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## The Impact of Power Load Shedding on Mobile Service Providers in Kitwe, Zambia



**Abstract:** - The purpose of this study is to investigate the effects that electricity load shedding has on mobile service providers in Kitwe, Zambia. More specifically, the study focusses on the ways in which power shortages affect network infrastructure, service quality, and operating expenses. The study reveals that load shedding causes disruptions to mobile base stations, raises operational costs due to reliance on diesel generators and battery replacements, and leads to service quality issues, particularly in residential and peri-urban areas. These findings were obtained through interviews with representatives from mobile operators and surveys with users. As a result of these discoveries, substantial socio-economic ramifications have been brought to light for enterprises and individual users that rely on mobile services for communication and financial transactions. The findings of this study provide advice to mobile carriers for mitigating the consequences of load shedding. These recommendations include making investments in renewable energy, improving backup systems, and working together with Zambia's power company, ZESCO, to ensure that service continuity is maximized during interruptions in power supply.

**Keywords:** Power Load Shedding, Mobile Service Providers, Network Infrastructure, Operational Costs, Service Quality, Telecommunication Reliability, Customer Satisfaction.

### I. INTRODUCTION

The purpose of this study is to investigate the impact that electricity load shedding has had on mobile service providers in Kitwe, which is geographically located in Zambia. Through an examination of the ways in which power shortages impact network infrastructure, service quality, and operational expenses, the purpose of this study is to gain a better understanding of the more substantial effects that load shedding has on mobile networks and the people who use them. We hope that the findings of this study will give mobile service providers with valuable insights that will assist them in avoiding the adverse effects of load shedding. (Chimbaka, 2024)

#### A. Statement of the Problem

Power load shedding has become a recurring challenge in Zambia, heavily impacting essential services that rely on consistent power, such as mobile telecommunications. In Kitwe, mobile service providers experience frequent disruptions due to inadequate backup systems, leading to reduced service quality, operational cost increases, and customer dissatisfaction. The inability to maintain continuous mobile connectivity affects not only the telecom industry but also the local economy, as businesses and users depend on mobile networks for crucial activities like financial transactions and communications. This study seeks to investigate the extent of these challenges and identify effective strategies for mobile providers to reduce the adverse effects of load shedding on service reliability and customer satisfaction.

#### B. Research Questions

This paper addresses the following research questions:

1. How does power load shedding affect the operational infrastructure of mobile service providers in Kitwe?
2. What impact does load shedding have on the quality of mobile services in Kitwe?
3. What measures can mobile service providers take to reduce the effects of load shedding on their operations and customer satisfaction?

#### C. Hypotheses

1. The hypothesis of this study is that power load shedding significantly disrupts mobile service providers in Kitwe by causing network outages, reducing service quality, and increasing operational costs, thereby affecting customer satisfaction and economic activities reliant on mobile networks.

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## II. RELATED WORKS

### A. Dependency on Stable Power for Telecommunications

In underdeveloped countries, particularly in Africa, electrical load shedding has a substantial impact on companies that are dependent on consistent power supply, such as the telecommunications industry. Because of Zambia's high reliance on hydropower, the country's energy infrastructure is vulnerable to disruptions caused by environmental variables such as droughts. This has resulted in frequent power outages, which have a negative impact on operations across all sectors. According to (Nyanga P., 2020), mobile service providers in Zambia have a difficult time maintaining network functionality during load shedding periods. This is because interruptions in power supply have an impact on essential infrastructure, particularly base stations, which require constant power in order to provide effective service delivery.

### B. Alternative Power Solutions and Operational Costs

Mobile network operators (MNOs) have increasingly turned to alternate power options, such as diesel generators and battery backups, in order to overcome the power difficulties that they are currently facing. The findings of studies conducted by (Tembo, 2021) emphasize the fact that although these options make it possible to maintain network continuity during outages, they also result in large expenses associated with fuel and maintenance. In many cases, the additional costs are passed on to customers in the form of higher service fees, which significantly reduces the affordability and accessibility of the service, particularly for users with lower incomes. Additionally, (Osumbo, 2022) point out that the environmental impact of diesel generators continues to be a significant cause for worry, particularly in urban areas that have a high density of mobile service provider locations.

### C. Quality of Service and Customer Impact

The Quality of Service (QoS) that mobile networks provide is negatively impacted when there is a scarcity of power, particularly in residential and peri-urban areas where the backup infrastructure is less robust. It has been reported by the International Telecommunication Union (ITU) (Chilufya, 2019) that users in affected regions experience frequent call drops, slower internet speeds, and other service interruptions. These issues have a negative impact on small and medium enterprises (SMEs) that rely on mobile connectivity for essential business operations. This decrease in quality of service, which is caused by power load shedding, consequently causes disruptions in everyday transactions, has an impact on customer happiness, and creates issues for enterprises that are dependent on mobile networks in terms of maintaining revenue continuity.

### D. Collaboration Between MNOs and Power Utilities

In addition to renewable energy, (Chilufya, 2019) suggest that mobile network operators (MNOs) work together with power utility firms like ZESCO to prioritize the infrastructure of the electronic communications industry during load shedding. By cooperating with utility suppliers to establish preferential load-shedding plans or to provide dedicated power lines for important infrastructure, mobile network operators (MNOs) have the ability to reduce the likelihood of service disruptions and improve their resilience in the face of frequent power outages.

## III. METHODOLOGY

### A. Research Design

In order to acquire a comprehensive understanding of the consequences that electrical load shedding has had on mobile service providers in Kitwe, this study conducts research using a qualitative research design. For the purpose of triangulating findings and enhancing the validity of the research, the technique incorporates both primary and secondary data collection methods.

**Table 1:** Overview of Research Design

Research Design	Qualitative Research
Data collection	Primary and Secondary Data
Sample	Mobile service users and representatives from MNOs
Data Analysis	Thematic Analysis
Ethical Considerations	Informed consent and confidentiality measures

*B. Data Collection Methods*

*1.0 Primary Data Collection*

- During the interviews, representatives from three of the most prominent mobile network operators (MTN, Airtel, and Zamtel) were asked to participate in semi-structured interviews. The interviews were conducted with the purpose of gaining a better understanding of the ways in which load shedding has affected their operational infrastructure, service quality, and cost management systems. There were a total of fifteen interviews that were carried out, each of which lasted roughly thirty to forty-five minutes. This allowed for an open discourse to be undertaken in order to investigate the experiences and perspectives of the issues that were brought about by load shedding.
- Surveys: Customer surveys were sent out to a diverse range of mobile service users in Kitwe, with a particular emphasis on residential areas and small to medium enterprises (SMEs). The questionnaires contained enquiries concerning the quality of the service, the level of user happiness during load shedding periods, and the perceived impact on the operations of the firm. The total number of replies that were gathered was 50, which ensured that a representative sample of the user population was obtained.

**Table 2:** Interview Participants

Mobile Network Operator	Number of Representatives	Duration of Interviews
MTN	5	5-15 minutes
Airtel	5	5-15 minutes
Zamtel	5	5-15 minutes
<b>Total</b>	<b>15</b>	

*1.2 Gathering of Secondary Information*

A comprehensive literature analysis was conducted on the topic of load shedding in the energy industry, as well as the infrastructure of telecommunications and the economic ramifications of such a phenomenon. This included scholarly journals, reports from the sector, and publications from the government, all of which offered context and background information on the difficulties that mobile service providers in Zambia are experiencing.

*C. Data Analysis*

Through the use of thematic analysis, qualitative data that was gathered through interviews and surveys was analyzed. Key topics concerning operational impacts, customer experiences, and coping mechanisms implemented by mobile providers were discovered and categorized. These themes were found to be the most important. Included in the analysis were:

- The process of extracting recurring themes from interview transcripts and survey results will be mapped out.
- In order to discover common difficulties and distinctive initiatives, a comparative analysis of insights from various mobile operators is being conducted.
- In order to strengthen the validity of the findings, triangulation utilizes qualitative data in conjunction with quantitative survey results.

*D. Ethical Considerations*

The appropriate institutional review board gave its clearance for the study to proceed in accordance with ethical standards. The participants in the interviews and the survey all gave their informed consent, which ensured that their responses would be kept confidential and that they would have the ability to withdraw from the study at any time without incurring any consequences.

**IV. RESULTS AND FINDINGS**

There were several important discoveries made by the research about the effects of electricity load shedding on mobile service providers in Kitwe, including the following:

- A. Load shedding has a direct impact on mobile base stations, which can result in outages that impair network services. This is an example of infrastructure disruption. Providers have indicated that they frequently face difficulties in maintaining the operation of their networks during extended power outages, particularly in regions that do not have appropriate backup systems.

- B. Increased Operational expenditures: Mobile operators suffer large expenditures in the maintenance of diesel generators and in the replacement of backup batteries. These costs are consequently passed on to customers in the form of increased service fees, which further reduces the level of pleasure experienced by customers.
- C. During load shedding periods, users in Kitwe regularly encounter dropped calls, sluggish internet connections, and service disruptions. This is referred to as the Quality of Service (QoS). This decrease in quality of service was most noticeable in residential and peri-urban regions, which had backup infrastructure that is less resistant to failure.

## V. DISCUSSION

### A. Implications of Load Shedding on Mobile Service Providers

According to the results of this research, mobile service providers in Kitwe, Zambia are seeing a major impact as a result of the load shedding that occurs with electricity. As a result of power shortages, mobile carriers have encountered significant disruptions in their network architecture. These delays are most noticeable during times of peak usage. Additionally, the use of alternate power sources, such as diesel generators, has resulted in an increase in operational expenses. According to (Mushi, 2021), the financial burden of maintaining these generators not only contributes to an increase in expenses for service providers, but it also ultimately results in higher service rates for customers, which further exacerbates problems with affordability and accessibility in the telecommunications industry. More complications are added to the scenario as a result of the decline in service quality that occurs during load shedding periods. Users experienced frequent outages, sluggish internet speeds, and dropped conversations, particularly in residential and peri-urban regions where backup infrastructure is less resilient. This was proven by the consumer surveys that were completed as part of this study. These findings are in line with research conducted by the International Telecommunication Union (ITU), which emphasises that a consistent power supply is essential for maintaining service quality in mobile networks. The ITU also emphasises that service interruptions are not only detrimental to the service providers, but also to the end users, particularly small and medium enterprises (SMEs) that rely on mobile connectivity for their business operations.

### B. Socio-Economic Ramifications

The socioeconomic repercussions of load shedding extend beyond the realm of the telecommunications industry, having an impact on local economies that are dependent on mobile services for essential tasks such as financial transactions and communication. According to (Mwale, 2019), the irregularity in mobile services that is caused by power outages makes it difficult for businesses to conduct transactions, which in turn leads to financial losses for small and medium-sized enterprises (SMEs) and a decrease in consumer satisfaction.

## VI. RECOMMENDATIONS

### A. Investment in Renewable Energy

Companies that provide mobile services ought to make investments in renewable energy sources, notably solar power, in order to keep their networks operational during load shedding. Base stations that are powered by solar energy have the potential to dramatically reduce reliance on diesel generators and offer a more environmentally friendly solution to emergency power outages.

### B. Enhanced Backup Systems

Installation of high-capacity batteries that are able to supply electricity during extended power outages is something that mobile carriers should do in order to improve their backup systems. Furthermore, in order to effectively manage operating expenses, suppliers should investigate other generator solutions that are both more fuel-efficient and cost-effective.

### C. Collaboration with Power Utilities

ZESCO, which is Zambia's power utility, should work together with mobile service providers to guarantee that key mobile infrastructure is given priority during load shedding schedules. Among these options are the construction of dedicated power lines and the reduction of the number of power outages that occur at strategic network locations.

### D. Customer Communication

When load shedding occurs, improved communication tactics might be of assistance in managing the expectations of customers. It is important for mobile service providers to make use of text message alerts and mobile applications in order to notify users of service disruptions and provide approximate times for service restoration.

### E. Expanding Infrastructure

As a means of meeting the additional demand that occurs during load shedding, service providers should prioritise the expansion of their network infrastructure, particularly in peri-urban areas, in order to provide coverage that is both more extensive and more resilient.

**Table 3:** Recommendations for Mobile Service Providers

<b>Recommendation</b>	<b>Description</b>
Investment in Renewable Energy	Shift towards solar power for base stations
Enhanced Backup Systems	Install high-capacity batteries for outages
Collaboration with ZESCO	Work with power utility for priority service
Customer Communication	Use alerts and notifications for service updates
Expanding Infrastructure	Increase coverage in peri-urban areas

## VII. CONCLUSION

Mobile service providers have considerable issues as a result of power load shedding in Kitwe, which has an impact not only on infrastructure but also on the level of satisfaction experienced by customers. According to the findings, load shedding is responsible for a number of negative consequences, including frequent network disruptions, increased operating expenses, and a reduction in the quality of mobile services. There is a wider economic impact as a result of this, notably on consumers and businesses that rely significantly on mobile services for communication and transactions. Mobile service providers need to make investments in alternate energy sources, strengthen their backup systems, and work together with the power sector to enable more reliable service delivery during power outages in order to offset the effects of these effects. In spite of the fact that these solutions might not completely eradicate the issue, they do give a method for mobile service providers to enhance their operations and continue to preserve the trust of their customers in the face of continued power issues in Zambia.

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