

Jan 26

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Whitepaper

Leveraging AI for Predictive Maintenance in Telecom Networks

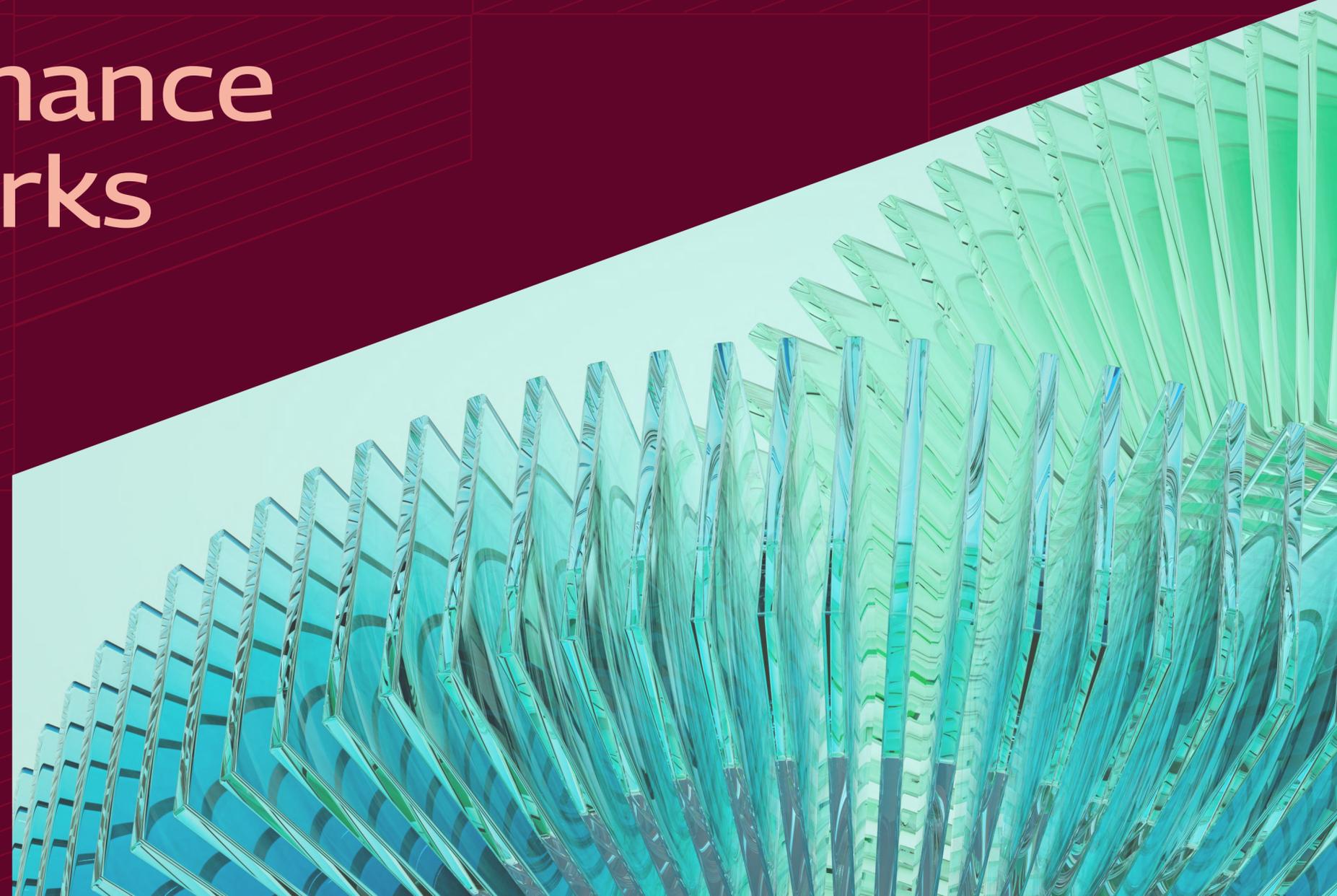
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Executive Summary

Telecom networks are becoming increasingly complex, with operators managing vast volumes of data, distributed infrastructure, and rising customer expectations for seamless connectivity. Traditional maintenance approaches—whether reactive or time-based—often result in unplanned outages, increased operational costs, and lower customer satisfaction.

Artificial Intelligence (AI)-driven predictive maintenance offers a proactive alternative. By analyzing patterns in network data, AI can detect anomalies, anticipate failures, and recommend preventive actions before disruptions occur. This transition from reactive to predictive maintenance enables telecom operators to reduce downtime by up to 50%, lower maintenance costs by 30-40%, and improve overall network reliability.

This whitepaper explores how predictive maintenance, powered by AI and advanced analytics, transforms telecom operations. It outlines the technologies enabling this shift, showcases insights from multi-operator implementations, and highlights how Tech Mahindra's Orion platform helps telecoms build self-learning, self-healing networks for the future.

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Telecom operators today face mounting pressure to deliver uninterrupted connectivity across increasingly complex network environments. With the rollout of 5G, edge computing, and IoT-enabled devices, the number of network elements requiring monitoring and maintenance has grown exponentially. Meanwhile, customer expectations for flawless service leave little margin for error.

Traditional maintenance models—reactive, where teams respond to faults after they occur, or preventive, where components are replaced on fixed schedules—are no longer sustainable. They drive unnecessary costs, increase downtime, and fail to account for dynamic network conditions.

Today, telecom operators are increasingly leveraging AI for predictive maintenance in their telecom networks. Through analysis of real-time data using advanced analytics and machine learning (ML), predictive maintenance is now facilitating telecom operators to detect anomalies early, forecast potential failures, and take corrective action before issues escalate. AI-driven predictive maintenance has shown promising results to date, yielding double-digit improvements in energy efficiency, ticket automation, and surge resilience, which translate into earlier ROI and lower OPEX.

This white paper explores the strategic importance of predictive maintenance in telecom operations, illustrating how AI technologies can revolutionize network maintenance. The paper also provides actionable insights and recommendations for telecom operators to effectively adopt and implement AI-driven predictive maintenance.

Current Operational Challenges

Telecom operators face numerous operational and technological challenges in maintaining their network infrastructure. Modern networks are complex, and this, coupled with high data volumes, causes many telcos to struggle with limited analytics capabilities. This often results in inefficiencies, high costs, and unplanned service disruptions. Some of the key challenges faced by telcos are:

Unplanned Downtime and Service Disruptions

Traditional maintenance approaches are largely reactive, addressing failures only after they occur. This reactive model leads to unplanned outages, service interruptions, and high customer churn.

Fragmented Data Ecosystems

Network data is often scattered across legacy systems, operational silos, and vendor-specific tools. This lack of unified visibility limits real-time fault detection and prevents effective correlation of network events.

High Maintenance Costs

Time-based or manual maintenance schedules lead to over-servicing some components while neglecting others. This inefficiency inflates operational expenses and strains already tight budgets.

Slow Fault Resolution

In the absence of predictive insights, technicians spend significant time identifying the root cause of issues—delaying resolution and increasing mean time to repair (MTTR).

Limited Scalability and Resource Utilization

As networks expand with 5G, IoT, and cloud adoption, traditional monitoring tools and static maintenance models struggle to keep pace, reducing overall network agility.

These interconnected challenges underline the urgent need for AI-enabled predictive maintenance to enhance network reliability, reduce costs, and improve customer satisfaction.



Figure. 1: Operational challenges faced by telecom companies in maintaining network infrastructure

Benefits of AI in Predictive Maintenance

By enabling predictive maintenance, AI transforms maintenance practices from reactive responses to proactive, intelligence-driven interventions. The following are key benefits driving adoption across the telecom industry:

Early Fault Detection

AI models analyze vast volumes of network data—from sensors, logs, and alarms—to identify early signs of degradation or anomalies that human monitoring might overlook. This allows operators to detect and address potential issues long before they cause outages.

Reduced Downtime and Service Disruptions

By predicting failures and scheduling maintenance proactively, AI-driven systems can reduce network downtime by up to 50%. Predictive analytics ensure service continuity and improve customer experience, particularly in high demand 5G and fiber environments.

Optimized Maintenance Costs

AI-driven insights enable condition-based maintenance, ensuring resources are deployed only when necessary. This minimizes unnecessary interventions and reduces operational expenses by 30-40%.

Enhanced Scalability and Agility

Predictive systems can continuously learn from network behavior and automatically adjust maintenance schedules as the infrastructure expands, improving scalability across 5G, IoT, and edge environments.

Data-Driven Decision Making

AI enables operators to move beyond intuition-based decisions by providing actionable insights through visualization dashboards and advanced analytics. This helps prioritize high-risk assets and optimize network investment strategies.

Many telecom companies are leveraging AI for predictive maintenance, enabling them to transition from reactive repairs to proactive upkeep. Real-world deployments demonstrate that operators implementing AI predictive maintenance achieve earlier ROI realization, supported by cost savings, increased availability, and reduced unplanned interventions.

Key Technologies Enabling AI-Driven Predictive Maintenance

Many telcos now rely on advanced technologies that leverage AI-driven predictive maintenance to monitor, analyze, and forecast network health with extraordinary accuracy. These technologies transform raw data from diverse sources into actionable intelligence, enabling network operators to address issues proactively rather than reactively. Some of the key technologies that enable AI-driven predictive maintenance of telecom networks are:

Machine Learning (ML)

ML algorithms are increasingly being used to analyze vast amounts of historical and real-time data to identify patterns and predict potential equipment failures. This is of tremendous help in precisely forecasting maintenance requirements, enabling telcos take corrective action to minimize unplanned downtime.

Natural Language Processing (NLP)

AI systems are now leveraging NLP extensively to interpret and analyze textual logs, trouble tickets, and other forms of unstructured data. This capability comes in very handy in detecting recurring fault patterns that might otherwise be overlooked.

Internet of Things (IoT)

IoT-enabled sensors are increasingly being deployed to provide continuous, real-time monitoring of network components. The critical health metrics collected using these sensors are then fed into predictive models, enabling faster and more accurate diagnostics.

Big Data Analytics

These tools are now being leveraged to process and correlate massive datasets from diverse sources. This enables the identification of hidden trends, anomalies, and root causes that traditional analysis methods often overlook.

Telcos are now quickly moving from reactive to predictive maintenance using these technologies. These telecom companies are increasingly leveraging these technologies to optimize resource utilization, reduce operational costs, and ensure a more reliable and high-quality service experience for end-users. AI-driven technologies have indeed facilitated the increased use of advanced analytics, real-time monitoring, and intelligent data interpretation, which is of tremendous help to telcos in maintaining their networks with greater accuracy and foresight, while minimizing downtime and preventing unexpected network failures.

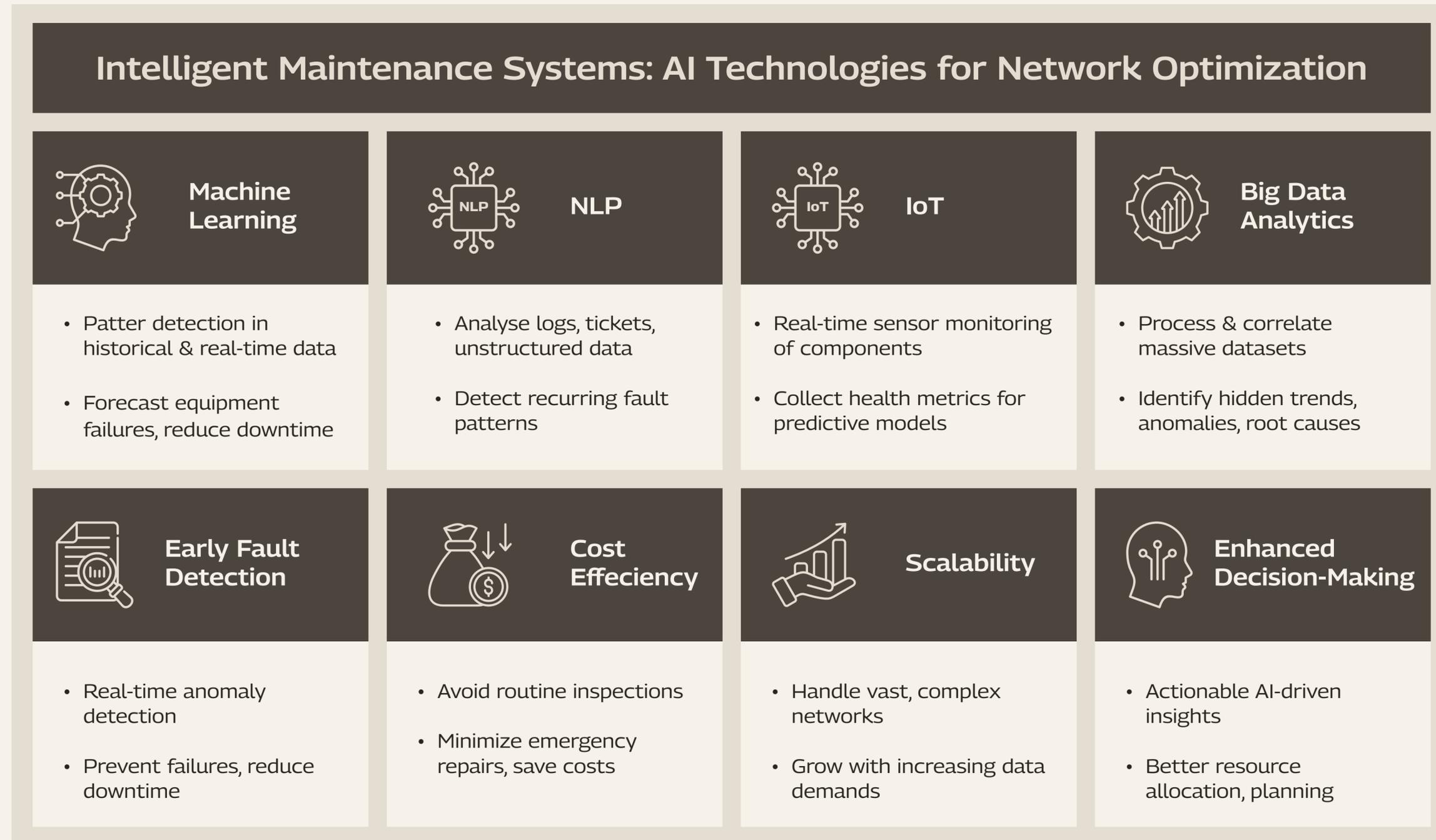


Figure 2: Benefits of deploying AI technologies for telecom network optimization

Multi-Operator Insights on AI-Driven Predictive Maintenance

AI-driven predictive maintenance is now widely adopted by top telecom operators worldwide. Case studies highlight how these companies use AI to enhance energy efficiency, develop autonomous networks, automate incident response, and boost surge resilience.

Operator	Objective	Challenges	Solution	Outcome
Operator A—Tier-1 APAC Telco	<ul style="list-style-type: none"> • Cut energy use, lower OPEX • Dynamic resource utilization 	<ul style="list-style-type: none"> • Over-provisioned resources • Energy waste in low load • Balance savings with performance 	<ul style="list-style-type: none"> • ZTE Green Telco Cloud + AI models • Auto CPU scaling & sleep modes • Real-time resource allocation 	<ul style="list-style-type: none"> • ~25% energy savings • Lower OPEX, longer equipment life
Operator B—European Mobile Carrier	<ul style="list-style-type: none"> • Create autonomous networks • Fewer outages • Higher efficiency 	<ul style="list-style-type: none"> • Demand spikes • Idle off-peak capacity • Heavy ticket volumes 	<ul style="list-style-type: none"> • AI/ML for dynamic workload • Sleep mode for low demand • LLM-based ticket handling 	<ul style="list-style-type: none"> • 20% lower energy intensity • Faster, accurate ticketing

Table Cont. on Next Page

Operator	Objective	Challenges	Solution	Outcome
Operator C—North American Telco	<ul style="list-style-type: none"> Automate incident management Boost efficiency, cut downtime Proactive customer service 	<ul style="list-style-type: none"> Data silos, weak governance High ticket volumes Complex, diverse tools 	<ul style="list-style-type: none"> AI Ops with ML/AI correlation Automated workflows & diagnostics Centralized monitoring & integration 	<ul style="list-style-type: none"> ~30% ticket deflection ~500,000 resource hours saved
Operator D—European Based Global Telecom Vendor	<ul style="list-style-type: none"> Reliable performance during surges Lower energy use, improve sustainability Automate ops & troubleshooting 	<ul style="list-style-type: none"> 4-5x traffic spikes at events Rising energy costs Managing thousands of sites in real time 	<ul style="list-style-type: none"> Digital Twin + Network Intelligence + GenAI for forecasting Dynamic site config & workload balance Real-time KPI monitoring & auto-optimization 	<ul style="list-style-type: none"> ~14% higher capacity under load ~20% lower energy intensity Reduced OPEX via fewer site visits

Figure 3: Multi-operator case studies with insights from leading telecom companies

Based on the experience of these large global telecom operators, a clear pattern has emerged: AI enables more innovative resource utilization, faster fault handling, and measurable OPEX reductions. These insights highlight that AI-driven predictive maintenance has become a critical industry requirement, enabling global telecom ecosystems to achieve greater operational efficiency and to sustain long-term competitiveness.

Framework for AI-Driven Predictive Maintenance

Despite clear benefits, many telcos face challenges in adopting AI-driven predictive maintenance due to siloed data, fragmented tools, and legacy systems. Tech Mahindra's proprietary framework for AI-driven predictive maintenance addresses these challenges by providing a practical roadmap to operationalize predictive maintenance through the unification of data, analytics, automation, deployment, and governance.

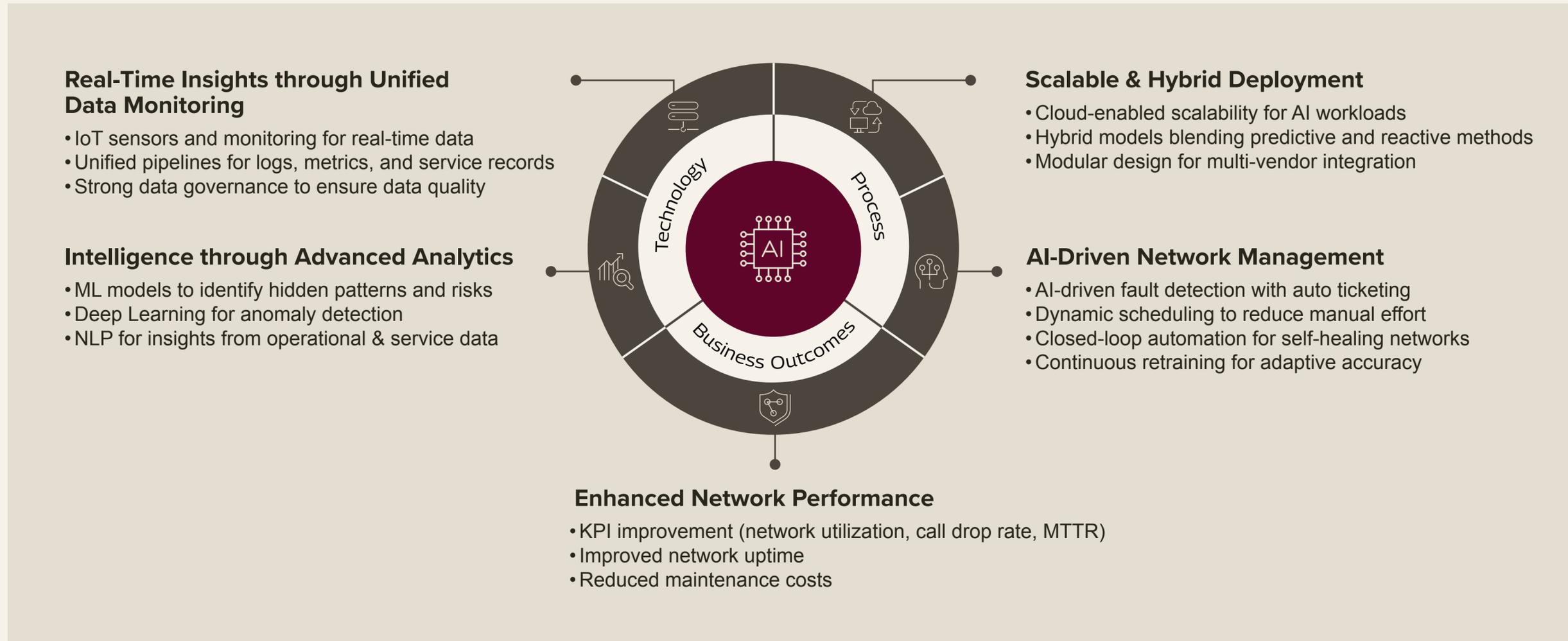
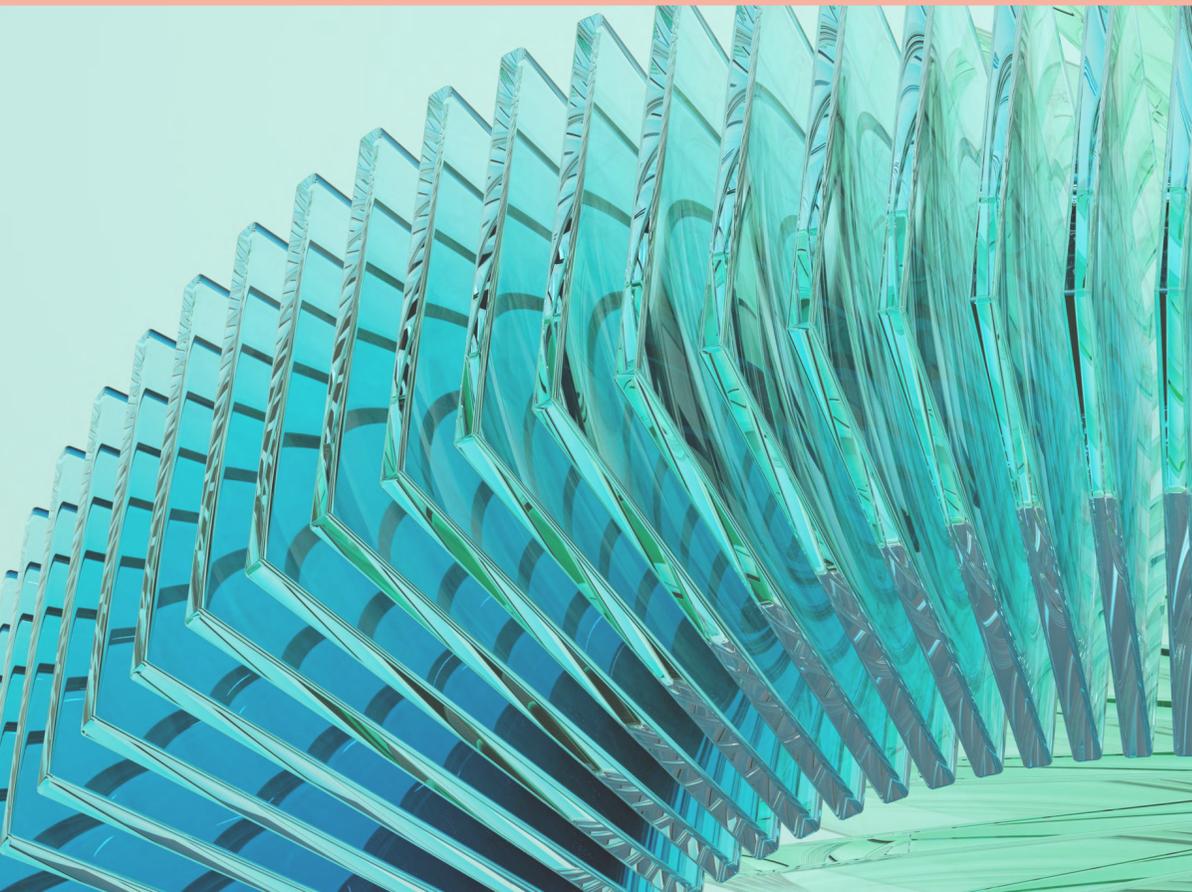


Figure 4: Tech Mahindra's proprietary framework for AI-driven predictive maintenance for telcos

By adopting this framework, telcos can move beyond isolated pilots to a cohesive, enterprise-wide strategy. The result is faster fault detection, lower costs, and stronger resilience, delivering both short-term efficiency gains and long-term competitive advantage.

Tech Mahindra's Orion Platform

Unlike traditional framework-heavy approaches, Tech Mahindra's Orion platform is built as a telecom-native, production-ready solution that accelerates AI-driven predictive maintenance. Orion uniquely combines agentic AI, interoperability, and governance-first design to drive measurable operational outcomes for telecommunications companies.



Some of the key differentiators of the Orion platform are:

Agentic AI at Scale

200+ pre-built, domain-specific AI agents for anomaly detection, predictive insights, and automated remediation across telecom operations.

Global AI Marketplace

Orion Marketplace provides ready-to-deploy, enterprise-grade agents, enabling rapid scaling and customization without lengthy build cycles.

Cross-Cloud and Hybrid Compatibility

Runs seamlessly across private, public, and hybrid environments, ensuring flexibility and cost efficiency.

Modular Interoperability

Designed to integrate with OSS/BSS, legacy stacks, and emerging digital platforms without disruptive rip-and-replace transformations.

Governance and Trust by Design

30+ embedded checks for compliance, transparency, security, and ethical AI practices.

Closed-Loop Optimization

Continuously learns from outcomes to enhance accuracy, resilience, and decision intelligence.

Tech Mahindra's Orion platform brings advanced agentic AI capabilities to enable autonomous, intelligent, and scalable predictive maintenance workflows.

Orion's Agentic AI design, Cross-Cloud Compatibility, and Modular Integration with telecom ecosystem make it uniquely suited for predictive maintenance at scale.

Its 200+ Production-Ready Agents and 30+ Governance Checks provide telcos with a robust, ready-to-deploy foundation that balances innovation with transparency and control.

Intelligent Workflow Automation

- Automated ticketing & escalation
- Seamless enterprise integration

Optimized Resource Allocation

- Dynamic maintenance scheduling
- Reduced costs & site visits

Proactive Failure Prediction

- ML-driven failure forecasts
- Pre-emptive outage prevention

Closed-Loop Network Optimization

- Continuous learning from outcomes
- Self-improving recommendations

Autonomous Fault Detection & Diagnosis

- Multi-source data ingestion
- Automated anomaly correlation

Governed & Scalable Deployment

- Compliance & ethical AI controls
- Modular, cross-cloud scalability

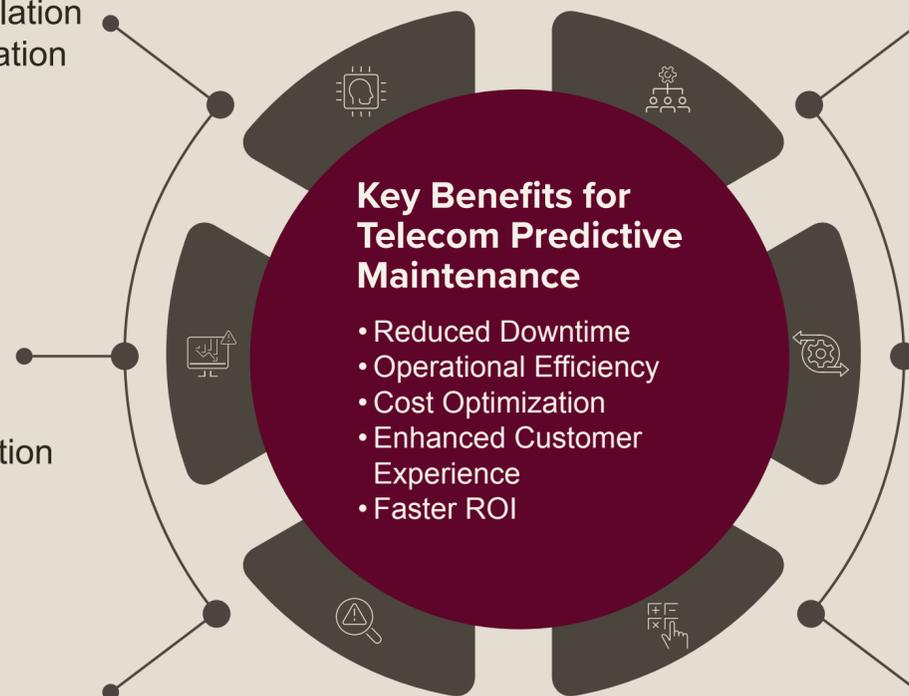


Figure 5: Tech Mahindra's Orion platform for AI-driven predictive maintenance for telcos

Orion moves operators from a reactive to a predictive approach by embedding AI agents directly into telco operations, thereby enabling faster ROI, reduced downtime, optimized costs, and an enhanced customer experience—an execution-led advantage that advisory-heavy roadmaps often overlook.

Key Recommendations

AI-driven predictive maintenance is transforming how telecom operators manage network reliability, efficiency, and customer experience. Drawing on multi-operator insights and Tech Mahindra's field implementations, including the case study shown below, the following recommendations outline how telcos can scale predictive maintenance effectively.

Computer Vision powered Fault detection in Fiber Equipment Installation for a Leading UK Telco		
As-is Process	Pain Points	
<p>Field engineer installs fiber equipment (CPE)</p> <p>Several installations in a day to meet fiber rollout targets</p> <p>Auditors identify installations issues by manual inspection of images submitted by engineers</p> <p>No self Audit by Engineers at the time of installation</p>	<p>Manual process is time consuming and not cost effective</p> <p>Multiple visits by field engineers for successful installations</p> <p>Efforts and Time to complete a connection is very high</p>	
Our Solution	Value Delivered	Model Performance
<p>Mobile App that uses Deep Learning powered Computer Vision (CV) to enable self-audit by field engineers at the time of installation itself and immediately resolve identified issues</p>	<p>Quick resolution turnaround, reduction in revisits of sites location, first time correct installation</p>	<ul style="list-style-type: none"> • Response time <10% • Avg. Accuracy - 85% • Avg. Recall - 87% • Avg. Precision - 93%

Figure 6: Case study at Tech Mahindra leveraging AI for fault detection in fiber equipment installation

Telecom operators must adopt a forward-looking roadmap that combines strategic clarity with operational readiness. By deploying advanced algorithms for establishing the right foundations across data, infrastructure, and process integration, telcos can enhance network resilience, reduce unplanned downtime, and drive cost efficiencies. The following recommendations outline the key actions that can be taken to realize these outcomes.

Build a Unified Data Ecosystem

Consolidate network, alarm, and operational data across vendors and regions into a single analytics layer. Unified visibility is the foundation of predictive accuracy.

Automate Maintenance Workflows

Integrate predictive insights directly with OSS/BSS systems and field operations to enable closed-loop automation—reducing mean time to repair (MTTR) and operational overhead.

Ensure Data Governance and Model Accountability

Establish governance policies for data use, algorithm transparency, and compliance monitoring to build trust in AI-driven decisions.

Adopt Modular, Scalable Architectures

Implement cloud and edge-enabled predictive frameworks that can scale dynamically with 5G rollouts and IoT growth.

Empower the Workforce

Train network and field engineers in AI interpretation and operational analytics to improve adoption and human-AI collaboration.

Accelerate Through Strategic Partnerships

Collaborate with AI platform providers and system integrators to leverage proven architectures and domain expertise, thereby reducing implementation complexity and shortening the time to value.

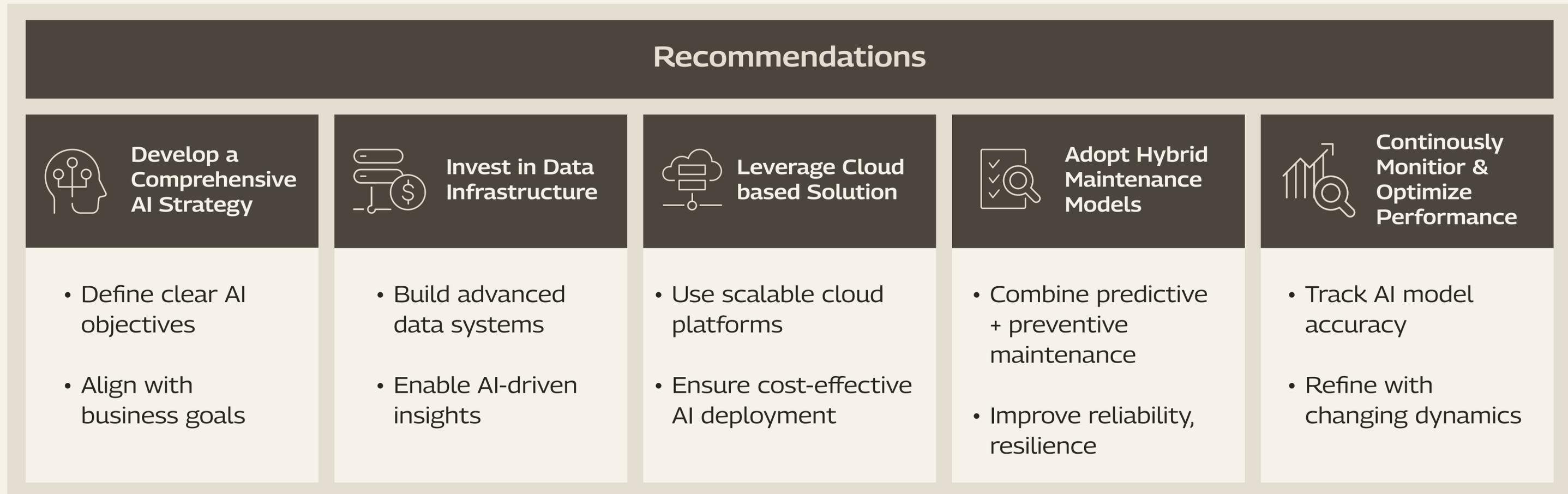
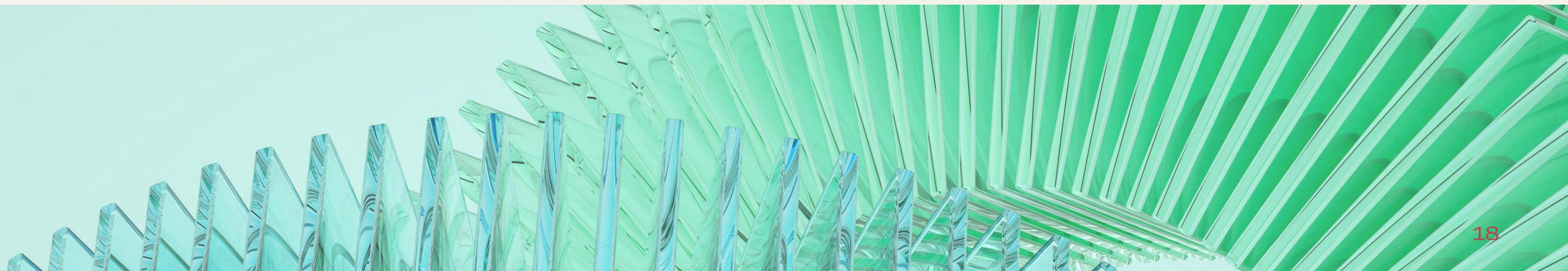


Figure 7: Key recommendations and the way forward

The AI-Driven Path Ahead

AI-driven predictive maintenance is redefining telecom network operations by shifting from reactive and preventive approaches to a predictive, intelligence-led model. Operators embracing predictive models are reporting 40% fewer outages, 30% lower costs, and measurable gains in customer satisfaction.

As networks become more complex and customer expectations rise, the adoption of AI will be critical for sustaining efficiency and competitiveness. Operators that act now, leveraging platforms such as Orion to integrate predictive intelligence into their maintenance models, can deliver cost savings, operational resilience, and seamless connectivity, while securing long-term competitiveness in the digital future.



About the Authors



Manvinder Singh Bhatia

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Manvinder has more than 24 years of work experience. He has a B.Tech (Hons.) from IIT-Kharagpur and a PGDM from XLRI Jamshedpur. He is an RPA certified Six Sigma Green Belt and brings expertise in driving large scale transformation projects across multiple industries such as Telecom, Finance, Banking & Consulting. Having worked across industries on various themes such as Service Assurance, Service Fulfillment, Customer Experience Management, etc, Manvinder brings an outside-in perspective to leverage the impact of digital technologies in solving pressing business problems.



Dr. Shekhar Anil Tankhiwale

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Dr Shekhar's focus areas of work are strategy, digital transformation, leverage of digital technology for business transformation, and business model innovation. He has 24+ years of experience in product R&D, manufacturing, and information technology. He has done his Doctorate (PhD), followed by an MBA with distinction. Shekhar has been an invited speaker at a number of conferences, the most recent being the Confederation of Indian Industries (CII) conference on Digital Transformation. Shekhar has seven international publications on a range of topics, including business model innovation and digital technologies.

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At TechM Consulting, we empower clients to turn disruption into opportunity by building future-ready capabilities. Our unique value velocity V Factor methodology, rooted in co-creation deep listening agile execution and seamless collaboration, enables enterprises to deliver greater stakeholder value with greater speed and agility.

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