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The impact of load shedding on a company in the Mining Industry

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Abstract. *South Africa, a major energy producer, relies on Eskom, its state-owned power supplier, for all electricity, which is crucial for various sectors, especially mining. The mining sector consumes about 30% of Eskom's supply, impacting employment and the country's gross domestic product significantly. However, increased electricity demand and Eskom's struggles to meet the demands have led to load shedding since 2015, impacting mining operations negatively. Therefore, this study aimed to explore the impact of load shedding on a mining company's operations in the Brits area. A qualitative approach was adopted to ascertain the study participants' opinions of the impact of load shedding on a mining company's operations. The purposive sampling technique was used to select participants who had adequate knowledge and experience of how load shedding impacts mining operations. Data was collected from 10 participants through face-to-face semi-interviews. Thematic analysis was employed to identify, organise and report the themes that emerged from the data set. The findings revealed that load shedding impacted the mining company's overall operations negatively, ranging from loss of production to high operational costs, work stoppages, system disruptions, revenue losses and poor network connectivity. The study provides an adequate understanding of how load shedding impacts the operations of mining companies. The study has practical and managerial implications for mining companies in South Africa because it provides measures to address the impact of load-shedding on mining operations. The study recommends that mining companies should invest in alternative energy power sources such as solar power, generators, and catch-up plans.*

Keywords: Load Shedding, Mining Operations, Production Loss, Revenue Loss, Work Stoppage.

JEL Codes: L71, L72

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1. Introduction

South Africa is among the largest energy producers on the African continent and has been self-sufficient in power generation and supply (Maringa, 2017). Hence, it exports electricity to various nations within the Southern African Development Community (SADC) region such as Lesotho, Zimbabwe, Namibia, Mozambique, Botswana and eSwatini (Power, Newell, Baker, Bulkeley, Kirshner & Smith, 2016). The sole enterprise that supplies electricity in South Africa is Eskom. Eskom is an integrated and state-owned organisation that produces almost 95% of the energy utilised in South Africa and other neighbouring countries (Roopnarain & Adeleke, 2017).

In South Africa, electricity is utilised in almost all business and private sectors, including banking, retail, and mining. The country's mining sector is one of the segments that consumes most of the electricity that Eskom supplies, consuming approximately 30% (Chitaka et al., 2018). The mining sector depends mostly on electricity supplied through the state-owned power supplier for efficient operations and productivity (Yaghoobi, Abdullah, Kumar, Zare & Soltani, 2019). The stable and consistent electricity supply through the power grid to the mining sector is crucial to enable effective production and a consistent supply of refined products to customers (Yaghoobi et al., 2019). A large proportion of South Africa's working populace depends on the mining sector as their means of employment. Additionally, the mining sector accounts for about 7.53% of the state's Gross Domestic Product (GDP). However, the main challenge facing the mining industry is the inconsistent supply of electricity from Eskom (Gibson, Nwaila, Manzi, Ghorbani, Ndlovu & Petersen, 2023). There has been an increase in demand for electricity supplied through the power grid in the mining industry because of new ventures and the expansion of existing mining activities (Votteler & Brent, 2016). Eskom has been struggling to provide the required electricity through the power grid to customers owing to the increased demand for electricity (Bowman, 2020).

With the imbalance between energy generated through the South African Electricity Supply Commission (Eskom) and the increased power demand, Eskom had to implement load shedding to avoid the grid's collapse. The implementation of load shedding has adverse implications for various institutions and businesses, including the mining industry. The adverse effects of load shedding on different sectors have resulted in reduced productivity, loss of revenue, unemployment, and the possible closure of businesses (Goldberg, 2015).

Background

Since 2015, most South Africans have raised various concerns about the country's electricity supply owing to load shedding, a term referred to as the rotation of electricity amongst the users of the primary South African power supplier (Mabuza & Maphosa, 2023). According to Naidoo (2023), international trends suggest that load shedding is a global phenomenon, and South Africa is not excluded. Naidoo (2023) points out that load shedding has impacted the South African economy

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negatively, resulting in industry shutdowns, a steep decline in productivity, unemployment, poor healthcare and an education crisis, to mention a few. It has been found that ongoing load shedding has impacted the operations of mining companies severely, as they have to switch off sections of their operations to comply with Eskom load-shedding directives (Gibson et al., 2023). According to Statistics South Africa (2023), the mining sector experienced a decline in output by 2.6% in March 2023 and a consistent decrease in infrastructure stability – across the electrical grid and other factors, including Transnet – which has seen the sector lose R150 billion in export value over the past year. Hence, the study focused on a South African mining company, located in the Brits area. The mining organisation specialises in the extraction of minerals such as chrome and platinum group metals (PGM's) from UG2 ore and tailings. The mine is located in the western part of the Bushveld igneous complex (BIC). The mining company is in the Northwest Province in the Zandfontein area, which is 7km south of Brits town (Eastplats, 2023).

The mine was originally established in 1987, then closed in 2013 owing to unfavourable economic factors such as declining mineral prices, and subsequently resumed operations in 2018 when economic conditions improved (Eastplats, 2023). Currently, the mine processes ore from the tailing storage facilities to raise funds for underground mining operations, which are costly to run. The mine employs two hundred contractors in addition to a permanent workforce of three hundred members. The expansion of production, which includes mining operations, will double the current employment rate. As a result, the mining company will be able to contribute to higher employment rates and contribute to increasing the country's total GDP.

Statement of the Problem

Eskom's implementation of load shedding has had widespread repercussions on mining operations in South Africa, leading to a negative economic outlook as mines currently operate below their planned full capacity (Li, He, Dou, Song & Wang, 2018). This situation has prompted mines to adapt their plans to accommodate load shedding, resulting in reduced production rates and an escalating unemployment rate, particularly concerning labour (Kenny, Cronje, Jeffery, Moloi, Dimant, Kane-Berman, Matsokotere & Zwane, 2015). Despite the global scope of the impact of load shedding on various industries, existing research conducted in South Africa has concentrated on the economic consequences of load shedding within the hospitality sector and municipalities (Goldberg, 2015). While Maringa (2017) conducted a study on the economic impact of load shedding resulting from recurrent Eskom plant failures. There is a noticeable gap in information regarding the specific effects of load shedding on the operations of organisations in the mining industry. Eskom's ongoing appeals for organisations to curtail their power demand and consumption necessitates that the mining company under study should continually reassess its business strategy to ensure sustainability amidst the constraints imposed by Eskom's load-shedding policy. Even though load shedding has been prevalent in South Africa for some time now, limited research has been conducted to establish its impact on companies in the mining industry. Therefore, it is imperative to investigate the impact of load shedding on a mining company's operations, which is the focus of this study.

1.3 Research questions

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The primary research question was:

- What is the impact of load shedding on the operations of a mining company?

2. Theoretical Foundations

2.1 An overview and contribution of the South African mining sector

Mining sectors across the globe have underpinned industrial and technological advancement, providing a foundation of raw materials, which are indispensable within economies of the modern industrialized era such as electronic chips, roads, railways, airports, and other essential contemporary infrastructure (Azevedo, 2022). In the mining industry, raw materials such as minerals and fossil fuels are processed to produce metals and energy as finished products (Igogo et al., 2021). The mining and mineral resources segment within South Africa is the primary driving force behind economic development across the entire African continent, as the country has a rich concentration of natural resources and exceptional mineral wealth of various kinds. As a result of the development of its mining industry, South Africa remains the most advanced and richest economic sector in the region, which is in line with the African Mining Vision (African Union, 2009). Most (40%) of the world's known gold reserves have been supplied mainly from the country's Witwatersrand Basin, while other mining commodities include 80% and 72% of the manganese and chromium, respectively, across the world (Swart, 2023).

Historically, mining in South Africa was once the main driving force behind the country's formation and development of its economy, with the infamous gold rushes of the late 1800s being the precursor (Casey, 2022). However, the involvement of mining in South Africa's economy has dwindled from 21% to 7% over the past ten years, with the industry predominantly in a loss position during the last two years owing to low commodity prices, regulatory uncertainty, load shedding, the collapse of the rail transport and port systems, and significantly higher input costs (Choshi, 2020).

2.2 South Africa's energy industry

Eskom is a dominant player in South Africa's energy business. Eskom is a government-owned company that generates 95% of the nation's electrical needs (Ang, Choong & Ng, 2015). The Eskom monopoly operates the national energy transmission grid and 70% of the energy distribution network, with the remainder owned by municipalities (Ayamolowo et al., 2022). The electricity sector is typically subject to political intervention and the government controls all energy cost adjustments to balance energy security with economic stability (Baker & Phillips, 2019). Since 2015, there has been a huge electricity energy crisis in South Africa, with rolling blackouts occurring for up to twelve hours or more daily (Ang et al., 2015). Since 2007, the national power utility of the country, Eskom, has struggled to supply enough electricity to meet the nation's demand; this issue reached its worst point in 2023, when the electricity generation capacity and infrastructure were not able to meet industrial, commercial, or household needs, resulting in monumental detrimental effects on the South African economy with significant impacts on factors such as manufacturing, industry, unemployment, food security, crime and political stability, amongst others (BizNews, 2023). Since the

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start of 2023, South Africa experienced over 4000 hours of scheduled electricity outages across the country by a practice known as load shedding (Akinbami et al., 2021). Load shedding is defined as an intentional temporary reduction in the amount of available electricity to limit the utilisation of available energy sources, thereby lessening the load on an electrical grid owing to an excessive demand for electricity outstripping generation capacity (Goldberg, 2015). Since the electricity supply is currently at a significant deficit, with Eskom having been unable to satisfy national demand adequately, load shedding is used as the final option for pressure reduction of the electricity grid to avoid its collapse and subsequent prolonged nationwide blackouts (Inglesi-Lotz, 2022).

2.3 Impact of load shedding on mining operations

In South Africa, underinvestment in energy supply capacity and a lack of infrastructure expansion in the energy sector culminated in restricted electricity supply to the country through load shedding. This inevitably led to a loss of competitive advantage for South Africa as a low-cost energy destination for mining projects (Nowakowska & Tubis, 2015), representing a major risk for the sustainability and profitability of the sector going forward. When load-shedding occurs, mining operations are typically shut down, and miners are evacuated. Operational equipment and machinery then require several hours to restart after the break in power supply, resulting in halted production being prolonged for several hours following the load-shedding period (Kenny et al., 2015). The inability to meet production targets owing to power outages can lead to missed deadlines and contract penalties, causing financial losses for mining companies (Smith & Jones, 2021). The uncertainty and instability created by load shedding can deter foreign investment in the mining sector, hindering its long-term growth potential (Brown et al., 2020). While other companies have relied on backup power generators during load-shedding periods, this can increase operational costs as these generators consume fuel and require regular maintenance (Doe & Roe, 2019). Therefore, load shedding presents a severe risk to the long-term viability and financial success of the mining industry, necessitating the requirement for effective solutions and alternative sources of energy (Nasir, Ali & Khan, 2022).

4. Methodology

An exploratory study was conducted to provide an in-depth understanding of how load shedding impacts mining operations. Couper (2017) states that exploratory studies are applicable to discover general details about a subject or phenomenon that has not been comprehended. This approach entails conducting interviews with diverse participants who have knowledge of or experience with the specific domain of inquiry to gather qualitative data and information about their perspectives and insights on the topic (Couper, 2017). Although there are three methods of research, this study used the qualitative research approach. The qualitative research approach is an approach which is commonly used among social sciences and other fields to gather and analyse data that focuses on understanding the subjective experiences, perspectives, and meanings that individuals attach to a given phenomenon or event (Gehman, Glaser, Eisenhardt, Gioia, Langley & Corley, 2018). The qualitative approach enabled the gathering and examination of non-numerical facts, which aided

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the understanding of experiences, opinions, and conceptualisations of the problem (Mehrad & Zangeneh, 2019).

The underlying philosophical assumption that is mostly aligned with the qualitative research methodology followed in the current study concerning the impact of load shedding on a mining company, is interpretivism. Interpretivist researchers employ methods such as interviews and participant observation to gain deeper insights into the participants' experiences and perspectives (Alharahsheh & Pius, 2020). This philosophical stance is appropriate because it allowed for the development of a deeper understanding of the complex and context-dependent human experiences and organizational dynamics that were influenced by load shedding. This study was conducted at a mining company in the Brits area, covering both surface and underground operations, administrative offices, processing plants, and maintenance workshops. The target population for the study included employees, contractors, and key stakeholders involved in the mining company's operations in the Brits area. The target population was approximately 500. The purposive sampling technique was used to select 10 participants for the study. Purposive sampling enabled the researchers to elicit important information from the participants who were directly affected by load shedding (Singh & Masuku, 2014). A semi-structured interview was conducted with the participants to gather in-depth information about the impact of load shedding on mining operations. Data analysis was conducted by employing the six thematic steps proposed by Braun and Clarke (2006): 1) data familiarisation; 2) generating initial codes; 3) searching for themes; 4) reviewing themes; 5) definition of themes; and 6) writing the report. The themes identified from the interviews are graphically represented, using a mind map.

4. Findings of the study

This section presents the study's findings.

4.1 Demographic information

The findings of the biographic data are shown in Table 4.1 below.

Table 4.1: Biographic data

Research participants	REP 1	REP 2	REP 3	REP 4	REP 5	REP 6	REP 7	REP 8	REP 9	REP 10	Total
Gender	Male	Female	Female	Male	Male	Male	Male	Male	Male	Male	F=2 M=8
Age	63	29	40	48	48	44	37	38	36	55	Average =44
Highest education	Grade 12	Degree	Diploma	Diploma	Degree	Masters	Grade 12	Diploma	Masters	Masters	Grade 12 =1 Diploma=3 Degree=1 Masters=3
Designation	Mine overseer	Production foreman	Production foreman	Engineering manager	Mining manager	Metallurgical manager	Mechanical foreman	Plant engineer	Process specialist	Human resource manager	Production foreman = 2 Mechanical foreman= 1 Process Specialist=1 Plant engineer =1 Mining overseer =1 Managers =4
Years of employment	8	2	2	4	1	3	15	0.25	2	2	Average years of employment= 3.9 years
Organisational level/positions	Middle management	Junior management	Junior management	Senior management	Senior management	Senior management	Junior management	Middle management	Middle management	Senior management	Junior management =3 Middle management =3 Senior management =4
Experience with load shedding	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes =10

Source: Author's fieldwork

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REP1 is a 63-year-old male who has worked at the mining company for eight years. He holds a grade 12 certificate and has experience in the mining industry, having worked for various companies. **REP 1** has experienced load shedding provided detailed responses to the questions and demonstrated a strong commitment to his work.

REP2 is a 29-year-old female who has been employed at the mining company for two years. She holds a degree and has been dealing with load shedding since 2022. **REP2** was calm and precise in her responses to the research questions.

REP3 is a 40-year-old female who has worked at the mining company for two years. She holds a diploma and has dealt directly with load-shedding issues since 2022. **REP3** was vocal and expressed concern about the impact of load shedding.

REP4 is a 48-year-old male who has been employed at the mining company for four years. He holds a higher diploma and joins the company at a middle management level, currently serving in a senior management role. He has been dealing with load shedding since he started with the company.

REP5 is a 48-year-old male who has been with the mining company for one year, serving in a senior management role. He remained calm during the interview and noted that his experience with load shedding has been minimal, as he only joined the company last year. Nevertheless, he displayed confidence in answering the research questions.

REP6 is a 44-year-old male who has been employed at the mining company for three years. He holds master's degrees in two disciplines and occupies a senior management position within the company. He noted that his department is impacted directly by load shedding. **REP6** demonstrated a thorough understanding of and experience with load shedding, and he displayed a prominent level of confidence during the interview.

REP7 is a 37-year-old male who has worked at the mining company for 15 years. He holds a grade 12 certificate as his highest qualification. Initially hired at a non-management level, he has since been promoted to a junior management position. REP 7 demonstrated a solid understanding and knowledge of load shedding.

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REP8 is a 38-year-old male who joined the company in January 2024. He holds a diploma, and his department is affected directly by load shedding. He remained calm and answered the interview questions with confidence.

REP9 is a 36-year-old male who has been with the company for two years. He holds a master's degree and is currently furthering his studies. Employed at a middle management level, he provided detailed answers to the research questions and was quite vocal about the impact of load shedding on the company.

REP10 is a 55-year-old male with two years of experience at the company. He holds a master's degree and serves in a senior management role. He was thorough in answering the interview questions.

4.2 Impact of load-shedding on overall operations of the mining company

The study examined the impact of load shedding on the overall operations of the mining company in the Brits area. From the interviews conducted with the participants, it was found that load shedding impacted the mining company's overall operations negatively, ranging from loss of production to high operational costs, work stoppages, system disruptions, revenue losses and poor network connectivity. These findings are illustrated in Figure 4.1 below.

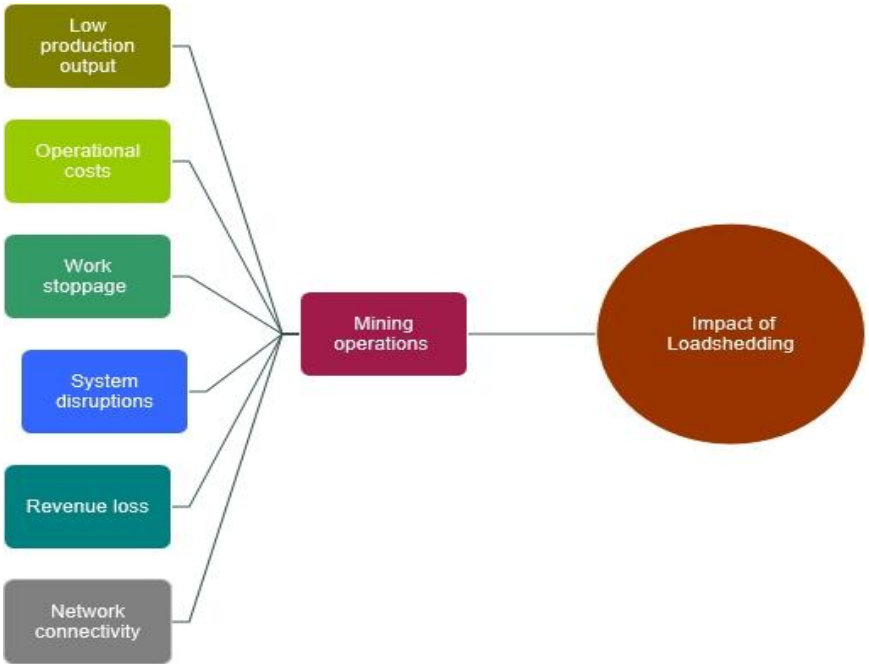

Figure 4.1: Impact of load shedding on overall mining operations
Source**:** Author's fieldwork (2024)

4.2.1 Sub-theme 1: Loss of production output

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All the participants agreed that load shedding experienced by South Africans over the last few years led to losses in production outputs, especially in the mines. Given the above, **REP2** said:

> *"It has negatively affected the operations of the mine due to reduced/low production output"*.

Similarly, **REP5** stated:

> *"All mining equipment depends on electricity, so if there is no power, it means there is no production and no income. So, this will result in production and income loss"* (Participant 5).

From the above quotes, it is evident that load shedding in the mining company led to a loss of production outputs because of disruption in the electricity supply and damage to mining equipment.

4.2.2 Sub-theme 2: Operational costs

In addition, the findings indicated that load shedding impacted the mining company's overall operations negatively owing to increased operational costs. Some participants said that the operational costs in the mining sector have increased over the years because of unplanned load shedding. **REP4** remarked:

> *"It has negatively affected the production output and power /energy costs, as the mine sometimes has to shut down some of the sections due to the imposed load shedding*".

REP6 said:

> *"Load shedding negatively impacted operations in the mine because of the increase in operational costs. Load shedding is costing the company a lot of money because of the alternative source of energy*.

The interviews showed that the participants perceived that the mining company's operational costs increased because of damage to its equipment and electrical surges caused by load shedding.

4.2.3 Sub-theme 3: Work stoppage

Furthermore, the study's findings revealed that load shedding had negative implications on the mining company's overall operations because of work stoppages. Most of the participants agreed that the load shedding had impacted operations negatively owing to the unavailability of power, resulting in work stoppages in some sections. For instance, **REP1** mentioned:

> *"Load shedding has negatively impacted the overall operations due to the stoppage of load curtailment, resulting in the stoppage of some sections to meet the required load*".

Similarly, **REP2** submitted:

> "*Because we have to stop other sections to comply with Eskom's requirement for load shedding"*.

Whenever load shedding occurs, mining operations must stop so that the company can comply with Eskom's requirement for load shedding.

4.2.4 Sub-theme 4: System disruptions

The findings indicated that Eskom's implemented load-shedding schedule impacted the mining company's operations owing to system disruptions. Some participants shared a common view that load shedding had

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impacted the mine's operations negatively because the company's system was not accessible. **REP5** remarked:

> *"Load shedding had negatively impacted mine operations due to interruptions of the company's systems, which were not accessible*".

Likewise, **REP9** stated:

> *"It has an effect when surface fans need to be switched off. Plant mills and winders schedules need to be changed".*

With reference to the interviews, load shedding caused system disruptions in the mining company, resulting in losses in production, revenue, and profitability.

4.2.5 Sub-theme 5: Revenue loss

The findings also showed that load shedding had negative implications on mining operations because of revenue losses. The participants expressed similar opinions that operations in the mine were halted because of the resulting revenue from the load shedding. **REP3** responded by saying:

> *"It has negatively affected the operations of the mine due to reduced/low production output, which also affects revenue and can result in loss of employment"*.

REP7 also submitted:

> *"The load shedding had negative implications on the overall mining operation(s) because the company kept losing revenue. Since the start of the load shedding, we have been unable to meet our revenue targets because of the disruptions to equipment and frequent work stoppages".*

Given the interview quotes presented above, the study concludes that load shedding had negative implications on mining operations owing to revenue losses.

4.2.6 Sub-theme 6: Network connectivity

Finally, the study established that load shedding impacted mining operations negatively at the company because of the unavailability of network connectivity. **REP1** mentioned:

> *Load shedding has negatively impacted the overall operations due to the unavailability of network connectivity*.

REP4 stated:

> *"It affects internet connectivity".*

According to the participants, load shedding impacted the company's mining operations negatively owing to the unavailability of network connectivity.

5. Discussion of findings

The study examined participants' perspectives on how load shedding impacted operations at the mining company, overall. The findings showed that load shedding did indeed impact the company's

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operations negatively, overall. This finding is consistent with Adler et al.'s (2017) study, which found that although the mining of natural resources represents the backbone of the South African economy, the current load-shedding programme can have significant constraints on mining operations, limiting productivity capacity and the ability to remain sustainable or globally competitive. According to ERERO (2023), load shedding impacted the South African mining sector seriously, thereby affecting mining operations.

Further, the study's findings suggest that load shedding resulted in loss of production, high operational costs, work stoppages, system disruptions, revenue losses and poor network connectivity. Andersen and Dalgaard (2013) argue that the economic impact of power outages suggests that industries like mining, which are energy-intensive, suffer substantial financial losses owing to halted operations and decreased productivity. Disruptions in the mining sector led to various operational challenges, loss of production, high operational costs, work stoppages, system disruptions, revenue losses and poor network connectivity (Andersen & Dalgaard, 2013).

6. Limitations of the study

There is no study without limitations. The major limitation of the study was its scope which was limited to a mining company, which is located in the Brits area. Hence, it is recommended that future studies should adopt a comparative approach to collect data from more than one mining company. Furthermore, the study relied on the qualitative method to address the research questions and the objectives. One criticism against qualitative research is that the findings cannot be validated. This critique arises because qualitative research often relies on subjective interpretations and non-replicable data such as personal interviews and observations (Patton et al., 2018). Therefore, the study recommends that future studies should integrate qualitative and quantitative methods. Another limitation of the study was the unit of analysis. The study included individuals of interest such as production engineers, and sustainability managers or executives, who are directly affected by load shedding, knowledgeable about the energy requirements of mining operations, and who influence decisions relating to energy technology and projects, including renewable energy. Therefore, the findings cannot reflect the opinions of the mining company's entire workforce.

7. Recommendations

It is evident that Eskom's implementation of load shedding has had widespread repercussions on mining operations in South Africa, resulting in disruptions in mining operations, damage to equipment, industrial injuries, low economic development, and loss of revenue, to mention a few. Against this background, the study recommends that mining companies should invest in alternative energy sources. By diversifying their energy portfolio, companies can mitigate the risks associated with dependency on conventional power sources like diesel generators, which are susceptible to price volatility and supply disruptions.

The study also recommends the need to adopt energy-efficient technologies. Adopting energy-efficient technologies within mining operations is pivotal to mitigating the impacts of load shedding. By transitioning to energy-efficient devices and systems such as LED lighting, efficient HVAC systems, and advanced machinery, mining companies can lower their overall energy consumption significantly.

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8. Conclusion

The study's primary objective was to establish the impact of load shedding on a mining company. It was found that load shedding impacted the overall operations of the mining company negatively in the form of loss of production, high operational costs, work stoppages, system disruptions, revenue losses and poor network connectivity. The findings revealed that the company's mining operations were severely impacted, resulting in revenue losses, declined productivity, increased operational and maintenance costs, damage to mining equipment, limited internet connectivity underground, and work stoppages.

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