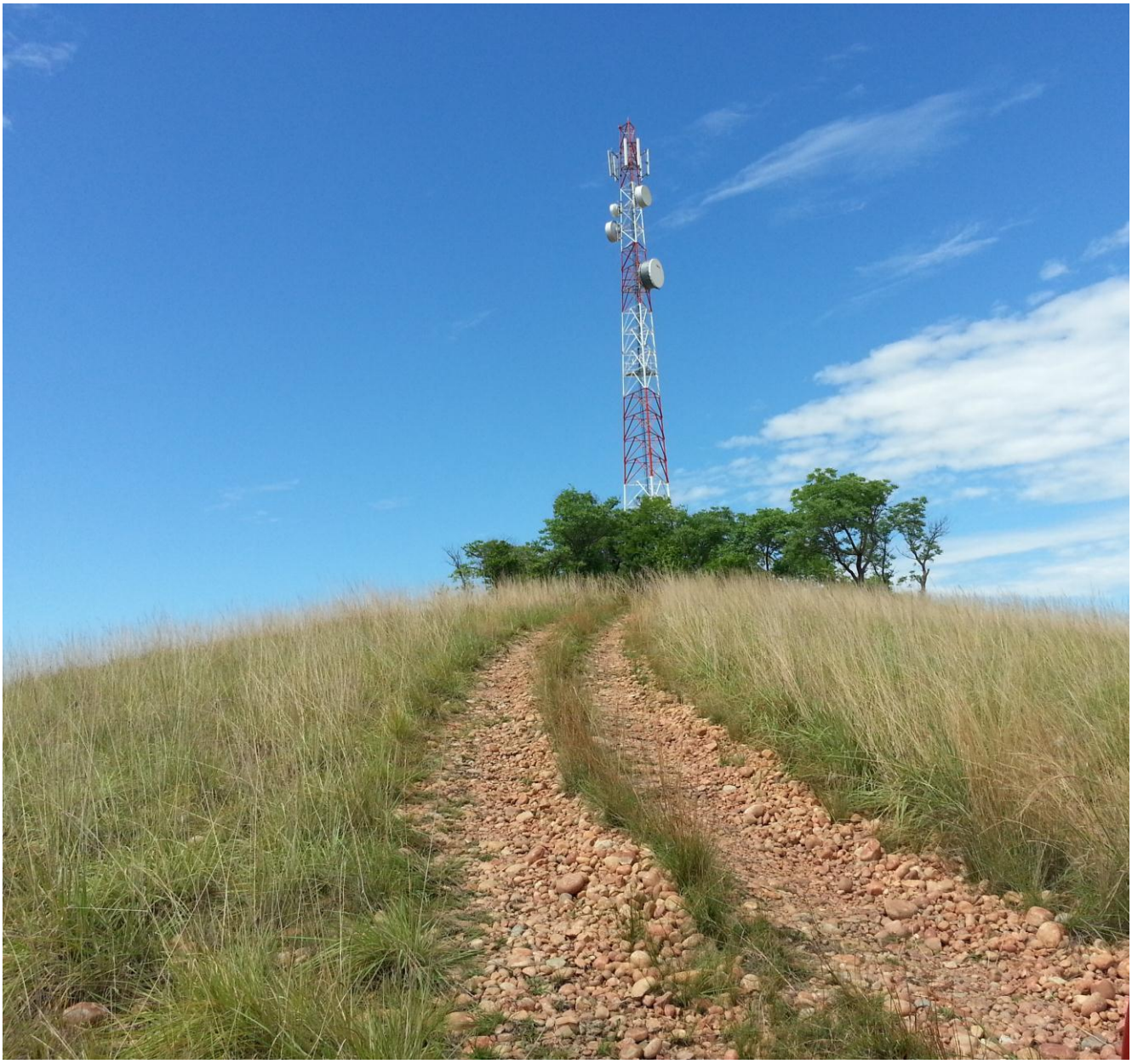
IFC International Finance Corporation World Bank Group

GSMA Green Power for Mobile

In partnership with the Netherlands

Best Practice Operations Guide – West Africa

Green Power for Mobile



Contents

Figures and Tables:

Glossary:

CAPEX: Capital Expenditure
DG: Diesel Generator
ESCO: Energy Service Company
TowerCo: Tower Company
MNO: Mobile Network Operators
MSP: Managed Services Partner/Provider
NOC: Network Operations Center
O&M: Operation and Maintenance
OPEX: Operational Expenditure
PV: Photovoltaic
SLA: Service Level Agreement

1. Introduction

The mobile telecommunications infrastructure in Africa has grown beyond the reach of other supporting infrastructure including power and roads. The limited reach of power infrastructure and poor accessibility to widely dispersed network of telecom sites has tremendously impacted the operations and costs of running the network.

Nigeria and Ghana in West Africa have reached a mobile subscriber base of over 107 and 25 million respectively, driven by strong growth in mobile penetration and mobile network coverage (coverage of 80% of the population). Nigeria and Ghana combined have a total of 35,000 sites of which 50% are located in areas without commercial grid power, and mostly in rural and remote locations often with difficult accessibility for smooth and effective operations. Therefore, operation and maintenance of the network remains a big challenge affecting the cost of operations, network availability and reliability of mobile telecommunication services.

Network and site operations are critical operational elements of managing and running telecom networks and energy provision is a major element of these operations. Energy is certainly the most crucial part of network and site operations in the telecom industry, highly impacting the availability of mobile network and services to end-users.

MNOs and Tower Companies in the region have faced with many operational challenges in the context of poor grid power supply, operational leakages (such as diesel pilferage), equipment vandalism, and lack of credible operational partners for sustaining their operations and performance.

This document focuses on best operation practices, to assist the MNOs/Tower Companies in adopting the most adequate approach to operations and maintenance of telecom power infrastructure in order to improve service availability and OPEX efficiency.

2. Operational Goals and Enabling Factors

Network availability and OPEX efficiency are the key operational goals of running a mobile telecommunication network. The factors affecting these key operational goals and their impact are presented below.

Table 1: Operational Goals, Affecting Factors, Business Impact and Enabling Factors

Operational Goal	Affecting Factors	Business Impact	Enabling Factors
Network Availability	▪ Failure in equipment performance ▪ Failure in energy provision	▪ Quality of Service due to disruption ▪ Revenue loss ▪ Negative impact on the brand	▪ Tight SLAs for performance ▪ Robust systems and processes to enable performance ▪ Proactive monitoring and control of performance failures
OPEX Efficiency	▪ Input costs ▪ Operational leakages ▪ Operational inefficiencies	▪ Profitability and Bottom line ▪ Cost of services ▪ Total cost of ownership	▪ Right technology and solutions ▪ Robust systems and processes ▪ Right supply chain integration ▪ Regular monitoring and reporting

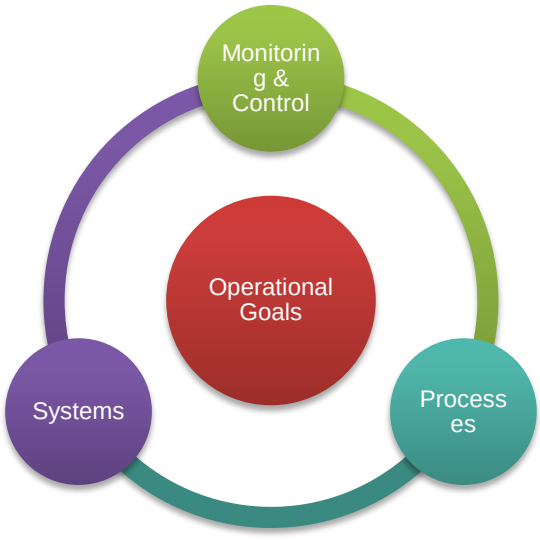
Network availability depends on equipment performance and the supply of energy to power up the network equipment. Any disruption in energy supply and equipment performance would affect the overall network performance leading to poor quality of service, revenue loss and adversely affect the brand. The MNO needs to implement robust systems and processes in order to tightly monitor and control the operational performance of the network. It is also important to set strict performance linked SLAs to enable quality network uptime.

Network OPEX will depend on various operational factors including energy supply, equipment maintenance, operational efficiency and robustness. Right technology, robust systems, right supply chain integration coupled with regular monitoring and reporting will enable the MNO to achieve OPEX efficiency and improve profitability.

3. Sustainable Operations: The Key Elements

In a holistic approach to operations, the MNO has to put in place the supporting systems, enabling processes and integrated monitoring and control mechanisms in order to achieve and sustain operational goals of high network availability and OPEX efficiency.

Figure 1: Sustainable Operations Framework



3.1. Systems

The right operations systems assist in active engagement in operations through monitoring and control of site operations and equipment performance.

The examples of key systems required for mobile network operations are listed below.

- Centralized network operations center (NOC) for managing entire network operations including active telecom equipment as well as overall site performance.
- An integrated remote site monitoring system for monitoring of site assets and performance, and to support regular maintenance activities
- Operations and partner management systems for effectively managing site operations and diesel logistics as well as managing operational resources including managed services partners

A system driven operational approach will bring transparency in operations and helps identify operational loopholes. The systems will enable operational insights and help decision making through clear understanding of operations and associated costs.

The systems also help mobilize operational resources in a controlled and predictable manner and drive operational efficiency.

3.2. Processes

The operational processes help in achieving operational efficiency through effective utilization of productive resources and removing loopholes and leakages in the operational activities. The processes will streamline site access, logistics, operations and maintenance activities and provide clear guidelines for issue resolution and escalation.

The key processes to be incorporated in overall network operations are listed below

- Diesel procurement, inventory and delivery processes
- Alarms maintenance and corrective maintenance processes
- Operational resource mobilization processes in order to enable smooth and uninterrupted operations and network uptime

3.3. Monitoring and Control

Regular monitoring and control of each activity is essential for successful operations. On top of the operational systems and processes, the MNO requires implementing and integrating a robust monitoring and control framework in order to ensure that the operational goals are achieved and sustained by the systems and processes in place.

The key monitoring and control activities of network operators in conjunction with operational partners is listed below

- Monitoring and control of asset performance and life
- Alarms monitoring and corrective maintenance
- Monitoring of field operations and site access control
- Monitoring of consumable (e.g. diesel) and control of supply operations
- Monitoring and control of site access and security in order to reduce risk of equipment theft
- Monitoring of OPEX and necessary reporting for decision making and control
- Monitoring of network uptime and SLAs for performance

3.4. Operational Goals and Enabling Systems & Processes

The MNO needs to map and implement each activity in the operations with a supported system and process in order to ensure the network and OPEX performance. Various systems and processes essential for achieving the operational goals are illustrated below.

Table 2: Operational Goals and Enabling Systems & Processes

Operational Goal	Affecting Factors	Enabling Systems and Processes
»Systems and processes for performance		
Network Availability	Equipment failure Power system failure Control system failure Supply failure Equipment Cooling	Monitor and control systems for - Equipment performance and health - Operation of Power systems - Supply of inputs (diesel) to power the equipment - Operating environment (temperature) O&M processes for - Proactive and preventive maintenance of equipment - Diesel supply logistics and operations
»Systems and processes for efficiency		
OPEX Efficiency	Operational efficiency Diesel operations Site access and security	Operational systems for - Streamlined operations and managing field operations partners - Effective resource mobilization for corrective O&M activities - Supporting proactive, preventive O&M activities - Controlling site access and asset security - Monitoring and controlling diesel logistics, diesel consumption and pilferage - Monitoring and reporting for decision making and OPEX control Operational processes for - Effectively manage and streamline O&M activities and supply chain integration - Effectively mobilize field operational resources - Manage and control site access and improve site security - Effectively manage and streamline diesel logistics and control diesel pilferage

4. Operations Context and Key Operations

The operations context and operational models will have a significant impact on tower operations, control of performance and efficiency. In the following sections, a detailed look at both the operations context and operational models prevalent for tower operations in the West Africa is presented.

4.1. Operations Context

Ghana has a reliable grid power supply compared to many other countries in the region. Excluding the regular load-shedding of grid power suppliers, the availability of grid power to the telecom tower sites is about 70% of the time, reducing the dependence on expensive and dirty diesel power of on-grid sites. However, there has been a decline in the quality and reliability of grid power supply in recent times due to supply shortages failing to catch up with the grid's expansion over the years. This has increased the dependence on diesel generators for powering telecom towers.

Grid power supply is a major concern in Nigeria and has affected telecom operations in terms of costs and reliability. More than half of the sites are off-grid and usually powered by diesel generators with huge OPEX. The remaining grid-connected sites suffer due to the poor quality of power supply and frequent outages lasting long hours. This has led to a heavy dependence on diesel generators for the grid-connected sites as well.

In addition to the poor grid power supply, Nigerian telecom tower operators face operation challenges. Site security, for example, is a major issue as there have been several cases of damage to tower assets across the country. Thefts of equipment and fuel pilferage have affected the OPEX of telecom sites. Also, the initiatives towards reducing the diesel consumption have been conflicting with O&M partners' interests, thus hampered the successful implementation of these alternatives.

Given the above context, it is critical for MNOs and Tower Companies in Nigeria and Ghana to strengthen their operational support systems and processes to reduce the risk of operational failures and thereby, reduce any unforeseen operational costs. In the following section, we look at the key operational activities and necessary systems and processes for smooth operational control and OPEX efficiency.

4.2. Key Operational Activities

The site operations of an MNO/TowerCo in West Africa can be broadly divided into active and passive maintenance, field operations and monitoring and control operations. Some of the key operational activities are highlighted below.

- Preventive and corrective maintenance of network equipment
- Monitoring and preventive as well as corrective maintenance of other active components including radio, transmission and antenna equipment
- Preventive, corrective, scheduled and breakdown maintenance of passive infrastructure elements including power systems, diesel generator, batteries, air conditioners and other related power system components and green power systems
- DG servicing and Over Hauling in accordance with the specification and guidelines
- Active monitoring and maintenance of alarms for site outages and link failures
- Diesel filling to ensure availability for uninterrupted back up (or primary) power supply

The key operational activities and associated systems and processes being deployed by MNOs/TowerCos in the West African region are described in following sections.

4.2.1. Asset Maintenance

Asset maintenance is related to the operational activities of proactive and corrective maintenance of equipment, and is essential for performance and operational life of the asset. For maximum output and performance, the asset maintenance activities need to be supported by relevant monitoring systems and processes for timely maintenance and failure resolution and prevent unplanned network downtime.

MNOs/TowerCos in Nigeria and Ghana have deployed various systems and process frameworks to actively manage asset performance and maintenance activities. Necessary monitoring controls and resource mobilization processes have helped MNOs/TowerCos in West Africa to reduce operational delays and to minimize service down times due to equipment failures.

Asset	Systems & Processes	Monitoring & Control
Active Network Equipment Maintenance ▪ BTS ▪ BSC/MSC ▪ Transmission and Backhaul	Network Operations Center (NOC) for monitoring equipment health alarms. ▪ Alarms monitoring and maintenance systems ▪ Transmission and backhaul link monitoring system	Centralized monitoring and control through NOC for mobilizing maintenance and upgrade activities.
Passive Maintenance ▪ Power Systems and components ▪ Diesel Generator ▪ Renewable power systems (solar, wind etc.) ▪ Batteries ▪ Telecom Tower ▪ Equipment Cabinets and Shelters ▪ Air conditioners	Deploy remote monitoring system to regularly report equipment operations, performance and fault alarms and also to regularize scheduled maintenance activities.	Centralized monitoring through NOC and integrate controls for reducing risks of operational failures and effective resource mobilization for proactive and corrective maintenance.

4.2.2. Field Operations

Field operations are the key part of telecom network operations and need to be process driven with integrated centralized monitoring and control systems.

Major TowerCos and MNOs in the region have deployed various systems and processes to closely monitor and streamline each of the field operational activities including diesel operations, equipment maintenance, grid power operations as well as performance monitoring, reporting and escalation processes. This has helped operators to take control over key operational activities and reduce performance shortfalls and operational leakages.

Operational Activity	Systems & Processes	Monitoring & Control
Performance monitoring	Effective monitoring, reporting, escalation and resource mobilization	For performance delivery through effective resource planning
Equipment maintenance	For effective and streamlined execution of maintenance activities Managing spare parts and technical field resources	Monitor and control site access and equipment maintenance activities
Diesel operations	Effective management of procurement, inventory and supply to sites Manage diesel consumption through automation of power system components with intelligent load profile	Monitor, report and control leakages in the diesel supply chain Monitor, report and control diesel consumption/theft at site
Grid power operations	Liaise with grid power supplier for new connections and fault resolution Billing, payments and connection management	Monitor regular bill payments and actively interface for grid extension possibilities

4.2.3. Site Access and Security

Security at telecom sites has become an integral part of managing telecom network infrastructure in order to protect the assets and control breach or theft of equipment and consumables. The MNO/TowerCo in the region, especially in Nigeria, is confronted with security concerns in protecting the critical passive power equipment and consumables such as diesel fuel, which are critical to achieve service reliability and network uptime.

Despite the potential for savings in energy OPEX, site security challenges have long been hindering the MNOs, in Nigeria and other West African countries, from investing in new technologies including green power to address the energy OPEX at many sites running on diesel generators.

The MNOs/TowerCos in Nigeria and Ghana have been focusing on integrating site access control and security into the overall OPEX saving strategy in order to reduce operational costs and improve service reliability. The systems and processes being considered by the MNOs/TowerCos in are -

- Prohibitive, to control breaches in access code and site security
- Detective, to detect site access and security breach

Site access control is a key aspect of site security and requires implementing fool proof procedures and guidelines to enable centralized access monitoring and control of site operations. The MNOs/TowerCos in Nigeria and Ghana should be looking at implementing a layered approach to site access and security through physical barriers, intrusion detection through centralized access control and video surveillance systems, integrated monitoring system for equipment protection and theft control.

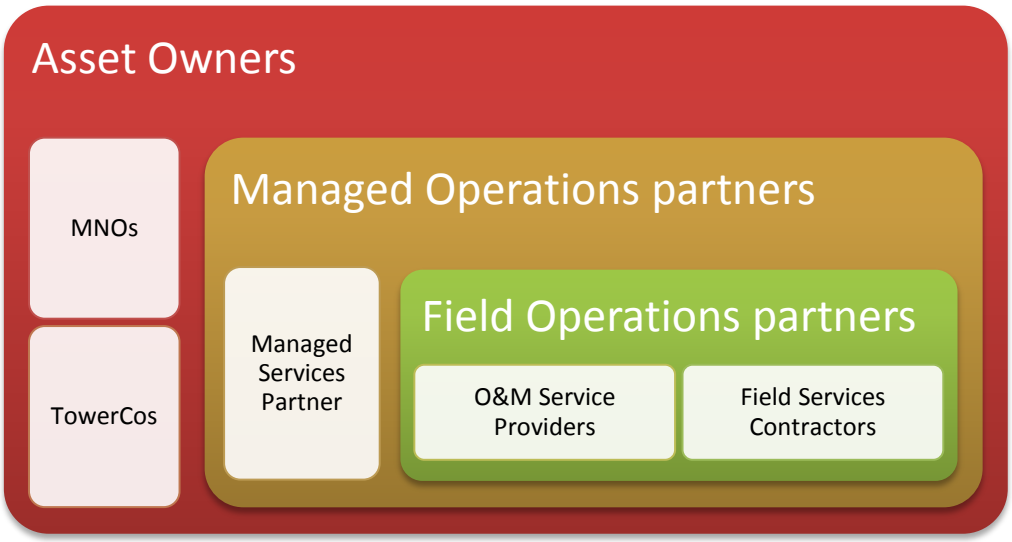
5. Operational Models and Key Processes

5.1. Operational Structure

The telecom infrastructure industry in Ghana and Nigeria is represented by Tower Companies and MNOs, as owners of telecom assets. Other key stakeholders in the industry include the telecom and power equipment vendors, managed services providers and O&M contractors. Nigeria's tower ownership structure is skewed towards MNOs owning about 91% of the telecom towers while around 9% are owned by Tower Companies. In contrast, Ghana has a majority of its towers (over 70%) owned or under the management of Tower Companies.

The broad operations structure and key operational stake holders in mobile network operations in Nigeria and Ghana is illustrated in the below graphic.

Figure 2: Operations Structure and Stakeholders



Telecom tower operations in West Africa are majorly represented by MNOs and Tower Companies as asset owners and Managed Services Partner (MSP) as key operational partners holding the SLAs with MNOs and TowerCos. The MSPs are supported with field level operations subcontractors including the O&M (operation & maintenance) service providers and field contractors.

5.2. Operational Models

The operational model and relative responsibility structure depends on the level of outsourcing and scope of services agreed between an MNO/TowerCo and the MSP. In the current scenario in Nigeria and Ghana, majority of the operations scope is managed by MSPs with strong SLAs for performance and uptime.

However, in many cases the MNO/TowerCo in West African region has in-house operational resources to support, monitor and control operations and performance.

5.2.1. In-house Operations model

In the in-house operations model, the MNO/TowerCo holds the responsibility for entire operations and maintenance as well as monitoring and control of performance and operations. The operational activities including equipment maintenance, alarms monitoring, field operations, site access and security are performed by in-house operations teams.

However, diesel procurement and delivery logistics can be outsourced to a third party field service contractor based on variable pricing for services and quantity of supply.

The inherent advantage of this model is that the MNO/TowerCo has greater control over

operational resources, field activities and performance. However, the MNO/TowerCo has to invest in human resources, capacity building and operational systems and processes in order to achieve operational goals with required performance metrics. The MNO/TowerCo has to undertake training activities for internal teams from time to time, in the context of changing technology landscape. The risk of attrition of trained resources is also a disadvantage in the in-house led operations model.

This model is in implementation at few major operators and TowerCos in both Nigeria and Ghana; however, there is shift towards outsourcing of operations due various disadvantages associated with the model.

5.2.2. Partially-outsourced Operations model

In this model, the MNO/TowerCo outsources the operations and maintenance activities to a third party O&M service providers, nevertheless holds the key responsibility for operational performance as well as monitoring and control of site operations.

While the monitoring and control activities are entirely the responsibility of MNO/TowerCo, the operational activities including equipment maintenance, field operations and site security are outsourced to the third party O&M service contractors with monthly fixed price for services and spares. The consumables such as diesel and diesel operations are outsourced to field service contractors with variable pricing depending on number site visits and supply quantity.

The performance SLAs in this model are loosely managed with the O&M service providers as the responsibility of operational performance lies with the MNO/TowerCo.

The advantage of this model is that the MNO/TowerCo still has the control over operations and performance without investing in in-house operational human resources and associated training activities. However, the major disadvantage of this model is that outsourcing of key operational activities to a third party O&M service provider is associated with various risks including operational leakages, service reliability, and credibility of the partner.

The partially-outsourced operations model is in implementation at many of the MNOs and TowerCos in both Nigeria and Ghana. Currently, this is the most popular model of operations across the region. However, due to leakages in operations and performance failures, the operators and TowerCos in West Africa have been looking at outsourcing the operations to strong operational partners with credibility and track record to adhere to performance SLAs and honour contractual terms.

5.2.3. Fully-outsourced Operations model

In the fully-outsourced model, The Managed Services Partner (MSP) holds responsibility for entire operational activities and performance SLAs. In many cases, the MSP jointly undertakes the monitoring and control of performance and SLAs with MNO/TowerCo.

The MSP in turn works in conjunction with field operations partners such as O&M service providers and field level sub-contractors in order to perform maintenance as well as site operational activities from time to time. The pricing of services depends on the scope and type of operational activity. There are two pricing approaches prevalent in this model- one, the fixed price contract for regular operations and maintenance activities and second, the variable pricing model for consumables such as diesel and spares.

The advantage of this model for MNOs/TowerCos is that the entire operations responsibility and performance SLAs is undertaken by a credible Managed Services Partner with strong resources including financial and operational resources. The MNO/TowerCo has strong control over monitoring of performance and SLAs.

MNOs and TowerCos in the region are moving towards outsourcing the entire operational activities including the active and passive infrastructure operations and maintenance to a credible third party Managed Services Partner. However, the MNO/TowerCo retains the ownership of equipment and components of the system.

The MNOs and TowerCos are also considering energy outsourcing as a way to offload key investment in equipment as well as maintenance and field operations activities to a third party specialized organization, such as an ESCO (Energy Service Company). The ESCO outsourcing model is still initial phases of trial, but the MNOs and TowerCos are increasingly interested in working with strong partners to make the model work.

In conclusion, the availability of credible and committed partners is the key element in sustaining operations and performance. The success of each of the above operational models also greatly depends on tight SLAs, robust operational systems and processes supported with integrated monitoring and control of performance objectives.

In the following sections, some of the key operations and their detailed activity-wise process flow is presented along with necessary operational best practices to achieve efficiency and performance.

5.3. Process Flow: Diesel Operations

The diesel supply chain can broadly be divided into procurement operations, supply operations and stock management. Depending on the operational model, the process flow and responsibility matrix varies for each of these operations.

Figure 3: Process Flow: diesel operations

Process	Process Flow	Process Ownership and Control	Remarks
Procurement Operations	Plan for monthly inventory based on cluster-wise diesel consumption levels and current inventory ↓ Raise purchase request with procurement team, followed by procurement and stocking.	The ownership of procurement and stocking lies either with the MNO or with the MSP, depending on the agreed scope in the Managed Services Contract. In some cases, even in the outsourced operations model, the MNO owns the procurement and inventory of diesel. The MNO has to implement necessary systems to monitor and control inventory in order to reduce the risk of un-foreseen shortages.	Regular monitoring of fuel stock at site and consumption levels is essential for inventory planning and purchase initiation. Procurement process depends on the type of inventory management – whether centralized or decentralized. For decentralized management, different purchase requests need to be raised for each cluster of operation.
Supply Operations	Plan for scheduled supply of fuel to each site based on site-wise consumption pattern. ↓ Efficient diesel supply logistics plan in order to optimize delivery costs. ↓ Efficient supply and refuelling of diesel at sites as per schedule	For outsourced supply operations, it is necessary for the MNO to implement right kind of systems for monitoring and control of fuel supply and logistics. Implement fuel monitoring systems to enable accurate reporting of fuel consumption pattern at sites to feed into supply planning and scheduling Plan cluster-wise supply logistics to reduce logistics costs through effective route mapping of sites within clusters	Tight control over inventory, supply logistics and fuel refuelling at sites is essential to control fuel supply costs. Implement systems to track end-to-end fuel supply chain for efficient supply operations and control system leakages through robust supply chain processes.
Fuel Inventory and Supply Management	On-site Inventory ↓ Procurement and Supply	MNO to deploy essential systems to track fuel stock at sites as well as central inventory. Implement systems driven processes to enable efficient procurement, stocking and supply of fuel to sites. For outsourced operations, MNO has to ensure tight control over on-site stock and supply.	Fuel inventory management should be driven by active site level monitoring of consumption in order to efficiently manage working capital for fuel procurement operations.

The fuel operations processes need to be supported by essential systems in order to achieve operational effectiveness. The key systems to be implemented are listed below.

- On-site fuel monitoring system to monitor fuel stock, fuel supply quality and consumption
- Systems to monitor and manage fuel inventory
- Systems to track fuel supply operations starting from collection at inventory, logistics to on-site fuelling and recording to ensure tight control over fuel supply operations

5.4. Process Flow: Alarms Management and Site Maintenance

Alarms management is very critical for corrective and break-down maintenance of site equipment including both active and passive equipment and controlling site security vulnerabilities. The alarms driven site maintenance operations can be broadly divided into alarms monitoring and issue of tickets, resource mobilization, and correction and feedback.

Figure 4: Process Flow: Alarms Management and Site Maintenance

Process	Process Flow	Process Ownership and Control	Remarks
Alarms Monitoring	Track alarms status and faults ↓ Analyse and categorize based on - Type of alarm - Criticality of alarm ↓ Automatic issue of tickets with complete information and time lines	The MNO needs to automate the alarm monitoring based on the type and category of alarms Integrate and automate ticketing system for mobilizing resources in order to achieve timely resolution of issues and equipment failures.	The MNO needs to initiate, track progress at each step and validate issue resolution as per SLA.
Resource Mobilization	Analyse and remote identification of the problem ↓ Prepare and initiate response ↓ Mobilize operational resources	The operational resources need to respond to the ticket by initial remote analysis and problem identification to prepare for response and resource mobilization. The MNO needs to monitor and track progress for timely problem identification and resource mobilization.	Accurate analysis and problem identification is essential for right response initiation and resource mobilization.
Correction and Feedback	On-site analysis and problem identification ↓ Issue resolution and correction No ↩ Prepare and initiate response ↓ Close the issue ticket and provide feedback	The technical resource needs to follow the issue resolution through systematic on-site problem identification and issue resolution. If required, the on-site resource needs to seek support from the backend resources for any additional information or resources. Post-resolution reporting and feedback has to be recorded.	A systematic approach is essential for timely resolution of the issue. Post-resolution reporting and feedback needs to be recorded for future reference and knowledge.

The key supporting systems for alarms management and correction are listed below.

- Alarms monitoring system integrated with NOC
- Response systems monitor and manage issue of tickets, mobilization of resources and tracking response and resolution
- Reporting systems to analyse and keep track of performance and SLAs

6. Operations and Monitoring: Green Power

Operations and monitoring of deployed green power solutions is the most crucial part for guaranteed savings and expected performance. As described in the previous sections, the MNO has to put in place robust operational practices and a monitoring framework in order to address the challenges and mitigate the risks of theft, vandalism, and ensure site security.

Site security is a major issue as there have been several cases of damage to tower assets across the region. This risk has hindered MNOs/TowerCos in Nigeria and Ghana from investing in green power alternatives for powering the network. Thefts of equipment and fuel pilferage have affected the OPEX of telecom sites.

Also, in many cases (especially in Nigeria) the MNO initiatives towards reducing the diesel consumption have been conflicting with interests of field level operations partners and Kabals (diesel mafias), and hence hampered the successful implementation of these OPEX saving alternatives.

For successful green power deployments and to overcome the operational hurdles, the MNO needs to consider various aspects as described below and integrate them into the overall operational framework.

The key aspects of operations and monitoring are outlined below.

- Operations and Maintenance
  - To identify and partner with a credible operations and maintenance partner for reliable operations of the deployed system.
  - An adequate training and knowledge transfer programme has to be coordinated with the equipment vendor partner to ensure capacity building for in-house and outsourced operations teams.
  - Carefully implement the necessary operations and monitoring systems during the implementation phase.
  - Build robust operational processes to address some of the challenges of site security, equipment vandalism and fuel pilferage.
  - Implement Access control and Security systems: Implement multi-level site access protocol and set strict guidelines and processes for site access in order to ensure site security and identify breach of site access protocol
  - Set clear performance benchmarks and penalty clauses. An SLA for individual components (PV, Battery, DG, Controller, rectifier etc.) should be agreed upon. If any of these components are down or malfunctioning, the O&M partner or supplier should be responsible for that and penalised
- Monitoring and Control
  - The MNO needs to set strict monitoring and control practices to regularly monitor the performance of the site and to assist in preventive and corrective maintenance of the site operations
  - Implement site performance monitoring framework and system and integrate the monitoring system with the central monitoring systems such as NOC
  - Monitor equipment level performance information to identify and address any discrepancies and mitigate operational risks
  - Plan a regular maintenance schedule based on performance and operating conditions of the equipment
  - Implement a central monitoring and control system for site access providing multilevel access based on operational requirements
  - Monitor fuel refilling supported by strict processes and guidelines to avoid leakages in the fuel supply chain and logistics operations

7. Conclusion

The MNO faces various operational challenges in running the network in order to achieve high network reliability and cost efficiency. There is a strong need for the MNO to put in place various enabling systems and processes, as well as implement stringent monitoring framework and operational practices, in order to control and manage the entire operations and supply chain. An integrated approach to operations is essential for achieving the operational goals of high network availability and OPEX efficiency thus enabling performance, operational efficiency, service reliability and competitive cost advantage for the operator.