigning data labels, we ensured the solar data was correctly processed, enhancing the overall accuracy of the energy management system.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{
 "data": [
  {
   "siteid": "e.coBD005427CM",
   "PacketTime": 1719209306,
   "Solar Controller": [],
   "Lithium BMS": [],
   "Rectifier Controller": [],
   "DCEM2": [],
   "DCEM1": [
    {
        "DCEMSlaveID": 51,
        "DCEMID": 688548,
        "DCEMStatus": 1,
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        "Channel1DischargeEnergy": 0.0,
        "Channel1ChargeDischargeCurrent": 25.4,
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        "Channel3ChargeDischargeCurrent": 0.0,
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        "Channel4ChargeDischargeCurrent": 0.0,
        "DCVoltage": 49.37,
        "DODPercentageofBatteryBank1orTotalSolar
    }
```



```
{
 "data": [
  {
   "siteid": "e.coBD005427CM",
   "PacketTime": 1719209306,
   "Solar Controller": [],
   "Lithium BMS": [],
   "Rectifier Controller": [],
   "DCEM2": [],
   "DCEM1": [
    {
        "DCEMSlaveID": 51,
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        "DCEMStatus": 1,
        "Channel1ChargeEnergy": 27161.6,
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        "Channel4ChargeDischargeCurrent": 0.0,
        "DCVoltage": 49.37,
        "DODPercentageofBatteryBank1orTotalSolar
    }
```


On its own, this represents a minor adjustment to the telemetry of a single site - but multiplied across the thousands of towers in a typical network, this type of machine integration is essential to ensure that data science tools are truly effective and insights are robust enough to drive business reprocessing.

HUMAN INTEGRATION STRATEGIES

DELIVER REASSURANCE

Clearly outline the new work practices, roles, and expected outcomes. Provide consistent updates and opportunities for employees to ask questions or provide feedback. Reassure them about how these changes will impact their job security and performance.

A critical part of managing fear is ensuring transparency in leadership communication. By offering town halls, webinars, or one-on-one meetings, leaders can address specific concerns and make the change feel less intimidating. Personalising the benefits for individual employees helps them see how the changes will positively impact their own roles, making the unknown less daunting. Also, engaging employees early on in the planning stages gives them time to acclimate, and creating documentation or FAQs provides a reference point to reduce ambiguity.

EMPHASISE THE BENEFITS

Highlight the efficiency and long-term benefits of the new processes, such as reduced workload or improved workflow. Provide ample training and support to ease the learning curve, and consider temporary workload adjustments during the transition.

It's important to address fear by focusing on the long-term benefits of the change. For example, showing how automating tasks or improving workflows through new practices can eventually reduce the overall workload.

To manage short-term overwhelm, organisations can allocate additional resources during the transition period, such as temporary hires or reduced KPIs, allowing employees to adapt without feeling overburdened. Case studies from other departments or companies that successfully implemented similar changes can also help to alleviate the fear of complexity.

By leveraging data science to streamline processes and automate routine tasks, employees can significantly increase their productivity, allowing them to accomplish more in a day. This shift enables them to focus on higher-value activities and tackle more interesting challenges, ultimately leading to greater job satisfaction and personal growth. Highlighting these opportunities can help employees see the changes as a pathway to improved efficacy and engagement in their roles.

PROVIDE TRAINING

Offer training programs that ensure employees can upskill without feeling overwhelmed. Promote the change as an opportunity for personal and professional development, emphasising how new skills will enhance their value within the organisation.

Employees who fear losing competence need reassurance that their expertise is valued and transferable. Organisations can emphasise that existing knowledge will serve as a foundation for acquiring new skills, framing the transition as an expansion of their capabilities rather than a replacement of their current competencies. Recognising and rewarding small achievements throughout the learning process can boost confidence. Mentorship programs, where employees who adapt quickly can help guide others, can also foster a supportive learning environment.

BE TRANSPARENT & HONEST

Foster transparency by being open about the reasons behind the change and how decisions are made. Build trust through inclusive leadership practices and ensure that changes are aligned with the organisation's values and employees' best interests.

Building trust is a long-term process, but the transition period offers an opportunity to strengthen employee relationships. Leaders should lead by example, demonstrating commitment to transparency by involving employees in discussions and decision-making processes. Consistent, open feedback loops where employee concerns are acknowledged and acted upon can help to dismantle trust issues. Additionally, visible investment in employee well-being during the change, such as offering mental health resources or flexible working options, can signal that leadership is genuinely committed to their teams' success, not just organisational profits.

OVER COMMUNICATE

Develop a comprehensive communication strategy that explains the reasons for the change, the benefits to both the organisation and employees, and the long-term goals. Ensure that communication is two-way, allowing employees to express their concerns and ideas.

Communication should be frequent and tailored to different teams or departments, as they may face unique challenges. It's important to note that the introduction of data science and AI tools need not happen suddenly; elements can be introduced gradually over time, allowing teams to adapt and integrate these innovations seamlessly. Including success metrics and real-life examples of how the change will bring improvement will help make the rationale more tangible.

Creating clear, step-by-step guides and ensuring leaders at every level are aligned with the message will help ensure a unified and consistent communication effort. Open forums, feedback loops, and even mechanisms for anonymous suggestions can foster a sense of inclusion and mutual understanding.

EMPOWER EMPLOYEES

Involve employees in decision-making and give them a voice in how the changes will be implemented. Empower employees to contribute to the process, allowing them to retain some control over their work environment.

Control can be restored by giving employees some autonomy over how they integrate the new practices into their daily routines. Instead of imposing a one-size-fits-all approach, allow flexibility in how the new work processes are implemented to make the shift feel more personal and manageable.

When employees feel they have a stake, they are more likely to take ownership of the change. Offering choices in training methods, time lines, or tools for adapting to new practices can also reduce feelings of powerlessness.

USE KEY INFLUENCERS

Engage with key influencers within the organisational culture who can advocate for the change. Align the new practices with core values or goals of the organisation, demonstrating how they will contribute to long-term stability and success.

Organisational culture can act as a powerful ally in promoting change if approached correctly. Leaders should map out how the new work practices align with the company's broader mission, showing that the change is a natural evolution rather than a disruption. Identifying cultural ambassadors or change champions who are well-respected within the organisation can help spread a positive narrative about the changes. These champions can advocate for the benefits and provide real-time feedback from peers, reinforcing that the change isn't just a top-down mandate but a collaborative, inclusive process.

65% **of business leaders cite culture and resistance to change as the top barriers to integrating data science into their processes[1].**

Businesses that invest in training and change management see an increase in adoption rates of data science technologies by 70%

BUILD NEW FAMILIARITY

Emphasise gradual transitions by incorporating familiar elements into the new work practices. Offer training and pilot programs that allow employees to get used to changes over time, reducing discomfort and anxiety.

Building familiarity can also involve showcasing examples of successful transitions within the organisation or similar industries. Highlighting how these changes have positively impacted both the business and employees helps normalise the shift. Another tactic is to create a phased implementation plan where smaller, manageable changes are introduced first, creating a sense of progression rather than an overwhelming overhaul. Providing support groups or discussion forums where employees can share their concerns and experiences can also promote adaptation in a more comfortable setting.

LEVERAGE THE PAST

Acknowledge past failures and how the current changes differ. Share success stories from similar implementations in other organisations. Ensure a structured, transparent, and well-supported approach to show that lessons have been learned.

Addressing past experiences requires an acknowledgment of what went wrong, paired with a clear explanation of how the current approach is different and more robust. Leaders can create a sense of trust by highlighting new support structures such as enhanced training, better communication channels, and more comprehensive contingency plans. Demonstrating that lessons have been learned - whether through technology updates, better planning, or involving employee feedback - can help overcome residual scepticism. Showing early wins or quick successes as the changes unfold can also ease lingering doubts.

[1] Eisenhauer, F., & Euler, C., & Scherpinski, J. (November 2022). Transformation towards a Data-Driven Business. Berlin, Germany: Deloitte Touche Tohmatsu Limited (DTTL). Retrieved from https://www2.deloitte.com/content/dam/Deloitte/de/Documents/consulting/Deloitte_Transformation%20towards%20a%20Data-Driven%20Business.pdf

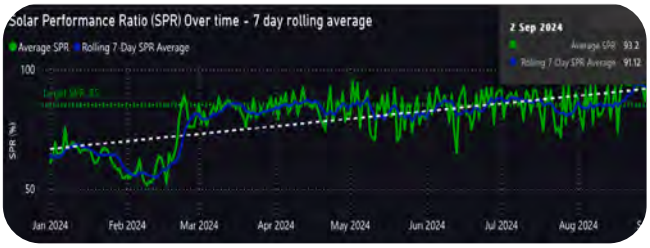
HUMAN INTEGRATION CASE STUDY

Data science insights and actionable interventions can only be leveraged to their full potential when they become an integral part of the network management workflow.

Often the introduction of a new system presents a significant obstacle to adoption. This can be exacerbated when employees are experiencing 'platform fatigue' – with the data science platform being positioned as 'just another piece of software' they have to learn to use.

Losing Solar

The graph below, taken from the PowerX platform, reveals a previously unseen persistent decline in solar generation over an eight-week period, affecting nearly every site in a 5,000 tower network in south eastern Africa.



There is an initial improvement in the solar performance in January 2024, which aligns with the implementation of the PowerX platform. But soon after this, the SPR starts to regress.

A Human Problem

The reason for the regress? Lack of human integration. Initially, under direct supervision of managers, NOC engineers used the platform to identify poorly performing solar arrays and address their underlying issues. But 'old habits' crept back into the workflow, and the benefits of data science were not fully realised.

Training: In this instance, PowerX worked with the customer on a number of different initiatives to ensure the platform was repositioned as an integral and indispensable part of the NOC engineers' workflow. Training was performed using real live data from the customers' tower network. Engineers and PowerX personnel jointly identified problems, worked through examples and brought everything to life with interactive questioning, worked examples and opportunities to practice.

Certification: PowerX is currently introducing its certification program, in which individual customers become junior, intermediate or advanced PowerX users based on rigorous and increasingly complex assessments. Offered in parallel with training, it is intended to instil a sense of pride in users and contribute to personal interest, increasing 'off-the-clock' learning and adoption of the platform.

Surgeries: PowerX held weekly 'surgeries' for users. These are open forums, where at a specific time of the day engineers can come to a virtual space and ask a product expert any question on the functionality of the software. This could be help with addressing a problem they might not have seen before, or a refresher on something they've only done once or twice. The surgery is a 'safe place' that allows staff to acknowledge a skills gap without fear of it affecting their competency status within the customer organisation.

Results: As work practices changed, more and more engineers used data science tools as an integral part of their workflow. This had an immediate effect on the performance of the network, shown by the uptick in solar performance that began when the training and surgeries were introduced.

After the introduction of training and surgeries, PowerX optimisation helped deliver...

+50.3% increase solar performance ratio

-$1.08M equivalent fuel cost reductions from grid

-2,430 tonnes CO_2 equivalent DG emission reductions per year

ORGANISATIONAL INTEGRATION STRATEGIES

ALIGN BUSINESS GOALS

Re-engineering processes starts with a deep understanding of a company's strategic objectives and how data science technologies can serve those goals. This requires collaboration between executive leadership and data science teams to clearly articulate how data science initiatives will contribute to long-term growth.

For example, if a key objective is to improve operational efficiency, data science solutions such as predictive maintenance or demand forecasting can be directly tied to these goals. It's critical to identify and prioritise use cases where data science can make a measurable impact, focusing efforts on areas that directly support strategic outcomes. This alignment ensures that data science projects are not isolated initiatives but integrated into the broader business strategy.

DATA-DRIVEN COMPANIES ARE

23 times more likely to acquire customers

6 times more likely to retain customers

19 times more likely to be profitable

COMPARED TO CUSTOMERS THAT DON'T FOCUS ON DATA-DRIVEN STRATEGIES [1]

INTEGRATE KPIs AND METRICS

Staff KPIs should be aligned, and if required, redesigned to reflect the integration of data science technologies into their roles. This means developing new, data-driven KPIs that go beyond traditional performance metrics.

Companies that integrate data science into their KPIs and decision-making processes see significant improvement in key performance indicators such as customer satisfaction, employee productivity, and revenue per employee

KPIs could include the percentage of decisions influenced by predictive insights or the efficiency gains from automating specific processes. Tracking these metrics regularly ensures that data science solutions are not seen as a one-off tool but as a consistent driver of performance. It also helps create accountability, ensuring that teams engage with the technology and derive maximum value from it.

REDESIGN BUSINESS PROCESSES

Rather than treating data science outputs as a separate layer of analysis, organisations should redesign their processes to naturally incorporate data-driven decision-making.

For example, traditional reporting processes can be replaced with dynamic, real-time dashboards that provide actionable insights derived from predictive analytics. These insights should be integrated into decision-making at all levels, enabling teams to make informed choices based on data.

Additionally, many repetitive tasks can be automated using data science techniques such as machine learning and AI. Automating tasks like alarm prioritisation or maintenance ticketing can lead to significant efficiencies while allowing for greater scalability across the business. A focus on process redesign ensures that data science outputs are not just used occasionally but become embedded into daily operations.

[1] Henke, N., Bughin, J., Chui, M., Manyika, J., Saleh, T., Wiseman, B., & Sethupathy, G. (December 7th 2016). The age of analytics: Competing in a data-driven world. San Francisco, USA: McKinsey & Company. Retrieved from https://www.mckinsey.com/~/media/mckinsey/industries/public%20and%20social%20sector/our%20insights/the%20age%20of%20analytics%20competing%20in%20a%20data%20driven%20world/mgi-the-age-of-analytics-full-report.pdf

TECHNOLOGY AND INFRASTRUCTURE

Successfully integrating data science tools doesn't require in-house expertise or significant investment in complex hardware and software. Instead, consider outsourcing data science functions to industry experts. Companies like PowerX are pioneering advanced AI and ML technologies with specialised skills at the forefront of this increasingly essential field.

Organisations should focus on embedding predictive models and automated workflows directly into core systems, ensuring data science becomes a seamless part of daily operations - making it more likely that the solutions will be used consistently. Additionally, setting up monitoring systems that track the performance of data science models and their impact on key business outcomes helps ensure that the technology is delivering the intended value over time.

GOVERNANCE AND ACCOUNTABILITY

Governance plays a key role in ensuring that data science initiatives are sustainable and aligned with the company's strategic objectives. Establishing clear governance frameworks defines how data science projects are prioritised, implemented, and maintained, ensuring that resources are allocated effectively. This governance can include setting up a steering committee or task force responsible for overseeing data science adoption across the organisation.

Assigning specific roles, such as "data champions" within each department, ensures that someone is accountable for ensuring data science technologies are effectively used in that area. By creating clear accountability structures, companies can ensure that data science initiatives are not only adopted but continuously monitored, optimised, and aligned with changing business priorities.

76%

of CEOs took at least one action last year that had a large or very large impact on their company's business model, including integrating data science [1]

64%

of CEOs say their company is employing emerging technologies to transform business models [2]

ITERATIONS AND SCALABILITY

Adopting data science technologies should not be viewed as a one-time project but as an ongoing, iterative process. To ensure successful and permanent integration, it's wise to start with small pilot projects that address specific use cases and gradually scale successful initiatives across the business.

This allows companies to test the effectiveness of data science solutions in real-world scenarios, gather feedback, and make necessary adjustments before wider implementation. By starting small, companies reduce the risk of failure and can demonstrate early wins that build momentum and support for further investment in data science.

Equally important is creating continuous feedback loops, where data science models are regularly evaluated based on their business impact. This iterative approach allows for agile adjustments, ensuring that the solutions remain relevant and effective over time. Scalable and adaptable solutions will enable the business to continuously evolve its use of data science technologies as new opportunities and challenges arise.

1 (2024). 27th Annual Global CEO Survey. London, UK: PricewaterhouseCoopers. Retrieved from https://www.pwc.com/gx/en/issues/c-suite-insights/ceo-survey.html
2 (2023). PwC's 2023 Emerging Technology Survey. London, UK: PricewaterhouseCoopers. Retrieved from https://www.pwc.com/us/en/tech-effect/emerging-tech/emtech-survey.html

ORGANISATIONAL INTEGRATION CASE STUDY

The integration of data science outputs with existing Trouble Ticketing systems for example is a prime illustration of the benefits of machine integration. Such systems play a central role in NOCs, where they are utilised to create, assign, manage, and close fault tickets for field teams. NOC Managers face the challenge of prioritising urgent issues and efficiently allocating resources, often under significant time constraints.

Trouble Ticket Integration

In the Philippines, PowerX's platform has revolutionised how a client manages network operations and maintenance. When the trouble ticket automation feature went live, PowerX's analytics began filtering and aggregating thousands of alarms generated by the network. It effectively eliminated false positives, duplicates, and unnecessary repetitions, prioritising only the most critical alarms for immediate action.

As a result, the NOC team's workload decreased by an astonishing 80%, and the Mean Time to Repair (MTTR) fell by 30%. This resulted in an average repair time of two hours, a full two hours faster than the client's contracted window to repair of four hours.

> **"We were able to handle a lot more trouble tickets that came in. Not because we had more trouble tickets, but because we could combine corrective maintenance and preventive maintenance visits. We were able to be very clear on what the field personnel needed to do on site while they were there."**

Less Cost, More Revenue

This improvement led to an increase in power availability to 99.98%, a vital metric for mobile network operators that ultimately influences customer retention, revenue protection, and competitive advantage. The enhanced network uptime translated to an average increase of approximately three hours per tower each month. This improvement triggered a rise in consumer data usage, generating an additional $500,000 in revenue for the client's MNO customer.

CONCLUSION

The telecommunications landscape is undergoing a dramatic transformation, driven by explosive data growth and the ubiquitous demand for connectivity. This white paper has explored the pivotal role of data science and AI automation in transforming the tower industry, moving beyond traditional, static models to one of dynamic optimisation and innovation. The message is clear: the time to integrate data science and AI automation into your tower company is now.

The Urgency of Action: The convergence of growth in computing power, the proliferation of IoT devices, and the termination of long-standing sale & leaseback leases has created an opportunity. Companies that hesitate to embrace these technologies risk being left behind in a rapidly evolving competitive landscape.

The benefits of digitalisation extend beyond mere operational efficiencies. Proactive, data-driven decision-making enables improved asset management, reduced costs, enhanced resource allocation, and improved service reliability, leading to a significant competitive advantage.

Short-term and Long-term Gains: The immediate benefits are substantial: improved maintenance schedules, minimised downtime, optimised energy consumption, and reduced operational costs. These directly translate to improved margins and increased profitability, fulfilling short-term business goals.

However, the long-term implications are more profound. The integration of data science into core business processes transforms the very nature of operations, leading to data-driven decision making, proactive risk management and ultimately, sustainable and scalable growth. Early adoption allows TowerCos to attract more MNO tenants and secure their position as market leaders.

Addressing the Challenges: While the transformation presents challenges, all are surmountable. Addressing machine-related challenges requires building a robust, reliable data foundation. Human challenges can be addressed through effective communication, training, and transparent leadership.

Organisational challenges require a fundamental shift in business processes and a commitment to integrating data science into the core of the company's DNA. By acknowledging and proactively addressing these issues, TowerCos can mitigate potential setbacks and ensure a successful transformation.

Competitive Disadvantage: Failure to integrate data science and AI is not just a missed opportunity; it is a growing competitive disadvantage. Companies that embrace these technologies will gain a decisive edge, creating efficiencies and innovating at a pace that leaves their competitors struggling to keep up. This gap will only widen over time, resulting in substantial long-term losses for those who fail to act.

The ability to proactively manage assets, respond swiftly to market changes, and deliver superior service will increasingly become the benchmark for success in the telecommunications sector. The competitive landscape demands proactive engagement with these transformative technologies; now is not just the time to act, but the crucial moment to lead.

THE POWERX PLATFORM

UPTIME ASSURANCE | **PEAK POWER MANAGEMENT** | **POWER MIX OPTIMISATION**

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.

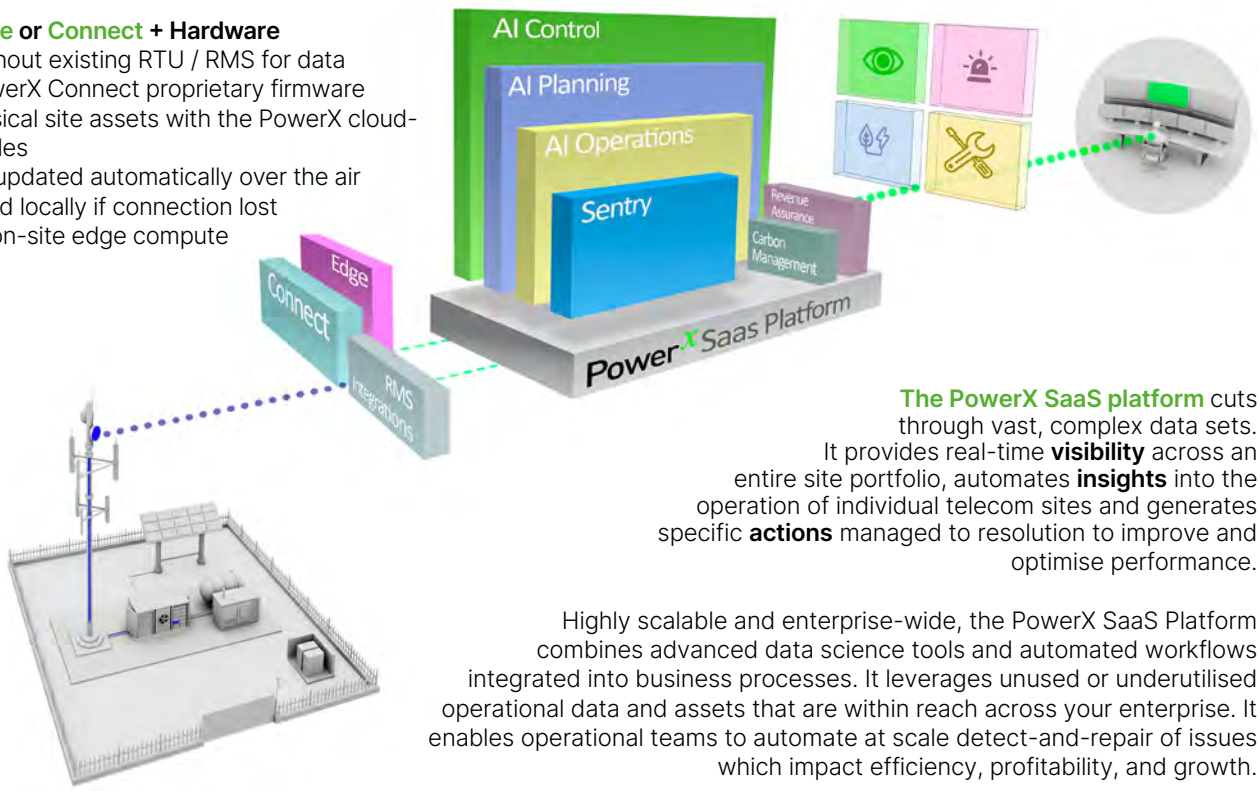
Reduced Power Backup Failures
Minimise the risk of backup system failures, reducing penalties, costly outages and site downtime by automating remote monitoring and diagnostics.

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 power 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 PowerX SaaS 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.

PowerX Blueprint to Business Transformation
PowerX puts data science at the heart of your business to rapidly reduce energy and maintenance costs, optimise capital expenditure, increase revenue, and reduce carbon emissions. It equips your organisation with the digital platform and auditable processes to **achieve operational excellence**, **business transformation** and **market leadership**.

THE POWER OF INTEGRATION

Increase Revenue

Optimise CapEx

Minimise OpEx

Reduce Fuel & CO_2

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.

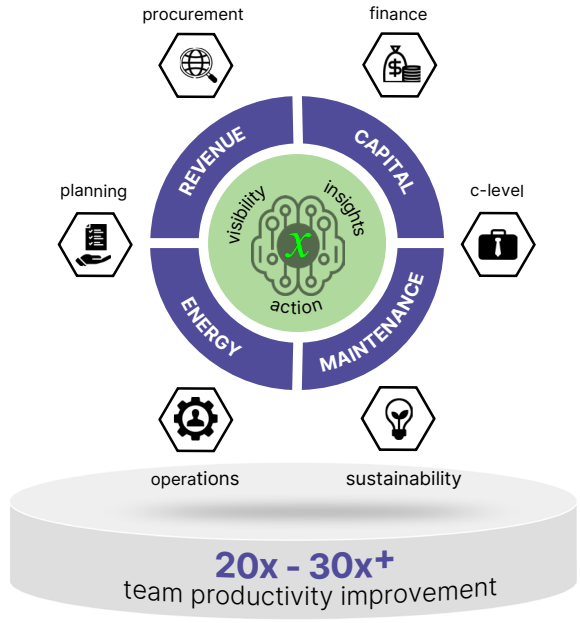
increase revenue & reduce risk

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



optimise capital expenditure

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

reduce cost of maintenance

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)

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

ABOUT POWERX

PowerX, a global Software-as-a-Service company, provides the market-leading data intelligence platform for managing and optimising energy assets. The platform's advanced data science tools and workflows, integrated with enterprise business processes, deliver efficiency, resilience and sustainability for critical asset operations.

In telecommunications, for example, the PowerX solution has achieved auditable 15%-30%+ energy and maintenance cost reductions, asset utilisation improvements, CO_2 emission reductions and revenue assurance. PowerX is a highly scalable, hardware agnostic platform that is quick and easy to deploy.

The solution leverages AI to automate improvements and processes at scale helping operational teams identify inefficiencies, prioritise responses and manage to resolution with detailed diagnostics and integrated workflows. The result is enterprise-wide visibility, specific insights and automated control actions, with increased workforce productivity, reduced cost and site-level efficiencies at scale across large, distributed estates.

For more information, please visit our website, or contact a member of the PowerX team at:

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THANK YOU FOR YOUR INTEREST

If you would like any further information on this, or any related data science issues, please contact us using the details on the previous page.

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