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2025

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Jagjiwan, Shamita. (2025). Impact of a black swan event on the performance of coal power station mega- projects in South Africa [Masters dissertation, University of the Witwatersrand, Johannesburg]. WIReDSpace. https://hdl.handle.net/10539/49138

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Impact of a black swan event on the performance of coal power station mega-projects in South Africa

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A study report submitted to the Faculty of Commerce, Law and Management, University of the Witwatersrand, in partial fulfilment of the requirements for the degree of Master of Business Administration

Johannesburg, 2025

CLASS:	BLOCK – 2023/2025
COURSE CODE:	BUSA7417A
COURSE:	Research Project
LECTURER:	Dr. Jacques Totowa
SUPERVISOR:	Dr. Erasmus Appiah
DUE DATE:	30 June 2025
WORD COUNT:	14593 (excluding abstract, contents, tables, figures references and appendix)

Dedication

This thesis is dedicated to my father, Sudhir Jagjiwan, and my mother, Vino Jagjiwan, whose love, wisdom, and strength have shaped the person I am today. Your sacrifices, encouragement, and quiet faith in me have been the foundation of every milestone I have reached.

To my family, thank you for being my constant source of support, laughter, and grounding. Your belief in me, even during the most challenging moments, gave me the courage to keep moving forward. I carry your spirit and strength with me in every page of this work.

Acknowledgments

I would like to express my deepest gratitude to my supervisor, Dr. Erasmus Appiah, for his guidance, feedback, and steadfast support throughout the development and completion of this thesis. My heartfelt thanks to Dr. Sylvester Horvey for the many hours of mentorship, advice, and critical insights.

A special thank you to Ms. Zandi Shange, Mr. Chris Barclay, and the management team at Kusile Power Station for your belief in my potential and your generous support throughout my pursuit of this degree.

Declaration

I Shamita Jagjiwan declare this thesis, which I hereby submit for the degree Master of Business Administration at the University of Witwatersrand, Johannesburg, is my work and has not previously been submitted by me for a degree at this or any other tertiary institution.

Signature: 

Date: June 2025

ABSTRACT

Black swan events such as COVID-19, are extremely rare and unpredictable yet have catastrophic operational impacts. This study examines how such events affect performance and explores strategies to enhance resilience in coal power station mega-projects, using Eskom's Kusile Power Station as a case study. The research assesses, analyses, and evaluates the impact of COVID-19 on schedule, financial and overall asset creation performance in mega-project construction at Kusile Power Station.

A quantitative mono-methodology approach with hypothesis testing was applied to audited and reliable secondary data from Kusile Power Station. This study investigates how COVID-19 factors (presence, lockdown levels, active cases) influenced schedule, financial, and asset performance, with control variables (claims, incidents, workforce size) and risk mitigation strategies as moderators. Descriptive and inferential statistical techniques—including group comparisons, correlation analysis, and regression modelling—were used for data analysis.

The outcomes revealed that while schedule performance showed no immediate disruption, significant delayed impacts from COVID-19 emerged compounded by workforce size and lockdown policies. Financial performance suffered an immediate and significant delayed effect driven by COVID-19 disruptions and staffing inefficiencies. Asset Creation Performance experienced an immediate negative effect from COVID-19 and incidents, but mitigation strategies yielded long-term improvements. Risk mitigations provided minimal direct benefits to schedules and financials but improved long-term asset creation performance.

Recommendations in the event of a black swan event included optimising resources through staggered shifts and modular team structures to limit the impact of resource inefficiencies on performance. Mitigating lagged shocks by revising force majeure clauses, contract frameworks, and contingency plans for future pandemics. Balancing mitigation strategies and adaptive learning in project management to sustain resilience during black swan events. This study contributes to project management literature by quantifying COVID-19's impact on mega-projects and proposing actionable strategies for crisis resilience.

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LIST OF ABBREVIATIONS

Acronym	Description
ACTCASA	Active COVID case numbers
CAPEX	Capital Expenditure
COVID-19	Coronavirus
DVs	Dependent Variable
EXCO	Executive Committee
IMF	International Monetary Fund
INCID	Operational Incidents
IVs	Independent Variable
KPIs	Key Performance Indicators
LOCKL	Lockdown level
NBPSITE	Workforce size
OMAC	Oversight Monitoring Assurance Committee
PACP	Asset creation performance
PFP	Project Financial Performance
PFMA	Public Fund Monitoring Assurance
PSCHP	Project Schedule Performance
PS	Power Station
RMSTRA	Risk mitigation strategies
SD	Standard Deviation
SPSS	Statistical Package for Social Sciences
WHO	World Health Organization

CHAPTER 1. INTRODUCTION

1.1 Title

Impact of a black swan event on the performance of coal power station mega-projects in South Africa

1.2 Statement of purpose

This study aims to understand how a black swan event impacts performance and how to improve the overall resilience of coal power station mega-projects during these events in the construction industry.

1.3 Background of the study

1.3.1 Black Swan Events and COVID-19

According to Nassim Nicholas Taleb (2007), a black swan event is an extremely rare and unpredictable occurrence that may have a significant impact. In 2020, the World Health Organization (WHO) declared COVID-19 a global pandemic, following the initial outbreak in late 2019 in Wuhan, China (Gamil & Alhagar, 2020). To mitigate the virus's spread and associated fatalities, countries worldwide implemented border closures and suspended commercial and social activities (Aigbavboa & Aghimien, 2022). In South Africa, the government enforced a five-level national lockdown starting on March 26, 2020, which required all on-site businesses to cease operations (Aigbavboa & Aghimien, 2022). COVID-19 represents a Black Swan event for the construction industry due to its unexpected nature and the profound impact it has had on this sector (Wildenauer & Basl, 2021). While many organizations transitioned to remote work using information and communications technology, the construction industry faced unique challenges (Aigbavboa & Aghimien, 2022). Due to its reliance on hands-on operations and slow adoption of innovative technologies, the construction sector struggled to adapt to the lockdown measures (Gamil & Alhagar, 2020).

1.3.2 The relationship between black swan events and performance

Black Swan events are defined by their nature as outliers that lie outside the realm of regular expectations and carry an extreme impact on the observer (Hajikazemia et al., 2016). In the project management context, these events exert profound effects on performance dimensions such as schedule, cost, and project outcomes (Hajikazemia et al., 2016). Such large-scale disasters are rarely true "unknown unknowns" but rather a combination of ignored early warning signs that eventually lead to catastrophic failure (Hajikazemia et al., 2016). For example, the Boston Big Dig project experienced cost overruns of over 100%, escalating from $2.6 billion to $14.6 billion, demonstrating the extreme financial impact of these risks (Hajikazemia et al., 2016). The systemic nature of Black Swans challenges traditional project management frameworks that assume stability and gradual change, necessitating novel solutions rather than repeatable best practices (Hajikazemia et al., 2016). Furthermore, the immediate aftermath of a black swan event often results in negatively impacted productivity as employees become concerned, uncertain, and distracted (Hajikazemia et al., 2016).

1.3.3 The shift in the construction industry

The COVID-19 pandemic has had both positive and negative impacts on the global construction industry (Ogunnusi et al., 2020). Ogunnusi et al (2020) administered a questionnaire to 71 construction industry professionals from various regions worldwide revealed common experiences with COVID-19 where respondents included 54.9% from Africa, 2.5% from Asia, and 18.3% from Europe.

Regarding positive effects, respondents noted that the pandemic facilitated improvements in virtual alternatives, enabling the continuity of meetings that were previously held face-to-face through digital platforms (Ogunnusi et al., 2020). On the negative side, the pandemic exacerbated existing project issues such as cost and schedule overruns, primarily due to daily hardships faced by labour and the ineffectiveness of remote work for site-based processes (Ogunnusi et al., 2020). Consequently, Ogunnusi et al (2020) recommended modifications to rules, particularly concerning health and safety, contingency plans, the definition of force majeure, and standard forms of agreements.

1.3.4 Eskom's energy availability and the impact on the economy

Eskom, South Africa's major supplier of electricity, has faced significant challenges with electricity shortages since 2007 (Mabunda et al., 2023). The inability of the power supply to meet the demand has resulted in loadshedding (Mabunda et al., 2023). The stages of loadshedding have increased becoming more severe, reaching stage 6 in 2019 and stage 8 in 2022 (Mabunda et al., 2023).

Electricity generation forms the backbone of the South African economy, thus when supply cannot meet demand the resultant loadshedding impacts economic growth (Hlongwane & Daw, 2023). The newly constructed Medupi and Kusile Power Stations (PS) were anticipated to alleviate South Africa's electricity supply challenges; however, construction delays have exacerbated electricity generation struggles (Hlongwane & Daw, 2023). The background of the study is detailed further in *Appendix A1: Background of the study*.

1.4 Research problem

The construction of mega-projects, such as coal power stations in South Africa, are vulnerable to black swan events (Wildenauer & Basl, 2021) resulting in poor project performance, significant construction delays, and increased costs (Shaikh et al., 2023). Current literature acknowledges the risks associated with black swan events, however, there is a significant gap on the true impact of COVID-19 within specific firms and/or sectors (Appiah et al., 2022).

This research addresses these gaps by quantitatively analysing the impact of a black swan event like COVID-19 within the construction sector on poor project performance, construction delays, and cost overruns on Eskom's mega-project, Kusile PS.

Currently, mega-projects in the construction industry are not sufficiently prepared to withstand the effects of a black swan event on construction progress and project performance. This is an issue as inadequate preparedness and mitigation strategies for these events impact the overall project performance significantly. This is important

as the potential further delays, due to the pandemic, that Kusile PS construction experienced, had economic implications on South Africa i.e., continued loadshedding.

Despite extensive global research on the effects of COVID-19 on construction projects, most studies have been qualitative or cross-sectional, focusing on perceived challenges rather than quantifiable performance outcomes. There remains a lack of empirical evidence examining the causal impact of a black swan event on the performance of mega-projects using longitudinal, audited secondary data. This study bridges that gap by employing secondary time-series data from Eskom's Kusile PS to quantitatively evaluate the effects of COVID-19 on schedule, financial, and asset creation performance. This unique approach contributes to project management literature by operationalising black swan theory through measurable project performance indicators. This study offers insights and lessons to enhance improve awareness, preparedness, and project management practices to ultimately ensure better project outcomes during a black swan event.

1.5 Research objectives

The research objectives of this study are to assess, analyse, and evaluate the impact of COVID-19 (represented by variables COVID-19 presence, COVID-19 active cases in South Africa and COVID-19 lockdown levels) on:

1. Schedule performance of the Eskom mega-project: Kusile PS
2. Financial performance of the Eskom mega-project: Kusile PS
3. Overall asset creation performance of the Eskom mega-project: Kusile PS

The research questions are defined in *Appendix A2: Research question*.

1.6 Significance of the study

This study contributes to theory by expanding the understanding of resilience in complex mega-projects and provides actionable insights for policymakers and project leaders to strengthen adaptive management and thus holds both theoretical and practical significance. Theoretically, it expands the understanding of how black swan events influence large-scale infrastructure project performance through the lens of

complexity and resilience theory. It quantifies the relationship between systemic shocks and project performance metrics, thereby enriching resilience modelling literature in project management. Practically, the research provides actionable insights for Eskom and other energy-sector stakeholders on how to anticipate and mitigate lagged disruptions during future crises. The findings support the design of adaptive management systems, contractual frameworks, and workforce strategies that enhance resilience in South Africa's energy infrastructure delivery.

1.7 Rationale

This research aims to ascertain whether performance, cost overruns and delays in mega-projects are positively correlated with black swan events like COVID-19. Understanding these effects can enhance future risk mitigation strategies, assisting Eskom and other mega-projects in South Africa and globally.

1.8 Delimitations of the study

The specific focus of this study is on Kusile PS, which may not be fully or easily generalisable to other types of projects or regions. The scope of this study is restricted to before, during and after the COVID-19 pandemic, which may not completely capture the long-term impacts. This study's foundation is secondary data, which may not fully account for all variables or information in a complex project environment.

1.9 Assumptions

The key assumptions include:

1. COVID-19 is categorized as a black swan event with no dispute.
2. Kusile project reports provide auditable, accurate, trustworthy and reliable data.
3. The impact of COVID-19 on the Kusile PS is indicative of its impact on other megaprojects of a similar nature.

CHAPTER 2. LITERATURE REVIEW AND THEORETICAL FRAMEWORK

2.1 Introduction

Existing research on the impact of a black swan event specifically COVID-19 on the construction industry is synthesised in this empirical literature review. The focus shall be on methodologies, findings, and implications to provide a comprehensive view of the effect of such events on mega-project constructions in South Africa and globally.

2.2 Empirical literature review

2.2.1 *The impact of a Black Swan Event on the construction industry*

The pandemic resulted in significant disruption to the global economic value chain and presented difficulties for conventional construction practices (Wildenauer & Basl, 2021). The challenges the pandemic created in the construction industry are projected to amount to losses reaching billions of dollars (Wildenauer & Basl, 2021). Due to major financial losses, operational difficulties, and resource constraints, the construction industry experienced delays and lower productivity (Sierra, 2022).

2.2.2 *The criticality of Kusile PS to the South African economy*

Kusile PS is considered a mega-project costing R161.4 billion (Landu, 2025) with construction spanning over the last 15 years (Groenendaal, 2025). Business Tech (2022) indicated Kusile PS progress has been negatively impacted by ongoing corruption investigations, commercial challenges, and the effects of the COVID-19 pandemic, leading to further delays. Business Tech (2023) further stated the South African reserve bank estimated loadshedding resulted in significant business hour losses of approximately 14% in the industrial sector and 11-12% in the commercial and agricultural sectors, contributing to an overall increase in inflation by 0.5 to 1.1 percentage points in 2023.

Bloomberg (2024) reported South Africa has experienced 150 days of sustained electricity supply, ending record loadshedding, which reached 250 days by the end of 2024 (Pillay, 2024). This improvement has positively impacted economic growth of the country and reduced the need for businesses to raise prices due to emergency power costs (BusinessTech, 2023). The International Monetary Fund (IMF) projects economic growth of 1.5% in 2025 and 1.6% in 2026, with inflation expected to slow, furthermore the IMF advised growth has the potential to reach 3% if structural reforms are successfully implemented (Zaghrah, 2025). This has come to fruition with the interest rate cuts in September 2024 and further interest rate cuts expected early 2025 (BusinessTech, 2025). Kusile has been instrumental in the sustained electricity supply (MoneyWeb, 2024; Choruma, 2025), thus illustrating the importance of finishing infrastructure projects timeously.

2.2.3 *COVID-19 global and South African construction industry impact*

Large, complex projects are more prone to cost overruns, and while schedule delays have always been a major construction industry challenge, the COVID-19 pandemic significantly worsened their impact (Shaikh et al., 2023; Adepu et al., 2023). Adepu et al (2023) defines schedule overruns/slippages/creeps, as the difference between the planned time and actual time it takes to complete a project while construction cost overruns are defined as the degree to which the final cost of a project exceeds its base estimate.

In Sindh, Pakistan, a similar study was conducted to assess the time and cost factors impacting Hyderabad's building construction projects during the COVID-19 pandemic (Shaikh et al., 2023). The study revealed that during the pandemic, significant factors such as unsafe working conditions, a shortage of labour, and escalating project costs were notably impacted (Shaikh et al., 2023).

A study was conducted in Nepal (Figure 1) and found financial, operational, and institutional impacts on the construction sector due to COVID-19, including reduced government budgets, deteriorating contractor finances, late payments, cost overruns, project delays, supply chain issues, workforce management difficulties, and health and safety challenges (Timilsina et al., 2021).

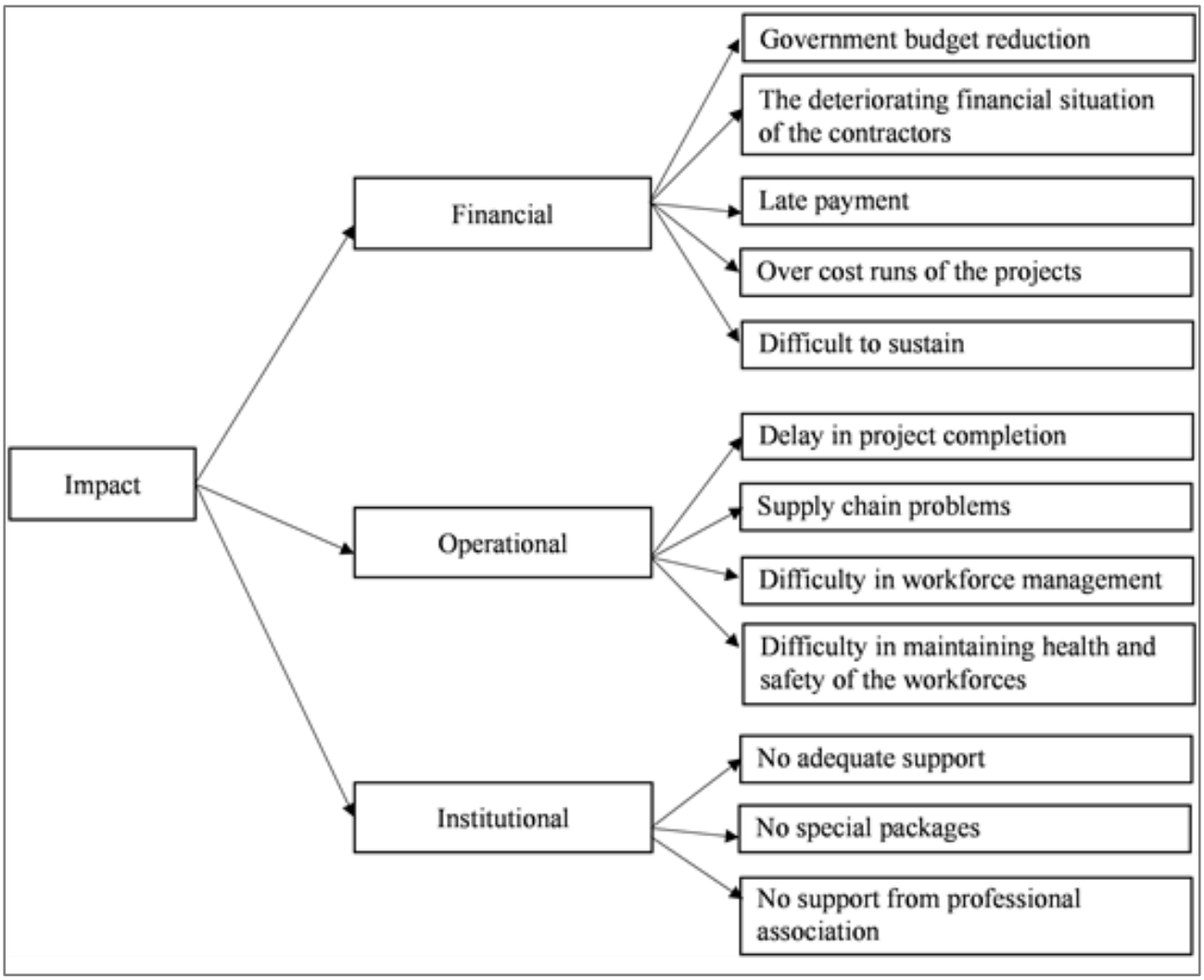


Figure 1: COVID-19 impact on the construction industry (Timilsina et al., 2021)

Gamil and Alhagar (2020) findings revealed that the most severe effects included material price fluctuations, supply shortages, legal and contractual disruptions, uncertainty about business survival, impact on completed activities, and effects on research and technology (Gamil & Alhagar, 2020).

Musonda and Rakolote (2021) conducted a study to evaluate the impact of the COVID-19 pandemic in the construction industry in South African where the administration of project contracts emerged as a significant challenge during the pandemic. Musonda and Rakolote (2021) consolidated views, based on the literature consulted regarding COVID-19s impact on the construction industry, highlights issues (Table 1) related to labour, contracts, liquidity, costs and time ((Musonda & Rakolote, 2021).

Table 1: COVID-19 construction industry impact (Musonda & Rakolote, 2021)

Impacts	*Author(s)*
Shortage of labour	Cosgrove *et al.* (2020: 10)
Supply chain disruptions	Cosgrove *et al.* (2020: 10); Chivilo *et al.* (2020: 10); PWC (2020: 5); McKinsey (2020: 4);
Delays and disruption to contracts	Doddy and Sorohan (2020: 12); KPMG (2020: 4); Chivilo *et al.* (2020: 3)
Suspension and termination of contracts	Doddy and Sorohan (2020: 11); McKinsey (2020: 4)
Stress on working capital and liquidity position	Doddy and Sorohan (2020: 12)
Increased project cost, due to revised standard working procedures incorporating social distancing	KPMG (2020: 4); McKinsey (2020: 4)
Additional interest cost on working capital loans	KPMG (2020: 4)
Labour impact and job losses	Gamil and Alhagar (2020: 5); PWC (2020: 5)
Time overrun	Gamil and Alhagar (2020: 122)
Difficulties with funding	PWC (2020: 5)
Cost overrun	Gamil and Alhagar (2020: 122)
Remote or smart working	McKinsey (2020: 4)

Source: Researchers' compilation

The study outcomes highlighted existing forms of contractual agreements were inadequate to address the unique circumstances brought about by the pandemic and proposed revising standard contract forms to better accommodate current and future pandemics (Musonda & Rakolote, 2021).

Kisi and Sulbaran (2022) study results showed the pandemic increased costs, impacted the project schedule and caused delays exceeding 56 days in some projects. COVID-19 made cost estimation far more difficult for project managers due to volatile material costs, supply chain disruptions, changing safety protocols, and frequent design or scope adjustments (Adepu et al., 2023). During COVID-19, companies saw project costs rise 4-5%, with longer-term projects (3-6 months) experiencing the highest median increase of 8-9% (Kisi & Sulbaran, 2022). Steady cost growth was driven by material/labour uncertainties, especially in projects lasting over six months (Kisi & Sulbaran, 2022). Whereas projects that experienced delays more than 56 days faced cost increases of approximately 11% (Kisi & Sulbaran, 2022).

The challenges contributing to construction cost overruns during the COVID-19 pandemic and the frequency with which they are cited in the literature are shown in Table 2 (Adepu et al., 2023).

Table 2: Challenges contributing to construction cost overruns during the COVID-19 pandemic (Adepu et al., 2023)

ID	Challenges	Frequency	Rank
C1	Shortage of labor	257	1
C2	Lack of materials	246	2
C3	Inaccuracy of cost estimation	187	3
C4	Changes in design and engineering	172	4
C5	Occupational health and safety issues	164	5
C6	Inflation or escalation of material prices	130	6
C7	Specifications and scope changes	126	7
C8	Unavailability of heavy equipment	92	8

Ogunnusi et al (2021) study showed that there were overhead cost reductions and improvements in productivity noted across the global construction industry (Table 3), the study also highlighted the several negative impacts of the pandemic (Table 4).

Table 3: Themes indicating the positive impact of COVID-19 on the global construction industry (Ogunnusi et al., 2021)

No.	Theme	Commonalities
1.	Overhead cost reduction	Cost-saving measures; cost reduction in travelling arrangement; opportunity to reorganise ensconced arrangements, cut back future costs, improved elements of communications and use of technology, e.g. teams
2.	Remote working environment	Opportunity to improve on virtual alternatives; appreciate the new model of work and the flexibility provided which we thought could not be achieved before COVID-19; more online communication
3.	Crisis management plans	Preparations against the worst situation; it gives a clear vision on how business can be planned against unforeseen circumstances; lessons learnt to be incorporated into future projects; accepting changes; greater awareness of particular relating to force majeure; greater contractual focus.
4.	Focus on health and safety	Safety measures took more seriously; increased patience Getting a secured workplace with a very high profile
5.	Improved productivity	Reduced working hours do not affect output; more family time; just able to rest and plan better; able to make an assessment and take a critical decision as it affects the progress and quality of the project; flexibility in the workplace; eliminated impact of traffic when working from home
6.	Sustainability goals	Less administrative paperwork; less carbon footprint at the project site; eliminated impact of traffic when working from home

Table 4: Themes showing the negative impact of COVID-19 on the global construction industry (Ogunnusi et al., 2021)

No.	Theme	Commonalities
1.	Low business turnover	Poor capital input; low/no income generation; poor business sustainability; revenue loss; increase in cost; lack of fund; client paused funds; financial impact and disruptions; extra budget; delayed project financial commitment
2.	Delays in construction payment and output	Delay in decision-making (design decisions or client decisions); time loss; work in progress; time expectations; project halted; delay and cost
3.	Difficulties in working from home	Space constraints; difficulty in keeping focus; added daily tasks
4.	Job losses	Loss of job and salary cuts; inability to obtain new work

2.2.4 *Synthesis of methodologies and findings*

Musonda and Rakolote (2021) used a mixed methods approach to evaluate the impact whilst Timilsina et al (2021) used semi-structured interviews and thematic analysis to explore the pandemic's impact on the construction business through participants' lived experiences. Shaikh et al (2023) and Alu et al (2024) utilised qualitative approaches, with Alu et al (2024) conducting surveys to identify challenges faced by project managers in Nigeria. On the other hand, Lagat et al (2023) and Gomes et al (2022) employed quantitative methods; Lagat et al (2023) used a cross-sectional survey to examine the Kenyan construction sector, while Gomes et al (2022) assessed the pandemic's impact on the restaurant industry using secondary data. Gamil and Alhagar (2020) conducted surveys and interviews on the construction industry, and Appiah et al (2022) performed a bibliometric and thematic review to understand the pandemic's impact on performance. Kisi and Sulbaran (2022) used a quantitative approach with surveys completed by executives of construction companies. Ogunnusi et al (2021) conducted a survey across five continents using artificial intelligence analytics to analyse the data qualitatively. Adepu et al (2023) used a systematic literature review with a thematic analysis to identify and categorise challenges and mitigations. The methodologies are further elaborated in *Appendix* B1: Comparative analysis - methodologies.

The variety of approaches—from qualitative explorations (Timilsina et al., 2021) to mixed methods (Musonda & Rakolote, 2021) and small-sample quantitative surveys (Kisi & Sulbaran, 2022), reveals a reliance on perceptual or small-scale data. While

this existing literature successfully provides the thematic identification of challenges (labour shortages, financial uncertainty), it lacks the quantitative precision required for evidence-based policy formulation. This is the gap this study addresses by using Kusile's extensive data to generate a statistically robust, large-scale quantification of COVID-19's impact on a mega-project. This study aims to move beyond these perceptual findings to achieve the critical objective of isolating and quantifying the marginal impact of the South African policy response (e.g., lockdown levels) on three distinct metrics.

Appendix B2: Comparative analysis of COVID-19 impacts on construction projects details the impact, challenges, and mitigation strategies across regions, revealing shared challenges like labour shortages, supply chain disruptions, and financial issues (Musonda & Rakolote, 2021; Shaikh et al., 2023; Alu et al., 2024; Appiah et al., 2022). Some regions prioritised financial support and institutional reforms, while others focused on labour management and safety measures (Timilsina et al., 2021; Shaikh et al., 2023). Differences included more pronounced institutional weaknesses in Nepal (Timilsina et al., 2021), South Africa and Kenya showed a need for faster adoption of digital technologies; with mitigation strategies varying across all regions (Musonda & Rakolote, 2021; Lagat et al., 2023).

The comparative analysis reveals that while black swan impacts share common global themes like supply chain disruption, the pronounced effect of contractual rigidity and institutional weaknesses in South Africa (Musonda & Rakolote, 2021; Timilsina et al., 2021) necessitates a targeted examination. Kusile PS is the ideal case study because it systemically embodies this contextual challenge, having already accrued a substantial baseline of schedule and cost overruns stemming from endemic, non-pandemic factors (governance, design defects) prior to 2020. This unique pre-existing condition allows the research to test how the COVID-19 shock interacted with and compounded existing institutional vulnerabilities, rather than simply hitting a 'clean' project.

Crucially, to ensure the validity of this quantification, the conceptual model is designed to explicitly control for the existing operational and governance challenges (BusinessTech, 2022) faced by Kusile prior to and concurrently with the pandemic,

thereby isolating the marginal economic and performance shock attributable only to the COVID-19 black swan event.

2.3 Analytical framework

2.3.1 *Theoretical framework*

2.3.1.1 The existing relationship between variables

A theoretical framework and relationship between variables for the pandemic impact on project performance is shown in Figure 2.

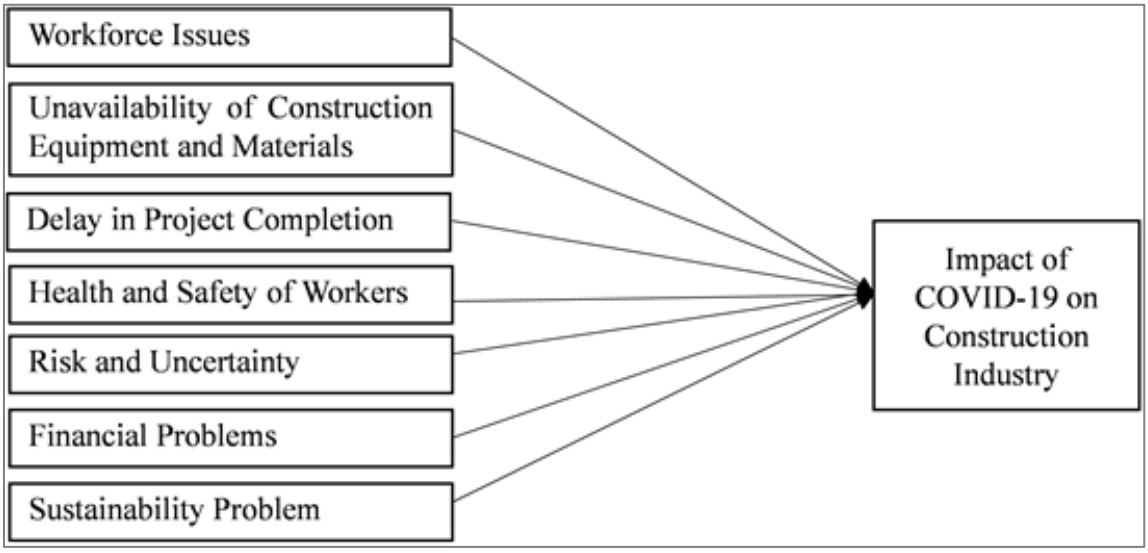


Figure 2: Theoretical Framework (Timilsina et al., 2021)

Figure 2 and the research studies detailed in section 2.2.4, indicate that a black swan event like COVID-19 have influenced time, cost, and overall project delivery. The greater the risk and uncertainty caused by a black swan event, the higher the costs, the higher the delays and the lower the performance (Timilsina et al., 2021; Kisi & Sulbaran, 2022). Shaikh et al (2023) study supports this framework refer to Figure 3.

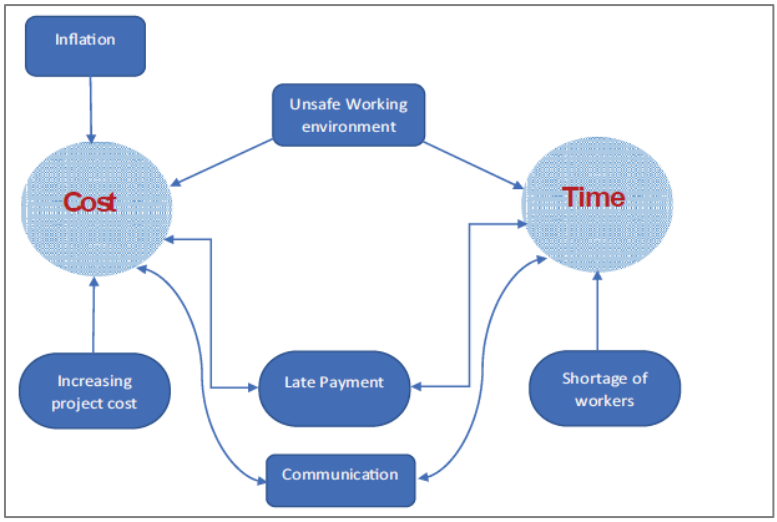


Figure 3: Key Factors affecting cost and time (Shaikh et al., 2023)

2.3.1.2 Complexity and resilience theory in mega-projects

The research is framed by the dual application of complexity theory and resilience theory, providing a robust lens to analyse the systemic effects and management responses to a black swan event like the COVID-19 pandemic.

Complexity theory recognises that mega-projects operate as dynamic, non-linear systems characterised by intricate, tightly coupled interactions between multiple actors, processes, and technologies (Bakhshi et al., 2016). The foundational construct of project complexity is defined across three dimensions, organisational, technical, and contextual, which determine a project's inherent vulnerability (Bakhshi et al., 2016). In such complex and tightly coupled systems, minor disruptions, like site absenteeism or supply chain delays, do not simply cause linear setbacks; they trigger emergent behaviour where non-linear interactions cascade into disproportionately large-scale project overruns (Bakhshi et al., 2016). The COVID-19 pandemic, while predating this theory's publication, served as a real-world case study, validating the theory by simultaneously impacting Kusile's organisational, technical, and contextual elements. This systemic shock magnified the single event across multiple project functions, leading the study to hypothesise the existence of non-linear and delayed (lagged) performance effects rather than immediate, proportional disruptions.

Resilience theory provides the necessary counterpoint, focusing on the system's capacity to anticipate, absorb, adapt, and ultimately recover from major disturbances

(Wang et al., 2022). Within the construction context, resilience is a dynamic process that operates through three primary mechanisms: resistance (absorbing the shock), recovery (returning to a stable state), and adaptation (learning and transforming the system) (Wang et al., 2022). The successful implementation of adaptive scheduling, flexible procurement, and reallocation of resources demonstrates the project's capacity for adaption (Wang et al., 2022). Integrating these theories provides a dual lens for the study: complexity theory explains the mechanism of disruption and the emergence of non-linear delays, while resilience theory explains the mechanism of managerial response and recovery that guided the project's interpretation of its performance response to COVID-19.

The study also draws on cross-disciplinary management theories to contextualise how crisis responses can stabilise complex systems and prevent recurrence. First, the concept of antifragility, derived from black swan literature, proposes that some systems not only survive chaos but improve from disorder and stress (Hajikazemia et al., 2016). Applying this to the Kusile project, the theory suggests that the system has the potential to exhibit an antifragile response, leading the study to investigate whether mitigation strategies yielded positive performance gains in the long term.

Second, the capacity for organisational learning (the process by which organisations acquire, share, and retain knowledge) is essential for converting disruptive shock into adaptive improvements (Hajikazemia et al., 2016). This framework guides the analysis of whether the project was able to execute rapid organisational learning, translating initial operational setbacks into improved protocols and sustained performance.

Finally, the effectiveness of any adaptive strategy hinges on the project's social capital, which refers to the trust and network structures within the project team (Wang et al., 2022). This internal capacity for communication and cooperation is critical for supporting the resistance and recovery mechanisms of resilience theory, allowing managers to rapidly re-baseline schedules and reconfigure workforce structures during periods of extreme uncertainty (Wang et al., 2022). These transdisciplinary perspectives collectively reinforce the need to move beyond simple risk checklists and apply systemic, multi-faceted approaches to sustain performance and build organisational learning capacity during black swan events.

2.3.2 *Conceptual Model*

This study investigates the relationship between the time, cost, and performance measures related to the COVID-19 pandemic, specifically in a mega-project in South Africa. The Kusile project is regarded as a complex environment where there are unpredictable interactions between multiple variables. Complexity theory helps explain how COVID-19 affected these dynamics, while resilience theory offers insights into strengthening Eskom's risk mitigation and improving future project performance in the face of future disruptions. A conceptual model describing the relationship between the variables is defined in Figure 4 below. The model includes both moderating and control variables which aim to increase the robustness and reliability of the model.

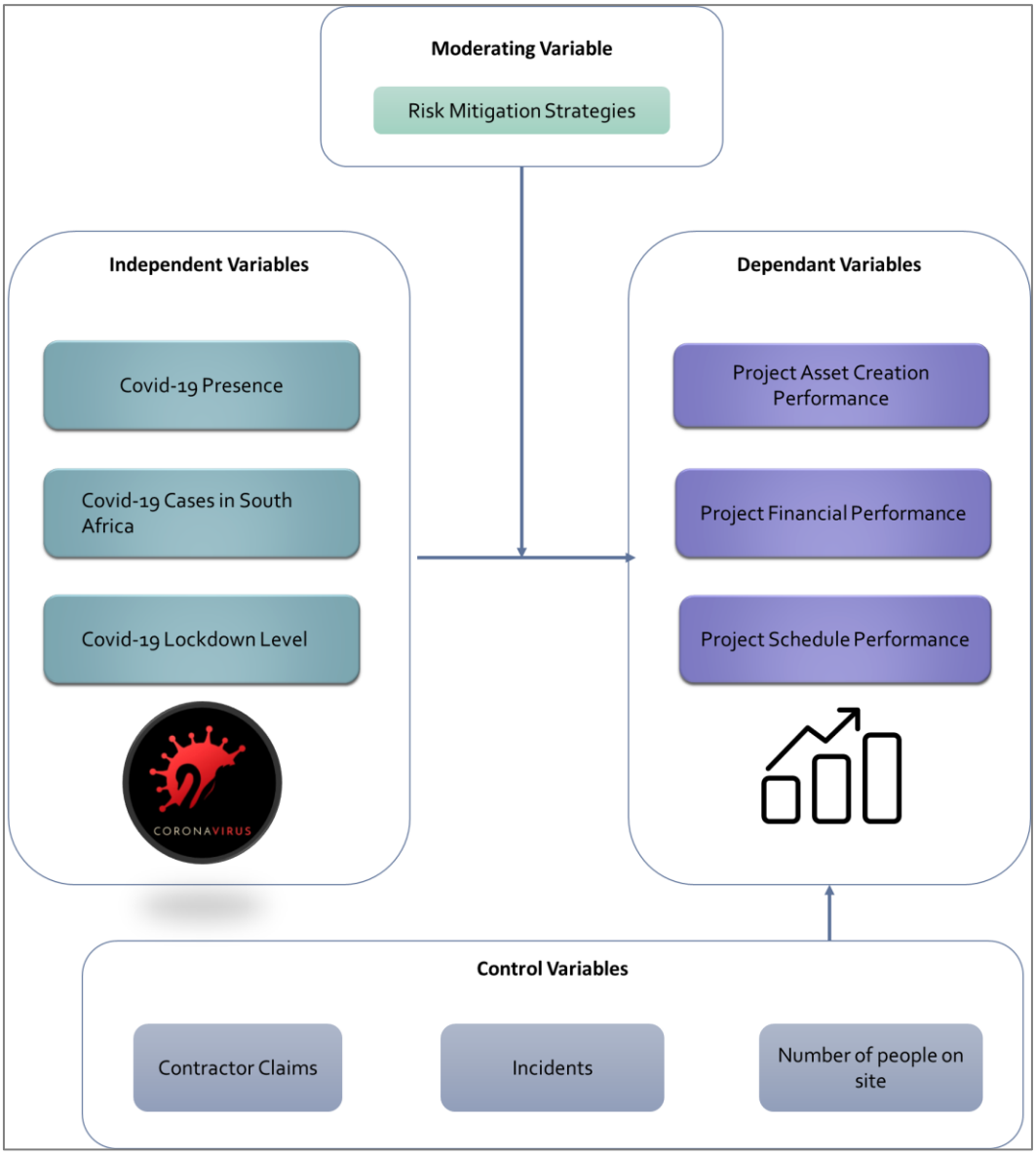


Figure 4: Conceptual model (authors' construction)

The risk mitigation strategies moderate and influence the relationship between the independent and dependent variables. Control variables such as contractor claims, incidents (e.g., breakdown related to operating and maintenance, contract terminations, unavailability of spares etc.) and non-pandemic workforce size fluctuations are included to isolate the specific marginal effects of COVID-19 by controlling for the endemic operational, contractual, and technical challenges that form the project's pre-existing baseline risk profile. Relationships exist between independent and dependent variables e.g., COVID-19 cases and lockdown levels, which affect project performance, financial health, and overall success. Variable relationships are further detailed in *Appendix B3: Relationship between variables.*

2.4 Conclusion of literature review

The majority of studies focused on data collection in the early stages of the pandemic (Appiah et al., 2022) and used qualitative methodologies to understand the impact of COVID-19, furthermore the quantitative studies were based on primary data collected through surveys and interviews (as detailed in section 2.2.3 and 2.2.4). A single study was identified in the restaurant industry, which used a secondary data quantitative analysis to understand the relationship between variables. The literature highlights a gap in understanding the specific impact of COVID-19 on coal power station mega-projects by using longitudinal project data to quantify the impact on performance, finance and delivery and the recovery post the pandemic.

2.5 Research hypotheses

Hypothesis 1:

- Null Hypothesis (H_0): The black swan event (COVID-19) has no effect on schedule performance at Kusile Power Station Project.
- Alternative Hypothesis (H_1): The black swan event (COVID-19) significantly impacts schedule performance at Kusile Power Station Project.

Hypothesis 2:

- Null Hypothesis (H_0): The black swan event (COVID-19) has no effect on financial performance at Kusile Power Station.
- Alternative Hypothesis (H_1): The black swan event (COVID-19) had a substantial impact on financial performance at Kusile Power Station.

Hypothesis 3:

- Null Hypothesis (H_0): The black swan event (COVID-19) had no impact on the overall asset creation performance at Kusile Power Station.
- Alternative Hypothesis (H_1): The black swan event (COVID-19) significantly hindered overall asset creation performance at Kusile Power Station.

CHAPTER 3. RESEARCH METHODOLOGY

Saunders et al (2019) defines the research onion (Figure 5) which has been used to define the analytical framework and research methodology for this study in the section below.

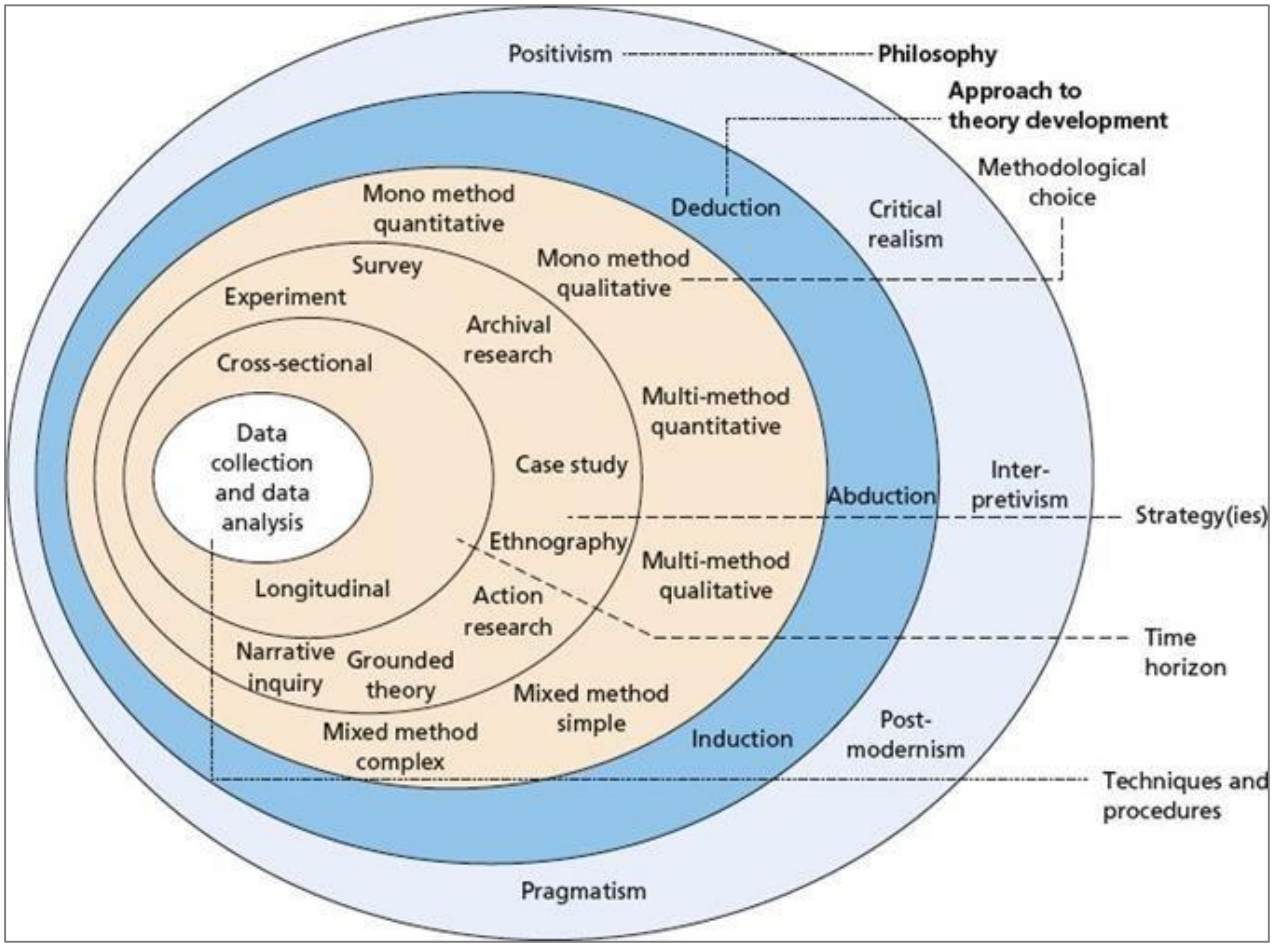


Figure 5: The Research onion (Saunders et al., 2019)

The positivism philosophy entails focusing on pure data and facts and is typically uninfluenced by human bias or interpretation (Saunders et al., 2019). This philosophy posits a single, objective reality, emphasises measurable facts and scientific methods, and requires researchers to remain detached and neutral. (Saunders et al., 2019). The methods related to this type of study are typically quantitative, and very structured, consisting of large samples (Saunders et al., 2019). The approach of deduction entails formulating a theory through a series of hypotheses, specifying existing conditions from

literature where the theory holds, collecting data to test the proposition, and performing an analysis to identify if the premise is indeed true or false (Saunders et al., 2019).

This study adopts a positivist philosophy and a quantitative time-series design to objectively test hypotheses about the relationships between pandemic-related variables and project performance outcomes. A quantitative approach is appropriate because it allows for measurable, statistical inference from audited secondary data, eliminating subjective bias common in qualitative methods. The time-series nature of the dataset (2018–2024) enables observation of lagged effects of COVID-19 disruptions across different project phases. This combination ensures a structured, quantitative analysis that remains unbiased and scientifically rigorous, furthermore

3.1 Research approach

The most applicable method to assess and evaluate the impact of a black swan event (COVID-19) on project performance in a megastructure project was found to be a quantitative research mono-methodology with hypothesis testing.

3.2 Research design

This explanatory study establishes the causal relationship between variables. Kusile PS represents a mega-project affected by COVID-19 and is a suitable case study for evaluating the hypothesis and illustrating the impact of a black swan event (COVID-19) on overall project performance. The time horizon is longitudinal and involved collecting data over 6 years, before, during and after the pandemic to analyse the impact over time.

3.3 Data collection methods

Documentary research was used to benefit from a range of secondary data available at Kusile PS, Eskom. The secondary data at Kusile PS was accessible, offering a unique opportunity to understand relationships directly from source data.

3.3.1 *Population*

The proposed population, sampling frame and sample are shown in Figure 6 below. The population for the proposed study is all coal power station mega-projects in the construction sector in South Africa, with a particular focus on projects affected by black swan events like the COVID-19 pandemic. The sampling frame is thus both Kusile and Medupi PS Projects as these were the two-mega-projects that were occurring in the coal power station area. Medupi Power station was deemed not suitable as construction was close to completion at the time of the pandemic which could have resulted in a potentially lesser impact on that station's performance. The proposed sample is thus the Kusile PS Project where critical data points will be selected specifically focusing on schedule performance, financial performance, and overall asset creation.

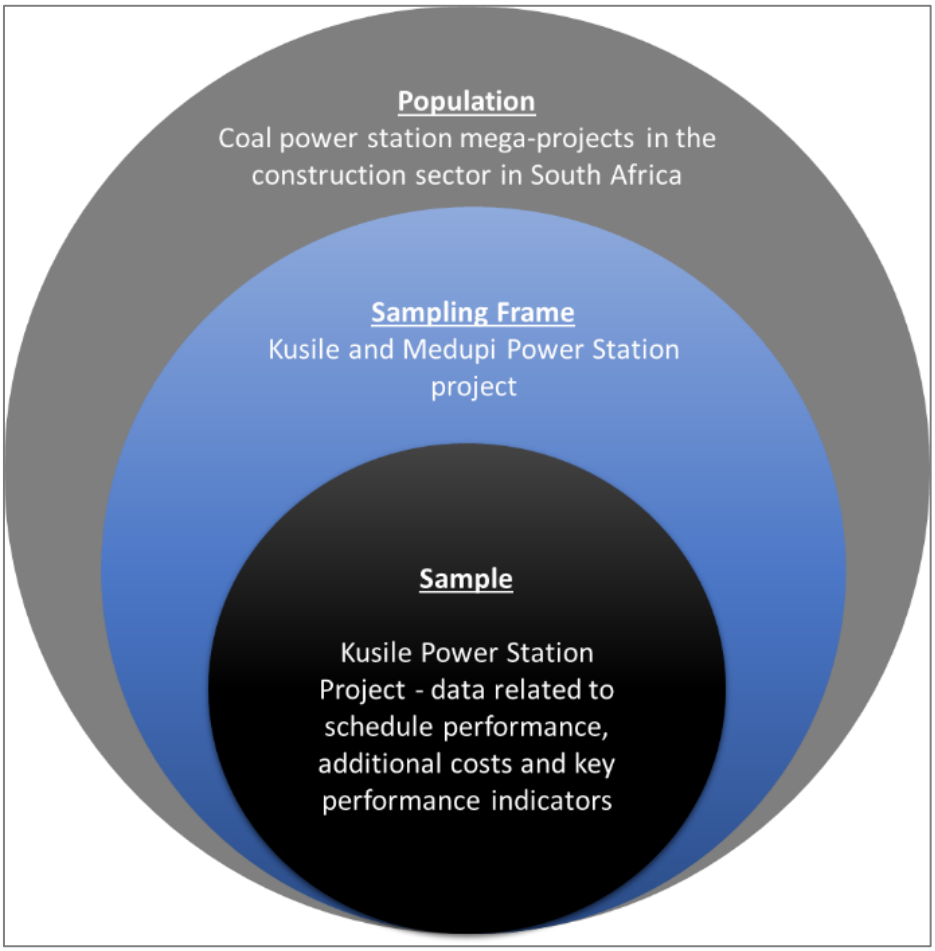


Figure 6: Population, sampling frame and sample (authors' construction)

3.3.2 *Sample and sampling method*

The dataset used in this study constitutes a complete case analysis of the Kusile Power Station Project, covering all available monthly performance records from pre-, during, and post-COVID-19 periods. As the dataset represents the full population of observations for the case, traditional sampling techniques were not required. Data will be purposefully selected through the critical case methodology where it provides information and insights about the performance criteria of Kusile PS project's construction progress and performance during the COVID-19 pandemic.

This data is internally (i.e. Kusile Oversight Monitoring Assurance Committee) and externally audited (i.e. Deloitte and other appointed technical auditors), used for critical decisions, reported to the Eskom Executive Committee (EXCO), communicated to external stakeholders (e.g. media, public), and is considered audited, accurate, valid, and reliable due to thorough reviews and scrutiny before publication. The data was assessed to ensure it addresses areas highlighted by Saunders et al (2019) namely research questions, population, and period, and has valid and reliable collection methods.

3.4 Research instrument

This research uses documentary and multiple secondary data sources, the following secondary data sources were identified for the variables of this study:

3.4.1 *Dependent variables*

1. **Schedule Performance** data relates to whether the project was able to complete construction activities timeously. The data consists of the overall schedule performance for engineering, procurement and construction.
2. **Financial Performance** metrics related to the overall project performance based on a continuous scoring system from 1-5 (where 1 is poor performance and 5 is exceeding expectations). Financial Key Performance Indicators (KPIs) are made of up several areas which include Capital Expenditure (CAPEX), cash flow index,

Public Fund Monitoring Assurance (PFMA), external audits and the settlement of claims index.

3. **Overall Asset Creation Performance** relates to the delivery of 6 units at Kusile PS in relation to the set milestones for specific units per month. This is based on a continuous scoring system from 1-5 (as described above).

3.4.2 *Independent Variables*

1. **COVID-19 Presence** in South Africa was classified as being present from November 2020 to March 2022 (Hasan et al., 2022)**:**
   - First wave: March 2020 - November 2020
   - Second wave (Beta): tentative duration is November 2020 - March 2021
   - Third wave (Delta): tentative duration is April 2021 - October 2021
   - Fourth wave (Omicron) tentative duration is November 2021 - March 2022
2. **COVID-19 cases in South Africa** are the number of cases recorded in South Africa per day and per month (Worldometer, 2024) provides an indication of the severity of COVID-19 from November 2020 to March 2022.
3. **Lockdown Level** relates to the government introduced five-level COVID-19 alert system to help manage the gradual lifting of the lockdown (Government, 2021). This approach, which adjusts based on risk, accounts for various factors such as the number of infections, transmission rates, healthcare facilities capacity, effectiveness of public health measures, and the social/economic impacts of ongoing restrictions (Government, 2021). In April 2022, the national state of disaster was lifted 750days after the first introduction of lockdowns (TimesLive, 2022).

3.4.3 *Control Variables*

1. **Contractor COVID-19 Claims** were introduced as a binary variable to understand when claims were made by contractors during and due to the COVID-19 pandemic. This reviews the duration where claims were present which may have impacted contractor availability on site and resulted in additional unplanned costs.

2. **Incidents** that occurred during the period where construction took place during the pandemic were introduced as a binary control variable as well and included breakdowns related to operating and maintenance, contract terminations, unavailability of spares etc. (refer to Table 33 for further details).
3. **Workforce size** relates to the number of people on site which had an influence on productivity and is thus a significant control variable, this was tracked daily between Eskom personnel and Contractor personnel through gate access biometrics.

3.4.4 *Moderating Variables*

1. **Risk mitigation strategies** were introduced as a binary moderating variable to understand whether this reduced the impact of COVID-19 includes but is not limited to the following (refer to Table 32 for further details):
    - Work-from-Home through hybrid work strategies
    - Increased hygiene protocols and Social Distancing and Covid19 personal protective equipment (PPE)
    - Reduction of non-critical staff on site
    - Shifting to online engagement platforms with increase in digital co-ordination platforms e.g. Microsoft Teams
    - Refocussing on critical path activities and limited construction
    - Conducting risk assessments in preparation for Level 1 and 2 return to site
    - Vaccine rollouts
    - Loaning of spares from other sites where order or deliveries cannot be fulfilled etc.

Table 5 details data sources for this study, which include Eskom databases, media accounts and government publications regarding COVID-19 statistics.

Table 5: Secondary Data Variables

Variables	Sources
○ COVID-19 Presence ○ COVID-19 Cases in South Africa ○ Lockdown Level	○ Published paper - COVID-19 outbreak trends in South Africa: (Hasan et al., 2022) ○ South Africa COVID - Coronavirus Statistics (Worldometer, 2024) ○ Government official communications (Government, 2021)
○ Project Overall Performance - Asset Creation (KPIs) ○ Project Financial Performance (KPIs) ○ Project Schedule Performance (Actual schedule progress)	Kusile monthly reports and Key Performance Indicators (KPIs) – internally and externally audited (Kusile, Kusile Project Performace Dashboard, 2024)
○ Risk Mitigation Strategies ○ Major Incidents	Kusile Oversight Monitoring Assurance Committee (OMAC) reports - internally and externally audited (Kusile, Oversight Monitoring Assurance Committee, 2024).
○ Contractor Claims (related to COVID-19) ○ Number of People on Site	○ Kusile records and actual contractor claims and results of the closed claims (Kusile, COVID-19 Kusile Contractor Claims, 2024). ○ Kusile records on actual entry to site, based on onsite biometrics system (Kusile, Kusile Personnel on Site, 2024).

Note: The business unit performance data is audited by the Eskom Performance Monitoring Department under Capital Execution Assurance, who are in turn externally audited by Deloitte and other appointed technical auditors. Further details on data to be used are shown in *Appendix* C2: Research instrument.

3.5 Data analysis strategies and interpretation

The purpose of this research is to determine the relationship between two or more variables. The proposed research instrument, type of data and analysis are quantitative in nature involving statistical and mathematical analysis of numbers.

The analysis will be conducted using IBM SPSS (Statistical Package for Social Sciences) version 22 software. Descriptive statistics shall be used to measure central

tendency (calculate the associated mean, median and mode) and measure variation (understand the range, standard deviation and variance to determine if the data distribution is normal or skewed).

Statistical inference shall be applied to test three hypotheses (defined in section 2.5.) by assessing both the strength and direction of relationships among variables. To test these hypotheses, variables representing COVID-19 characteristics (presence, lockdown level, and number of cases) and project-related factors (contractor claims, incidents, number of people on site and risk mitigation strategies) were compared with three outcome variables: schedule performance, financial performance, and project asset creation performance.

A combined approach was used involving group comparisons, correlation analysis, and regression modelling. Group comparisons were conducted using appropriate statistical tests based on the number of levels in each categorical variable and the distribution of the outcome variables. If the variable had two levels, a t-test (parametric) or Mann-Whitney U test (non-parametric) was used. For variables with more than two levels, ANOVA (parametric) or Kruskal-Wallis test (non-parametric) was applied. In each case, the null hypothesis of no difference between group means was tested.

The correlation analysis was used to identify any multicollinearity in the regression analysis, that is, highly correlated independent variables in the regression models. Furthermore, correlation analysis shall be used to measure the strength of the association between two variables (bivariate analysis) through the Pearson or Spearman correlation coefficient.

The correlation coefficient ranges from -1 for perfect negative correlation up to +1 for perfect positive correlation, where the sign (positive or negative) of the coefficient indicates the direction of the relationship. The range of any correlation coefficient is as follows (Schober et al., 2018):

- 0,00 to 0,09 (negligible correlation)
- 0,10 to 0,39 (weak correlation)
- 0,40 to 0,69 (moderate correlation)
- 0,70 to 0,89 (strong correlation)
- 0,90 to 1,00 (very strong correlation).

Finally, regression analysis was carried out to understand and quantify the relationships between the output variables of the study (project schedule performance, project financial performance, and project asset creation performance) and explanatory or independent variables (here, characteristic aspects of COVID-19 and characteristics related to the project). The outcome assisted in making predictions about the output variables based on the values of the explanatory variables.

Three different models are used for each output variable to understand the relationships between those variables better.

- **Model 1**: Regress each dependent variable on all independent variables.
- **Model 2:** Regress each dependent variable on all independent variables. Control variables are added to the regression model to account for their effects.
- **Model 3:** Regress each dependent variable on all independent variables. Control variables are added to the regression model to account for their effects. Moderating variable is then included and interaction terms to see if it changes the relationships

Four (4) regression analysis (Table 6) were conducted to understand the normal data and the potential lagged data impacts (with variables combined and split).

Table 6: Regression Description

Regressions	Description	Intent
Regression 1	Normal Data with variables combined	Understand the existing relationship
Regression 2	Lagged Data with variables combined	Understand the time lagged relationships (if any)
Regression 3	Normal Data with variables split	Understand the impact when Covid is present and not, and through each lockdown level
Regression 4	Lagged Data with variables split	Understand the lagged impact (if any) when Covid is present and not, and through each lockdown level

Statistical significance thresholds were set at $p < 0.05$, consistent with established standards in inferential statistics (Salkind & Frey, 2020). Results significant at $p < 0.01$ and $p < 0.10$ are also reported for robustness which follows best practices and aligns with recent empirical research on COVID-19's impact on project performance (Adepu et al., 2023; Kisi & Sulbaran, 2022), which similarly used parametric and non-parametric methods to assess performance impacts under pandemic conditions.

The data type for this study shall be numerical in nature, sub-divided into data types as shown in Table 7.

Table 7: Variable measurement and data type (authors' construction)

Variable Type	Variable	Measure	Data Type
Dependent	Project Schedule Performance	Actual performance (%) monthly	Continuous
Dependent	Project Financial Performance	Financial KPI scores per quarter	Continuous
Dependent	Overall Project Asset Creation Performance	Asset Creation KPI scores per quarter	Continuous
Independent	Covid-19 Presence	Present (1) or Not present (0)	Discrete (1 or 0)
Independent	Covid-19 Cases in South Africa	Number of active cases per month	Continuous
Independent	Lockdown Level	Level of Lockdown from 0-5	Discrete (0-5)
Control	Contractor Claims	Present (1) or Not present (0)	Discrete (1 or 0)
Control	Incidents	Present (1) or Not present (0)	Discrete (1 or 0)
Control	Number of People on site	Number of people onsite per month	Continuous
Moderating	Risk Mitigation Strategies	Present (1) or Not present (0)	Discrete (1 or 0)

The data used for this analysis is shown in *Appendix C2: Research instrument.* The methodology is further expanded in Ap*pendix* C5: Data analysis methodology. *Appendix E – Proposed schedule and timelines* provides the link between the hypothesis and data analysis methodology.

3.6 Possible limitations and challenges of the study

Limitations include reliance on secondary data, a focus on Kusile PS, and not fully accounting for other influencing factors like contract terminations and supply issues. Incorporating primary data and expanding research beyond the coal power station environment could enhance the study's insights and generalisability.

3.7 Quality assurance

3.7.1 *Validity and reliability*

The data, sourced from Eskom's Oversight Monitoring Assurance Committee (OMAC), covers the period January 2018 to December 2024. Each data point was independently

validated and audited by internal and external auditors (Deloitte), ensuring data reliability and accuracy. The use of secondary data reduces the risk of respondent bias and enhances replicability.

3.8 Ethical considerations

The study adheres to the university's ethical standards and guidelines. Informed consent has been obtained from Eskom Holdings Ltd (*Appendix F – Ethical considerations and permissions),* and specific contractors will remain unnamed to ensure anonymity and confidentiality. Eskom permissions and anonymised data ensure ethical compliance, in addition data usage was transparent, maintaining ethical and responsible conduct.

CHAPTER 4. RESEARCH FINDINGS AND DISCUSSIONS

This chapter provides the outcomes of the descriptive and inferential data analysis carried out using SPSS to address the research objectives detailed in section 1.5.

4.1 Research findings

4.1.1 *Descriptive Analysis*

In the descriptive analysis, frequency distributions of categorical variables are presented in pie charts or bar graphs, and descriptive statistics of continuous variables are presented in a table format. Histograms depict the distributions of these continuous variables to ascertain the normality assumption for regression analysis.

4.1.1.1 Frequency distribution of categorical variables of the study

The distribution of COVID status is almost the same before (32%), during (35%), and after (33%) with COVID-19 only present in 25 (34.7%) of the 72 periods selected in the sample. Of the 25 periods of COVID-19 selected in the sample of the study, 13 (18%) were during lockdown level 1, 7 (10%) during lockdown level 3, 6 (9%) during lockdown levels 2, 4, and 5 combined. This reflects the intensity and duration of government restrictions that influenced project activities and the workforce. During the period of the study, claims or disputes from contractors specifically related to the pandemic were apparent over 6 periods (8%) (Figure 4), and incidents (not related to the pandemic) were recorded over 31 periods (43%). Eskom, Kusile PS executed risk mitigation strategies over 40 periods (56%) to manage the associated risks of the pandemic. The complete descriptive analysis is shown in *Appendix D1: Frequency distribution*.

4.1.1.2 Descriptive statistics of the continuous variables in the study

Table 8 indicates the summary of the continuous variables in the study.

Table 8: Descriptive statistics of the continuous variables

	Count	Minimum	Maximum	Range	Median	Mode	Mean	SD*
COVID-19 cases in South Africa	72	0	196574	196574	5424	0	30259	47160
Project asset creation performance	72	1,871	3,659	1,787	3,091	3,000	3,014	0,4096
Project Financial Performance	72	1,95625	4,73111	2,77486	3,38872	2,19792	3,26909	0,69025
Project schedule performance	72	0,86986	0,99487	0,12501	0,98118	0,96888	0,96624	0,3661
Number of people on site	72	2004	17742	15738	5817	2004	7056	4158

*SD stands for Standard Deviation

The variable, COVID-19 cases in South Africa, has the highest standard deviation (SD = 47 160), that is, the variable exhibits higher variability, indicating fluctuating COVID-19 infection rates. A similar pattern is also observed for the number of people on site, with an SD of 4 158.

Project schedule performance exhibits the lowest SD of 0,3661 with a mean of 0,96624. The SD being the average discrepancy around the mean, values of project schedule performance do not, on average, fluctuate much from their mean. That could suggest consistency in project time delivery despite the COVID-19 shocks. Project asset creation performance has the second lowest SD of 0,4096, followed by the project financial performance with a moderate variability (SD = 0,690), possibly reflecting cost volatility.

The three dependent variables of the study, project asset creation performance, project financial performance, and project schedule performance, have means of 3,014, 3,26906, and 0,96624, respectively. From the initial scale of 1 to 5, the score of almost 3 for project asset creation performance and project financial performance indicates that the two variables are rated neutral, as 3 is the middle score between 1 and 5.

4.1.1.3 Frequency distribution of continuous variables of the study

The histograms shown in *Appendix D2: Descriptive statistics - histograms of continuous variables* show the frequency distributions of the continuous variables in

the sample of 72 observations grouped in different ranges depending on the values of each variable.

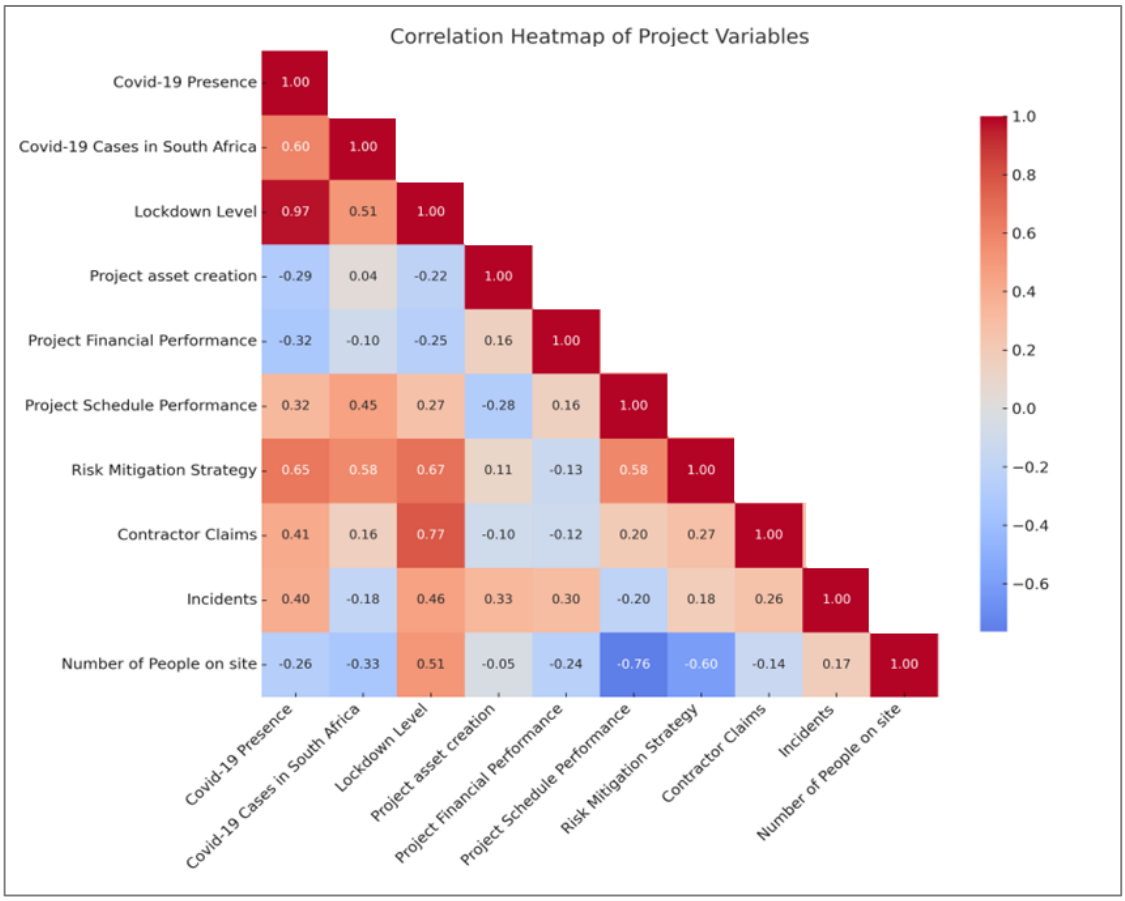
The summary of this assessment is detailed below. The distribution of the COVID-19 cases in South Africa is therefore not normally distributed. The distribution of the project asset creation performance can be approximated by a normal distribution. The frequency distribution of the project financial performance suggests that the distribution is not normal. The distribution of the project schedule performance indicates this distribution is not normal as it is left-skewed. The frequency distribution of the number of people on site is right-skewed, and therefore not normally distributed.

4.1.2 *Correlation Analysis Outcomes of all Project Variables*

Figure 7 below shows the matrix of bivariate correlation of the ten variables in the study. The continuous variables are COVID-19 cases in South Africa, project asset creation performance, project financial performance, project schedule performance, and the number of people on site.

Categorical variables are COVID-19 presence (binary), lockdown level (six categories), risk mitigation strategy (binary), contractor claims (binary), and incidents (binary). Histograms in *Appendix D2: Descriptive statistics - histograms of continuous variables* indicate that the continuous variables are not normally distributed, except for the project asset creation performance. Therefore, Spearman's correlation coefficient is used instead of Pearson's correlation coefficient as it is robust to non-normality.

COVID-19 presence in South Africa is very strongly correlated to the lockdown level, with a Cramer's V coefficient of 0,971, this indicates a very strong relationship where stricter lockdowns were implemented as COVID-19 presence increased. The lockdown level is strongly correlated to contractor claims with a Cramer’s V coefficient of 0,773, suggests that stricter lockdowns led to more claims by contractors, possibly due to delays and disruptions. All the other correlation coefficients are either weak or moderate. This high correlation between Covid-19 presence and lockdown level (ρ = 0.971) and lockdown level and contractor claims (ρ = 0,773) may lead to multicollinearity, however since COVID presence and lockdown levels are both critical assessment areas that are required for this study, a decision has been made to retain both variables in the regression analysis.



Note:

For Continuous with continuous with used Spearman correlation coefficient

For nominal with Nominal with used Cramer's V/Phi measures of association

For Nominal with Continuous we used Point-biserial correlation

Figure 7: Correlation Heatmap of Research Study Variables

4.1.3 *Inferential Statistics*

This section deals mainly with testing the three hypotheses as defined in section 2.5. The test results of the difference in the mean of the project asset creation performance, project financial performance and project schedule performance across the different levels of COVID-19 status, COVID-19 presence, lockdown levels, contractor claims, incidents, and risk mitigation strategies are discussed in this section.

4.1.3.1 Comparison of project schedule performance across different levels of categorical variables

Project schedule performance is not normally distributed (refer Figure 22), hence, a non-parametric test, the Kruskal-Wallis or Mann-Whitney test, is used.

The results of the Kruskal-Wallis test of project schedule performance across the three levels of COVID-19 status are presented in Table 9. The null hypothesis of no difference in the medians of project schedule performance is rejected, at a 5% significance level, as the p-value is 0,000 is far less than 0,05. The difference mainly lies between Before COVID and After COVID (median difference is 0,070 with the standard deviation difference of 0,034), also between Before COVID and During COVID (median difference is 0,057 with standard deviation difference of 0,028).

Table 9: Comparison of project schedule performance across COVID-19 statuses

	COVID-19 Status	Mean	Median	Range	Standard Deviation	P-value
Project schedule performance	Before COVID	0,92287	0,91093	0,09660	0,03572	0,000
	During COVID	0,98026	0,98064	0,02265	0,00768	
	After COVID	0,99321	0,99349	0,00412	0,00132	

Table 10 below indicates the results of the Mann-Whitney test of equality of medians of project schedule performance between the two levels of COVID-19 presence in South Africa. It can be noticed that the null hypothesis of no difference is rejected at a 5% significance level (p-value = 0,001 < 0.05). That is, the presence of COVID-19 in South Africa has an impact on project schedule performance.

Table 10: Comparison of project schedule performance between the presence and absence of COVID-19 in South Africa

	COVID-19 presence in South Africa	Mean	Median	Range	Standard Deviation	P-value
Project schedule performance	No	0,9438	0,9587	0,1250	0,0440	0,001
	Yes	0,9853	0,9885	0,0249	0,0082	

The lockdown levels do not affect project schedule performance, as the hypothesis of

no difference of medians across the six levels is not rejected at the 5% significance level (p-value = 0,926 > 0,05) of the Kruskal-Wallis results, Table 11.

Table 11: Comparison of project schedule performance across lockdown levels

	Lockdown level	Mean	Median	Range	Standard Deviation	P-value
Project schedule performance	0	0,95810	0,97864	0,12501	0,04351	0,926
	1	0,98491	0,98799	0,01464	0,00562	
	2	0,98128	0,98128	0,01224	0,00866	
	3	0,97705	0,97847	0,01738	0,00678	
	4	0,97734	0,97734	0,01694	0,01198	
	5	0,96840	0,96840	0,00095	0,00067	

Table 12 shows the results of the Mann-Whitney test of the difference in the medians of project schedule performance between the two levels of contractor claims. These results indicate that the contractor claims have a significant impact on the project schedule performance. The p-value of 0,033 is less than 0,05, indicating that the null hypothesis of no difference is rejected at a 5% significance level.

Table 12: Comparison of project schedule performance on presence of contractors claims or not

	Contractor claims	Mean	Median	Range	Standard deviation	P-value
Project schedule performance	No	0.96594	0.98462	0.12501	0.03824	0,033
	Yes	0.96957	0.96888	0.00603	0.00218	

The Mann-Whitney tests revealed incidents (Table 13) have no impact on project schedule performance as its p-value of 0,341 is greater than 0,05 whereas the risk mitigation strategies (Table 14) have an impact on the project schedule performance, as the null hypothesis of no difference is rejected at a 5% significance level (p-value = 0,002 < 0,05).

Table 13: Comparison of project schedule performance on whether there is an incident or not

	Incidents	Mean	Median	Range	Standard Deviation	P-value
Project schedule performance	No	0,97112	0,97847	0,09183	0,02662	0,341
	Yes	0,95980	0,98853	0,12451	0,04639	

Table 14: Comparison of project schedule performance on whether any risk mitigation strategy was applied or not

	Risk mitigation strategies	Mean	Median	Range	Standard Deviation	P-value
Project schedule performance	No	0.94300	0.95737	0.12501	0.04444	0,002
	Yes	0.98484	0.98826	0.02586	0.00852	

4.1.3.2 Comparison of project financial performance across different levels of categorical variables

Project financial performance is not normally distributed (refer Figure 21), hence, a non-parametric test, the Kruskal-Wallis or Mann-Whitney test, is used.

The results of the Kruskal-Wallis test of project financial performance across the three levels of COVID-19 status are presented in

Table 15. The null hypothesis of no difference in the medians of project financial performance is rejected, at a 5% significance level, as the p-value is 0,000 is less than 0,05. The difference mainly lies between Before COVID and After COVID (median difference is 0,767 with the standard deviation difference of 0,3667), also between After COVID and During COVID (median difference is 0,969 with standard deviation difference of 0,1863).

Table 15: Comparison of project financial performance across different COVID-19 statuses

	COVID Status	Mean	Median	Range	Standard Deviation	P-value
Project Financial Performance	Before COVID	3,10850	3,05925	2,53319	0,77700	0,000
	During COVID	2,96814	2,85767	1,89675	0,59726	
	After COVID	3,73649	3,82667	1,85722	0,41093	

Table 16 indicates that the COVID-19 presence has no impact on the project's financial performance. The p-value of 1,000 is far less than 0,05. Hence, the null hypothesis of no difference in the medians of project financial performance between the presence

and absence of COVID-19 in South Africa is not rejected at a 5% significance level. Note that the Mann-Whitney test was carried out for the test of medians in Table 16

Table 16: Comparison of project financial performance between the presence and absence of COVID-19 in South Africa

	COVID-19 presence in South Africa	Mean	Median	Range	Standard Deviation	P-value
Project Financial Performance	No	3,33841	3,37333	2,53319	0,80392	1,000
	Yes	3,21044	3,40289	1,98042	0,58159	

The lockdown levels do not affect the project's financial performance, as the hypothesis of no difference of the medians across the six levels in the Kruskal-Wallis test is not rejected at the 5% significance level (p-value = 0,056 > 0,05), Table 17.

Table 17: Comparison of project financial performance across the lockdown levels

	Lockdown level	Mean	Median	Range	Standard Deviation	P-value
Project Financial Performance	0	3,43036	3,60806	2,53319	0,69593	0,056
	1	2.89244	2,85767	1,84608	0,60861	
	2	3,03958	3,03958	0,75717	0,53540	
	3	3,34548	3,45450	1,50115	0,58270	
	4	2,85392	2,85392	0,52883	0,37394	
	5	2,38546	2,38546	0,25008	0,17684	

The results of the Mann-Whitney tests (refer to *Appendix D3: Comparison of project financial performance across different levels of categorical variables*) of the difference in the medians of project financial performance across the two levels of contractor claims, incident, and risk mitigation strategies revealed none of the three categorical variables has an impact on project financial performance.

4.1.3.3 Comparison of project asset creation across different levels of categorical variables

Project asset creation is normally distributed (refer Figure 20), hence, a parametric test, the two-sample independent t-test, or one-way ANOVA, is used.

The results of a one-way ANOVA test indicate that COVID-19 status (before, during, and after the pandemic) had a statistically significant impact on project asset creation performance (Table 18). Specifically, the mean performance score was 3.0200 before COVID-19, increased to 3.1651 during the pandemic, and declined to 2.8500 after COVID-19. The p-value of 0.024 is below the 5% significance threshold, indicating that the null hypothesis of no difference can be rejected. The most notable difference was observed between the during and after COVID-19 periods.

Table 18: Comparison of project asset creation across different COVID-19 statuses

	COVID-19 status	Mean	Median	Range	Standard Deviation	P-value
Project asset creation performance	Before COVID	3,0200	3,1548	1,3665	0,3775	0,024
	During COVID	3,1651	3,2933	1,3925	0,4645	
	After COVID	2,8500	3,0000	1,1877	0,3219	

Table 28 indicates the results of the two-independent samples t-test of equality of means of project asset creation performance between the two levels of COVID-19 presence in South Africa. It can be noticed that the null hypothesis of no difference is rejected at a 5% significance level (p-value = 0,016 < 0.05). This result confirms that the national presence of the pandemic adversely affected asset creation outcomes.

Table 19: Comparison of project asset creation between the presence and absence of COVID-19 in South Africa

	COVID-19 presence in South Africa	Mean	Median	Range	Standard Deviation	P-value
Project asset creation performance	Not present	3,1005	3,0741	1,7872	0,3847	0,016
	present	2,8506	3,1085	1,0622	0,4125	

The lockdown levels do not affect the project asset creation performance, as the hypothesis of no difference of means across the six levels is not rejected at the 5% significance level (p-value = 0,164 > 0,05) of the one-way ANOVA results (Table 20).

Table 20: Comparison of project asset creation across the different lockdown levels

	Lockdown level	Mean	Median	Range	Standard Deviation	P-value
Project asset creation performance	0	3,1027	3,0941	1,7872	0,3887	0,164
	1	2,8352	2,7600	1,0622	0,3882	
	2	2,8899	2,8899	0,8069	0,5705	
	3	2,8320	3,1111	1,0272	0,4680	
	4	3,2022	3,2022	0,1822	0,1289	
	5	2,6990	2,6990	0,8242	0,5828	

Table 21 below indicates the results of two-independent-sample t-test of the difference in the means of project asset creation performance between the two levels of contractor claims. Similarly, the contractor's claim has no impact on the project asset creation performance. The p-value of 0,397 is greater than 0,05, indicating that the null hypothesis of no difference cannot be rejected at a 5% significance level.

Table 21: Comparison of project asset creation on whether contractors claim or not.

	Contractor claims	Mean	Median	Range	Standard Deviation	P-value
Project asset creation performance	No	3,02623	3,0741	1,7872	0,4122	0,397
	Yes	2,8756	3,1111	0,8631	0,3853	

Table 22 shows that the incident affects the project asset creation performance, as the null hypothesis of no difference in the means between ‘no’ and ‘yes’ is rejected (p-value = 0.004 < 0.005) at a 5% significance level. This suggests that the presence of operational incidents—although typically associated with potential delays—may paradoxically correlate with improved performance in certain contexts.

Table 22: Comparison of project asset creation on whether there is an incident or not

	Incidents	Mean	Median	Range	Standard Deviation	P-value
Project asset creation performance	No	2,8965	3,0741	1,7872	0,4537	0,004
	Yes	3,1687	3,2054	1,3967	0,2811	

Table 23 indicates that the risk mitigation strategies have no impact on the project asset creation performance. The p-value of 0,347 is less than 0,05. Hence, the null hypothesis of no difference is not rejected at a 5% significance level.

Table 23: Comparison of project asset creation with and without risk mitigation strategy

	Risk mitigation strategies	Mean	Median	Range	Standard Deviation	P-value
Project asset creation performance	No	2,9642	3,0741	1,3665	0,3435	0,347
	Yes	3,0534	3,1111	1,3925	0,4561	

4.1.4 *Trend Analysis of Project Variables*

The major incidents that the project experienced are shown in Figure 8, the trend graph shows a decline in the overall asset creation performance approximately 4 months after each major incident occurs, and in some cases there is a decline in performance during the incident. During the first 3 major incidents the financial performance reaches some of its lowest values. Similar to the major incident impact on asset creation performance being lagged by approximately 4 months, the impact of Covid-19 at Kusile PS may have not been immediate. It can be seen on the trend graph a decline in financial and asset creation performance occurs approximately 4 months after the onset of Covid-19 around June 2020. The lag on the independent variables (COVID-19 factors) may be due to:

- Delayed reporting, consolidation, and conceptualisation of data to the relevant departments.
- COVID-19's overall impact on project performance likely occurs with a delay (e.g., lockdowns, case surges) may take time to affect project outcomes.

Due to decline in performance and the risk of not meeting milestones the schedules were reviewed, and re-baselined i.e. new targets were set based on the constraints at hand. Furthermore, there were no major incidents noted in the period between Jan 2020 and August 2021, thus Covid-19 was one of the largest influences on performance during this period.

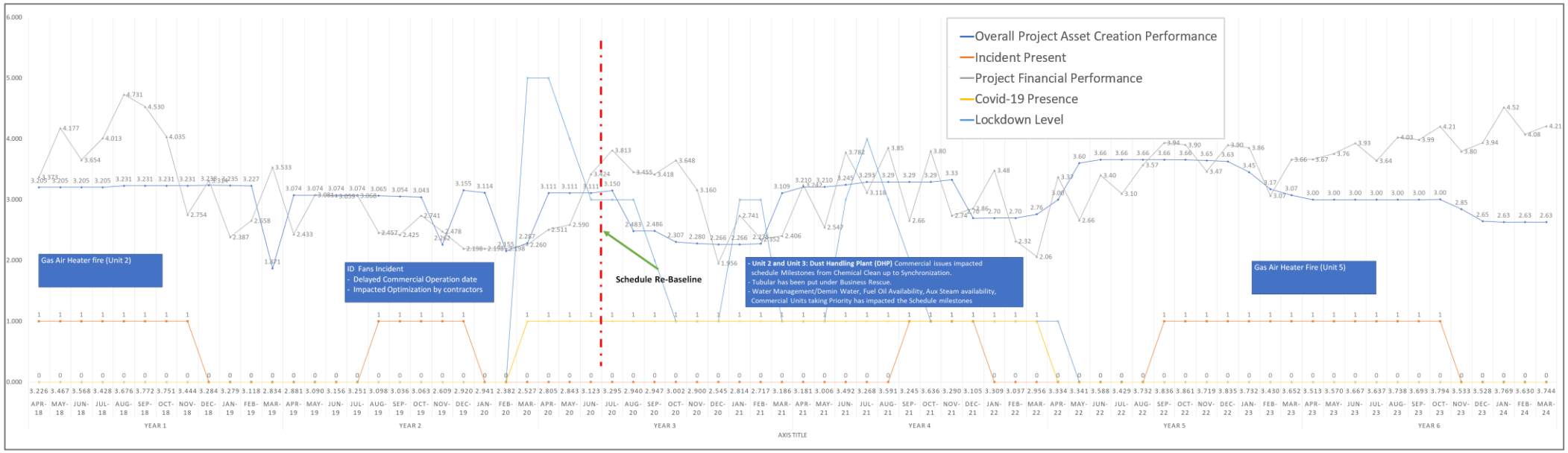


Figure 8: Trend Analysis of Dependent variables and Independent Variables (No Lag)

In SPSS, a lag of 4 months was introduced, which shifted the independent variables (predictors), to understand how historical data affects present outcomes. Thus, the past values of your independent variable(s) from 4 months earlier are used to predict its influence on each of the current dependent variables. Figure 9 shows the lag introduced on the independent variables (COVID-19 factors) and allows the model to test how COVID-19 conditions from a few months earlier, influenced project performance.

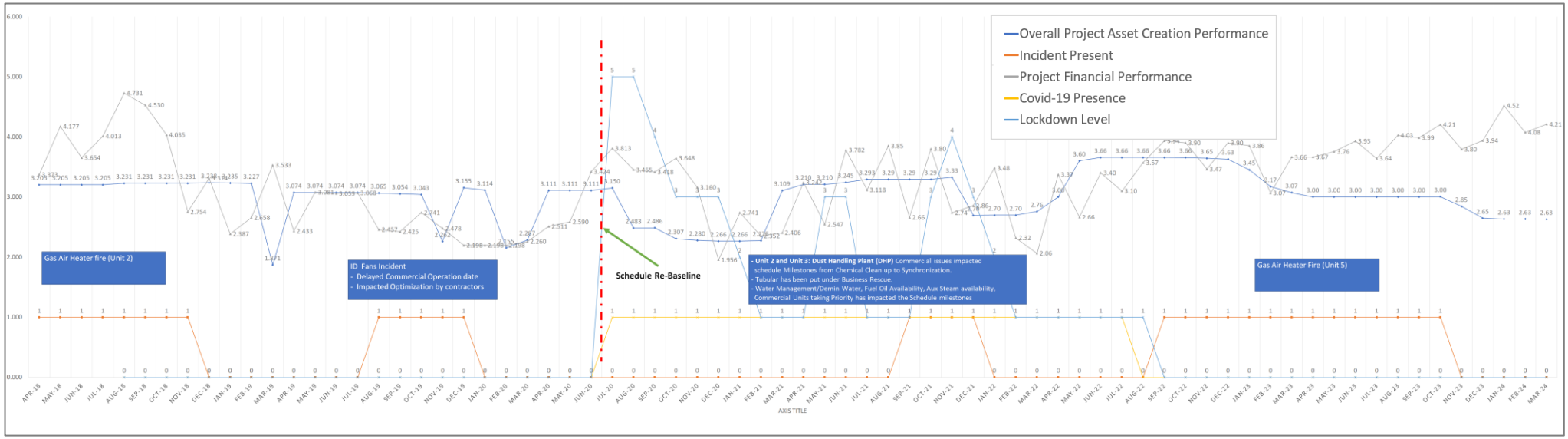


Figure 9: Trend Analysis of Dependent variables and Independent Variables (4 Month Lag)

4.1.5 *Regression Analysis*

Instead of using multiple linear regression models, which assume normality of the dependent variable, generalised linear models (GLMs), which are a broader class of models that include multiple regression as a special case, are used to account for non-normality of the dependent variables, as is the case in this analysis. To assess the goodness of fit of the GLMs, Akaike's Information Criterion (AIC) statistic is used where the smaller the value of AIC is the better the model. The p-value, that is, the probability that the observed effect could have been due to chance alone, of the overall model, is provided by Prob> χ^2 (probability greater than the observed value of the chi square distribution).

In all the regression tables below, values represent the estimated coefficients (β) of the regression, and the value in brackets represent the standard error of the estimation and significant levels are represented as 1% (***), 5% (**), and 10% (*). Furthermore, the basic model (dependent vs independent only, model 1), adding control variables to the basic model (model 2), and adding moderating effects to model 2 (model 3).

4.1.5.1 Regression Analysis 1 - normal data with variables combined

Table 24: Regression analysis (1) - normal data with variable combined

	Dependent Variable:	Asset Performance Model 1	Asset Performance Model 2	Asset Performance Model 3	Finance Performance Model 1	Finance Performance Model 2	Finance Performance Model 3	Schedule Performance Model 1	Schedule Performance Model 2	Schedule Performance Model 3
	Intercept	1,128*** (0,020)	1,295*** (0,178)	1,146*** (0,174)	1,221*** (0,030)	1,537*** (0,262)	1,483*** (0,274)	-0,045*** (0,005)	0,046** (0,019)	0,038* (0,020)
Independent	Covid-19 Presence	-0,112* (0,058)	-0,097* (0,059)	-0,172** (0,060)	-0,199** (0,088)	-0,170* (0,089)	-0,144 (0,097)	0,016 (0,016)	0,011 (0,007)	0,014** (0,007)
Independent	Covid-19 Cases in South Africa	0,000000365 (0,000000423)	0,000000251 (0,000000427)	-0,000000927 (0,000000412)	0,00000178* (0,000000642)	0,00000109* (0,000000655)	0,00000121* (0,000000677)	0,000000162 (0,000000113)	-0,004 (0,003)	0,000000064 (0,0000000473)
Independent	Lockdown level	0,003 (0,020)	0,007 (0,027)	0,008 (0,026)	-0,008 (0,031)	-0,016 (0,041)	-0,016 (0,041)	0,000 (0,005)	0,000000049 (0,00000014)	-0,004 (0,003)
Control	Contractor Claims		-0,013 (0,085)	-0,010 (0,079)		-0,074 (0,124)	-0,075 (0,124)		-0,014 (0,009)	-0,014 (0,009)
Control	Incidents		-0,075** (0,034)	-0,057* (0,032)		-0,085 (0,052)	-0,093* (0,053)		0,002 (0,004)	0,001 (0,004)
Control	Number of People on site		-0,00000440 (0,00000385)	0,00000469 (0,00000454)		-0,00000611 (0,00000564)	-0,00000868 (0,00000692)		-0,00000833*** (0,000000424)	-0,00000872*** (0,000000524)
Moder	Risk Mitigation Strategy			-0,161*** (0,050)			0,051 (0,079)			0,007 (0,006)
	Akaike's Information Criterion (AIC)	83.151	83.637	75.968	150.178	152.323	153.939	270.012	-398,555	-398.061
	Prob> χ^2	0.078	0.055	0.003	0.012	0.022	0.033	0.021	0,000	0,0000

Significant levels include 1% (***), 5% (**), and 10% (*)

Table 24 above presents the regression analysis results for normal data, incorporating the combined independent variables. COVID-19 presence has a negative effect on asset and finance performance in all three models. That is, COVID-19 decreases asset performance and financial performance. For asset performance, COVID-19 presence has the highest negative effect in model 3 (β=-0,172, p<0,05), and for financial performance, in model 1 (β=-0,199, p<0,05). In all three models of schedule performance, the COVID-19 presence has a positive effect, with only one statistically significant coefficient (β=0,014, p<0,05) in model 3.

The number of COVID-19 cases has very little effect on the three dependent variables in all three models, the only significant coefficients of the number of cases are for financial performance, at a 10% significance level, in all three models.

Lockdown level has only a negative effect on financial performance in all three models, and on schedule performance in model 3. This means that financial performance decreases during lockdown levels, and schedule performance only decreases in the presence of control variables: claims, incidents, and number of people on site.

Control variables (contractor claims, incidents, and number of people on site) have not changed the direction of the impact of the three independent variables (COVID-19 presence, lockdown level, and number of COVID-19 cases) on asset, schedule and financial performance (the signs of their coefficients remained the same from model 1 to model 2). Contractor claims is negative on all the three predicted variables (that is, asset, finance, and schedule performance decrease when the contractor's claims are controlled in the models), but not statistically significant in any of them, while incidents are only statistically significant on asset and financial performance.

Asset and financial performances decrease when incidents are controlled in the models. The significant coefficients of incidents are in asset performance (β=-0,075, p< 0,05) in model 2, and (β=-0,057, p<0,10) in model 3, and in finance performance (β=-0,093, p<0,10) in model 3. The number of people on site slightly decreases asset performance in model 2 (β=-0,0000044), financial performance in model 2 (β=-0,00000611) and model 3 (β=-0,00000868), and schedule performance in model 2 (β=-0,00000833, p<0,01) and model 3 (-0,00000872, p<0,01). Risk mitigating strategy decreases asset performance only (β=-0,161, p-value < 0,01). Further analysis outcomes are detailed in *Appendix D4: Regression analysis 1*.

4.1.5.2 Regression Analysis 2 - lagged data with variables combined

Table 25: Regression analysis (2) models in lagged data with variables combined

	Dependent Variable:	Asset Performance Model 1	Asset Performance Model 2	Asset Performance Model 3	Finance Performance Model 1	Finance Performance Model 2	Finance Performance Model 3	Schedule Performance Model 1	Schedule Performance Model 2	Schedule Performance Model 3
	Intercept	1,113*** (0,022)	1,094*** (0,049)	1,032*** (0,059)	1,202*** (0,033)	1,303*** (0,069)	1,327*** (0,083)	-0,037*** (0,005)	0,018*** (0,005)	1,337*** (0,082)
Independent	Covid-19 Presence	0,025 (0,061)	0,088 (0,066)	0,018 (0,076)	-0,229** (0,091)	-0,238** (0,100)	-0,204* (0,118)	0,004 (0,013)	-0,005 (0,007)	-0,207* (0,116)
Independent	Covid-19 Cases in South Africa	0,000000176 (0,000000443)	-0,000000304 (0,000000465)	-0,000000342 (0,000000454)	0,000000569 (0,000000642)	-0,000000225 (0,000000665)	-0,000000207 (0,000000665)	0,000000106 (0,0000000931)	-0,0000000287 (0,0000000452)	-0,000000203 (0,000000656)
Independent	Lockdown level	-0,031 (0,021)	-0,034 (0,022)	-0,030 (0,022)	0,044 (0,031)	0,071** (0,032)	0,068** (0,032)	0,003 (0,004)	0,006*** (0,002)	0,069** (0,032)
Control	Contractor Claims		0,014 (0,068)	-0,037 (0,073)		-0,163 (0,100)	-0,138 (0,110)		0,002 (0,007)	-0,141 (0,108)
Control	Incidents		0,102*** (0,039)	0,082** (0,040)		0,059 (0,056)	0,070 (0,061)		0,001 (0,004)	0,065 (0,061)
Control	Number of People on site		-0,00000513 (0,00000485)	0,000000762 (0,00000573)		-0,0000162** (0,00000686)	-0,0000185** (0,00000813)		-0,00000781*** (0,000000475)	-0,0000195** (0,00000813)
Moderating	Risk Mitigation Strategy			0,104* (0,058)			-0,046 (0,085)			-0,048 (0,084)
Moderating	Covid-19 Presence* Risk Mitigation Strategy									
Moderating	CovidCases*Risk Mitigation Strategy									
Moderating	Lockdown Level*Risk Mitigation Strategy									
	Akaike's Information Criterion (AIC)	84.989	83.097	81.938	146.379	144.212	145.917	-280.091	-386.931	144.936
	Prob> χ^2	0.382	0,090	0.049	0.102	0.026	0.04	0.067	0,000	0.032

Significant levels include 1% (***), 5% (**), and 10% (*)

The results of the regression of performance outcomes (asset, financial, and schedule) on lagged COVID-19 variables, with control variables and a moderating variable, in combined data, are presented in Table 25 above. Lagged variables are frequently used to model how past values of a variable influences its current or future values. In this analysis, the 4-month lag of the independent variables (COVID-19 presence, lockdown level, and COVID-19 cases) is used as explained in the trend analysis in section 4.1.4.

The 4-month lagged COVID-19 presence has a negative impact on financial performance in all three models and on schedule performance in models 2 and 3 (Regression Analysis 2 - lagged data with variables combined

Table 25). That is, COVID-19 decreases financial performance and schedule performance. For the two performance outcomes, that is, for financial performance regression analysis 2 (β=-0,229, p<0,05), and for financial performance, in regression analysis 1 (β=-0,199, p<0,05), the significant coefficients of COVID-19 presence have almost an equal negative effect of 20% between the concerned models. COVID-19 impact on asset performance diminishes in the lagged model, showing the effects are more immediate than lagged.

COVID-19 cases in South Africa did not have any statistically significant coefficient on any of the three models of each of the three performance outcomes. Nonetheless, it negatively impacts all three performance outcomes in models 2 and 3.

Lockdown level only negatively impacts asset performance in the three models and has statistically significant positive coefficients on the financial performance in model 2 (β=0,071, p<0,05) and model 3 (β=0,068, p<0,05), and on the schedule performance in model 2 (β=0,006, p<0,001) and model 3 (β=0,069, p<0,05).

In the presence of control variables (contractor claims, incidents, and number of people on site), the three independent variables (COVID-19 presence, lockdown level, and number of COVID-19 cases) remained statistically insignificant on asset performance, with only significant incidents (β=0,102, p<0,01). On financial performance, control variables kept COVID-19 presence significant (β=-0,238, p<0,05) and changed lockdown level to statistically significant (β=0,071, p<0,05) together with the number of people on site (β=-0,0000162, p<0,05). The control

variables in the schedule performance model changed the lockdown level to a statistically significant (β=-0,006, p<0,01), together with the number of people on site (β=-0,00000781, p<0,01).

The moderating variable, the risk mitigation strategy, did not change the significance of the independent variables and control variables in asset and financial performance. The level of significance of COVID-19 presence in financial performance only changed from 5% to 10%.

The coefficient of regression of COVID-19 presence became statistically significant at 10% (β=-0,207, p<0,10). The presence of a risk mitigation strategy in the models increases the asset performance (β=0,104, p<0,10) and decreases financial performance (β=-0,046) and schedule performance (β=-0,048). Further analysis outcomes are detailed in *Appendix D5: Regression analysis 2*.

4.1.5.3 Regression Analysis 3 - normal data with variables split

Table 26: Regression analysis (3) in normal data with variables split

	Dependent Variable:	Asset Performance Model 1	Asset Performance Model 2	Asset Performance Model 3	Finance Performance Model 1	Finance Performance Model 2	Finance Performance Model 3	Schedule Performance Model 1	Schedule Performance Model 2	Schedule Performance Model 3
	Intercept	1,128***(0,020)	1,120*** (0,040)	1,004*** (0,049)	1,227*** (0,030)	1,230*** (0,058)	1,250*** (0,074)	-0,046*** (0,005)	0,022*** (0,004)	0,027*** (0,006)
Independent	Covid-19 present (1=present; 0=otherwise)	-0,065 (0,138)'	-0,076 (0,133)	-0,082 (0,123)	-0,175 (0,204)	-185 (0,197)	-0,185 (0,197)	-0,007 (0,037)	0,009 (0,014)	0,009 (0,014)
	Covid-19 not present (1=not present; 0=otherwise)									
	Lockdown Level 0 (1=lockdown 0; 0= otherwise)									
	Lockdown Level 1 (1=lockdown 1; 0= otherwise)	-0,047 (0,135)	-0,012 (0,132)	-0,091 (0,125)	-0,037 (0,199)	0,004 (0,196)	0,022 (0,197)	0,023 (0,036)	-0,006 (0,014)	-0,002 (0,014)
	Lockdown Level 2 (1=lockdown 2; 0= otherwise)	-0,020 (0,169)	-0,006 (0,163)	-0,089 (0,152)	0,031 (0,248)	0,059 (0,242)	0,077 (0,245)	0,030 (0,045)	0,005 (0,018)	0,009 (0,018)
	Lockdown Level 3 (1=lockdown 3; 0= otherwise)	-0,067 (0,155)	-0,011 (0,162)	-0,064 (0,151)	0,084 (0,229)	0,148 (0,242)	0,160 (0,243)	0,012 (0,041)	-0,014 (0,017)	-0,011 (0,018)
	Lockdown Level 4 (1=lockdown 4; 0= otherwise)	0,067 (0,171)	0,108 (0,176)	0,059 (0,163)	-0,059 (0,253)	-0,016 (0,261)	-0,005 (0,262)	0,021 (0,046)	-0026 (0,019)	-0,024 (0,019)
	Lockdown Level 5 (1=lockdown 5; 0= otherwise)	-0,071 (0,168)	-0,060 (0,186)	-0,151 (0,174)	-0,184 (0,248)	-0,189 (0,276)	-0,169 (0,279)	0,033 (0,045)	-0,022 (0,020)	-0,017 (0,020)
	Covid-19 Cases in South Africa	0,000000393 (0,000000492)	0,000000178 (0,000000506)	-0,000000294 (0,000000482)	0,000000621* (0,000000734))	0,000000307 (0,000000761)	0,000000404 (0,000000795)	0,000000203 (0,000000129)	0,000000018 (0,0000000530)	0,0000000824(0,0 000000544)
Control	Contractor Claims		0,030 (0,089)	0,019 (0,082)		0,053 (0,131)	0,056 (0,131)		0,016* (0,010)	-0,016* (0,009)
	Incidents		0,075** (0,035)	0,055* (0,033)		0,099* (0,052)	0,104** (0,053)		-0,003 (0,004)	-0,002 (0,004)
	Number of People on site		-0,00000429 (0,00000389)	0,00000531 (0,00000444)		-0,00000761 (0,00000556)	-0,00000930 (0,00000677)		-0,00000834*** (0,0000000422)	-0,00000876*** (0,000000516)
Moderating	Risk Mitigation Strategy			0,178*** (0,050)			-0,035 (0,079)			-0,008 (0,006)
	Covid-19 * Risk Mitigation									
	CovidCases*Risk Mitigation									
	Lockdown Level*Risk Mitigation									
	Akaike's Information Criterion (AIC)	89.257	89.763	80.11	155.398	156.332	158.139	263.11	393.253	393.151
	Prob> χ^2	0.275	0.164	0.007	0.055	0.042	0.06	0.148	0,000	0,000

Significant levels include 1% (***), 5% (**), and 10% (*)

Table 26 represents the results of the regression models where categorical independent variables, COVID-19 presence, and lockdown level are separated into distinct dummy variables, allowing for more granular effects. Dummy variables are used to represent categorical variables in a regression model. For each categorical variable, one category is always considered the reference category, used to compare other categories to it. For COVID-19, category 0 (COVID-19 not present) is the reference category, and for the lockdown level, level 0 is the reference category.

When COVID-19 is present, in model 1, asset performance is decreased on average by 0,065 compared to when it is not present, while holding other variables (lockdown level and number of COVID-19 cases) constant. For financial performance, it decreases by 0,175, and by 0,007 for schedule performance.

In model 1, asset performance has decreased, on average, in all lockdown levels except in level 4, compared to lockdown 0, while holding other variables constant. Financial performance, on average, when compared to lockdown 0 while holding other variables constant, has decreased in lockdown 1 (β=-0,037), lockdown 4 (β=-0,059), and lockdown 5 (β=-0,184). Schedule performance did not experience a decrease in any lockdown level.

In model 2, the use of control variables in the model did not change the direction of the impact of COVID-19 presence, nor of the different lockdown levels on asset performance. This use changed only the direction of lockdown level 1, from decrease (β=-0,037) to increase (β=0,004). Control variables have changed the direction of the impact of COVID-19 presence on schedule performance, from a decrease (β=-0,007) to an increase (β=0,009), as well as the direction of the impact of lockdown level 1 from an increase (β=0,023) to a decrease (β=-0,006), lockdown level 3 from an increase (β=0,012) to a decrease (β=-0,014), lockdown 4 from (β=0,021) to (β=-0,026), and lockdown level 5 from 0,033 to -0,022. The direction of COVID-19 cases did not change either by the introduction of control variables.

In model 3, the moderating variable, the risk mitigation strategy, changed the direction of the impact of the COVID-19 cases, on asset performance, from increasing (β=0,000000178) to decreasing (β=-0,000000294), and for the number of people on site, from decreasing (β=-0,00000429) to increasing (β=0,00000531). On financial

performance, the moderating factor did not change the direction of the impact of any of the independent variables, nor of any of the control variables. Schedule performance did not experience any change in the direction of the impact of the independent variables due to the risk mitigation strategy. It only changed the direction of the impact of the contractor claims from increasing (β=0,016, p<0,10) to decreasing (β=-0,016, p-value < 0,10).

It must be noted three interaction terms were tested (COVID×RMSTRA, LOCKL×RMSTRA, and ACTCASA×RMSTRA) to assess potential moderation effects. As none reached statistical significance (all p>0.10) this was found to be due to the binary nature of how the variable was represented thus actually not moderating the independent variables and serving more as a standalone variable. Thus, only the main effect of RMSTRA was retained in the final models to maintain parsimony while controlling for its independent influence on project outcomes.

Further analysis outcomes are detailed in *Appendix D6: Regression analysis 3*.

4.1.5.4 Regression Analysis 4 - lagged data with variables split

Table 27: Regression analysis (4) models in lagged data with variable split

	Dependent Variable:	Asset Performance Model 1	Asset Performance Model 2	Asset Performance Model 3	Finance Performance Model 1	Finance Performance Model 2	Finance Performance Model 3	Schedule Performance Model 1	Schedule Performance Model 2	Schedule Performance Model 3
	Intercept	1,103*** (0,021)	1,067*** (0,049)	1,024*** (0,055)	1,198*** (0,033)	1,323*** (0,071)	1,323*** (0,081)	-0,037*** (0,005)	0,020*** (0,005)	0,022*** (0,06)
Independent	Covid-19 present (1=present; 0=otherwise)	-0,152 (0,139)	-0,148 (0,129)	-0,154 (0,127)	-0,229 (0,214)	-0,193 (0,196)	-0,193 (0,199)	-0,011 (0,031)	0,005 (0,013)	0,005 (0,013)
	Covid-19 not present (1=not present; 0=otherwise)									
	Covid-19 Cases in South Africa	0,0000003 (0,000000488)	-0,000000306 (0,000000485)	-0,000000242 (0,00000048)	0,0000009 (0,000000728)	0,000000239 (0,000000725)	0,000000238 (0,000000727)	0,000000137 (0,000000107)	-0,0000000334 (0,0000000501)	-0,0000000366 (0,00000005)
	Lockdown Level 0 (1=lockdown 0; 0= otherwise)									
	Lockdown Level 1 (1=lockdown 1; 0= otherwise)	0,181 (0,136)	0,255* (0,131)	0,191 (0,135)	0,036 (0,209)	-0.004 (0,200)	-0,003 (0,211)	0,020 (0,030)	-0,004* (0,013)	0,000 (0,014)
	Lockdown Level 2 (1=lockdown 2; 0= otherwise)	-0,055 (0,169)	0,022 (0,161)	-0,044 (0,164)	0,125 (0,261)	0,082 (0,247)	0,083 (0,256)	0,017 (0,037)	-0,007 (0,017)	-0,003 (0,017)
	Lockdown Level 3 (1=lockdown 3; 0= otherwise)	0,030 (0,155)	0,114 (0,147)	0,048 (0,151)	0,066 (0,237)	0,067 (0,224)	0,068 (0,234)	0,018 (0,034)	0,011 (0,015)	0,014 (0,016)
	Lockdown Level 4 (1=lockdown 4; 0= otherwise)	0,088 (0,172)	0,132 (0,161)	0,073 (0,163)	0,088 (0,263)	0,063 (0,245)	0,064 (0,253)	0,024 (0,038)	0,013 (0,017)	0,016 (0,017)
	Lockdown Level 5 (1=lockdown 5; 0= otherwise)	0,084 (0,169)	0,128 (0,168)	0,121 (0,165)	0,319 (0,261)	0,538** (0,257)	0,538** (0,257)	0,043 (0,037)	0,024 (0,017)	0,024 (0,017)
Control	Contractor Claims		0,013 (0,072)	-0,051 (0,082)		-0,262** (0,107)	-0261** (0,129)		0,000 (0,007)	0,004 (0,009)
	Incidents		0,117** (0,038)	0,091** (0,041)		0,042 (0,059)	0,042 (0,065)		0,001 (0,004)	0,002 (0,004)
	Number of People on site		-0,00000342 (0,00000462)	0,00000107 (0,0000054)		-0,0000169** (0,00000679)	-0,0000169** (0,00000798)		-0'00000791**** (0,000000477)	-0,00000816*** (0,00000057)
Moderating	Risk Mitigation Strategy			0,089 (0,060)			-0,001 (0,091)			-0.005 (0,006)
	Covid-19 * Risk Mitigation	0	0	0	0	0	0	0	0	0
	CovidCases*Risk Mitigation	0	0	0	0	0	0	0	0	0
	Lockdown *Risk Mitigation	0	0	0	0	0	0	0	0	0
	Akaike's Information Criterion (AIC)	85.238	81.146	80.875	153.207	148.434	150.434	-273.053	-380.781	-379, 485
	Prob> χ^2	0.147	0.022	0.017	0.39	0.052	0.078	0.321	0,000	0,000

Significant levels include 1% (***), 5% (**), and 10% (*)

The results of the regression of asset, financial, and schedule performance on split lagged COVID-19 variables, with control variables and a moderating variable, in lagged data, are presented in Table 27 above. As in Table 25, the 4-month lag of the independent variables (COVID-19 presence, lockdown level, and COVID-19 cases) is used as explained in the trend analysis in section 4.1.4. Furthermore, for lagged COVID-19, category 0 (COVID-19 not present) is the reference category, and for the lagged lockdown level, level 0 is the reference category.

When COVID-19 is present, in model 1, asset performance is decreased on average by 0,152, financial performance by 0,229, and schedule performance by 0,011, compared to when it is not present, while holding other variables (lockdown level and number of COVID-19 cases) constant. Asset performance, in model 1, has decreased, on average, only in lockdown level 1, compared to lockdown 0, while holding other variables constant. Both Financial and schedule performance, on average, did not decreased during all levels of lockdown, when compared to lockdown 0 while holding other variables constant.

The use of control variables in the model 2, did only change the direction of the impact of the lockdown level 2, from decreasing (β=-0,055) to increasing (β=0,022) on asset performance. Furthermore, these variables changed lockdown level 1 to become statistically significant (β=0,255, $p<0,10$). The presence of control variables also changed the direction of impact of lockdown level 1, from increasing (β=0,036) to decreasing (β=-0,004) on financial performance. Control variables, as well, turned the lockdown level 5 to statistically significant (β=0,538, $p< 0,05$) on financial performance. On schedule performance, lockdown level 1 changed from increasing (β=0,020) to decreasing (β=-0,004, $p<0,10$).

In model 3, the moderating variable, the risk mitigation strategy, has practically no influence in the values of the coefficients, the direction of the impact, and the significance, on financial performance. It also turned the lockdown level 2 to decreasing (β=-0,044) and contractors claims to decreasing (β=-0,051), on asset performance. Risk mitigation strategy did not change anything significantly on schedule performance. As in regression 3, the three interaction terms yielded no moderation effects due to the binary nature of the interaction terms. Further analysis outcomes are detailed in *Appendix D7: Regression analysis 4*.

4.2 Discussions of findings

The objectives, defined in section 1.5, for the associated research study involve assessing the impact of COVID-19 on the schedule, financial and overall asset creation performance of the Kusile project, further assessing the impact of risk mitigation strategies and finally to provide recommendations for efficient and effective methods to manage black-swan events in relation to mega-project construction going forward. The key findings of the study are grouped per objective and discussed below.

4.2.1 *Objective 1 – Analyse, assess and evaluate the impact of COVID-19 on Schedule Performance during a black swan event*

The regression results for schedule performance uncovered that while COVID-19 had no immediate statistical significance ($p>0.05$) in earlier models, the secondary effect of government mandated lockdowns was statistically significant only in lagged models (e.g., $p=0.003$). Interestingly, the positive coefficients (e.g., $\beta=0.006$, $p<0.001$) suggest that schedule performance may have benefitted from reduced operational complexity during lockdown periods — possibly due to less congestion, tighter planning, reduced parallel activities, or due to schedule re-baselining that may have masked the true impact with regards to schedule performance. Regression models 1 and 3 (Normal) showed COVID-19 presence was likely underreported due to re-baselining of the schedule, however regression models 2 and 4 (Lagged) revealed true disruptions (-0.207*) as the re-baseline adjustments faded. The finding that COVID-19 was only significant in lagged models ($p=0.003$) is a critical insight into mega-project inertia. Unlike smaller projects that feel an immediate site stoppage, Kusile's size meant the initial shock was absorbed by schedule float, delayed material dependency, or administrative re-baselining. The true, compounding pressure of reduced efficiency and supply chain backlogs only manifested 3-4 months later when the float was exhausted. This suggests schedule management systems must use lagging indicators to forecast black swan risks.

Workforce size proved to be the most powerful predictor and negative driver of schedule delays, demonstrating a high significance across all models ($p<0.001$), this indicates that larger on-site teams may have unintentionally exacerbated pandemic-related scheduling challenges at Kusile PS. This is potentially due to social distancing

causing constraints and reducing efficiency, increased complexity in coordination, higher infection risks leading to absenteeism etc. The highly significant, negative relationship between workforce size and schedule performance (even surpassing lockdowns) fundamentally shifts the interpretation of "essential service" site management. In a systemic shock, a massive workforce becomes a logistical liability rather than an advantage. The sheer complexity of enforcing physical distancing, managing segregated teams, and addressing sequential absenteeism effectively created a larger-than-necessary bottleneck, a critical failure point in Kusile's operational resilience framework.

Risk mitigation strategies proved statistically ineffective in protecting schedule performance (i.e. $p>0.05$ across all models), indicating that the business continuity plans failed, during pandemic conditions at Kusile PS, to address the specific operational realities of mega-project execution.

The contradiction between the Kruskal-Wallis test (showing schedule improvement during COVID-19) and the lagged regression results (showing significant delays after re-baselining faded, $p=0.003$) highlights a key methodological contribution. The apparent "improvement" likely represents a statistical masking effect which is either due to a deliberate re-baselining of the schedule or the early completion of non-critical tasks. The regression analysis, by controlling for other factors, successfully unmasked the true systemic delay once the project consumed its hidden safety margin.

Contractor claims appeared harmful in Mann-Whitney tests ($p=0.033$) but were overshadowed by workforce size ($p<0.001$) in regression, suggesting claims were a symptom and not the root cause. Risk mitigation strategies seemed effective in group comparisons ($p=0.002$) but failed in regression ($p=0.217$-0.291), indicating their benefits were perhaps blended with other project advantages.

The study outcomes indicate that lockdown measures rather than COVID-19 infections directly were responsible for schedule delays, which aligns with multiple international studies. Similarly, Shaikh et al (2023) identified the primary driver of construction delays in Pakistan as government involvement. The strong correlation between workforce size and delays ($p < 0.001$) supports Timilisina et al (2021) who highlighted workforce management difficulties (Figure 1) exacerbated scheduling challenges in Nepal. Furthermore, Gamil and Alhager (2020) found that having more people on-site

increased the perceived risk during COVID-19 and projects thus responded by reducing gatherings, implementing social distancing, and this potentially caused operational inefficiencies. Musonda and Rakolote's (2021) South African findings (Table 1) imply that labour instability and COVID-19's disruption of normal workforce functioning potentially affected project timelines. The ineffectiveness of risk mitigation strategies however, contrasts with Ogunnusi et al.'s (2021) global observations of productivity improvements through adaptive measures during the pandemic (Table 3), suggesting potential implementation gaps in the Kusile project.

Thus, Null Hypothesis (H_0) COVID-19 had no significant effect on schedule performance is rejected, COVID-19 direct impact was not statistically significant, but the impact grew as the re-baselining adjustments faded Furthermore, lockdowns (as a delayed secondary effect) and workforce size increases were also statistically significant in negatively affecting schedule performance and thus the hypothesis is rejected.

4.2.2 *Objective 2 - Analyse, assess and evaluate the impact of COVID-19 on Financial Performance during a black swan event*

The initial significant impact reflects immediate shocks (p=0.06 - 0.023) in the initial models (regression 1 and 3) like currency volatility, cost escalations, material cost spikes, and standing time claims. However, the subsequent, larger negative impact in lagged models (p=0.012) is the more critical finding. This delayed deterioration (regression 2 and 4) is indicative of cascading financial fragility, the point where contractors face liquidation, complex negotiation time and costs spike, and financial controls fail to contain the crisis. This suggests financial risk mitigation must focus on contractor stability and liquidity support for months after the initial event.

Unlike other performance dimensions, active COVID case numbers showed marginal significance (p=0.066 - 0.095) in some financial models. The positive coefficients in regression model 1 and 3, suggest that higher COVID case numbers were associated with slightly improved financial performance ratings, possibly reflecting cost deferrals, reduced on-site activity, or enhanced financial controls during periods of disruption.

However, in the lagged models, COVID case numbers impact is insignificant, suggesting no long-term financial impact from case counts.

Lockdowns showed insignificant negative trends (too weak to conclude real harm (*p > 0.10*)) in immediate regression models (1 and 3) but displayed a significant recovery in lagged regression models (2 and 4). Financial performance was negatively impacted by incidents (β=-0.093*, p<0.10) in regression model 1, but this was not consistent across all regression models. However, increased on-site staffing had a negative impact across all models, with greater significance in lagged models (β=-0.0000169**, p<0.05), suggesting staffing inefficiencies contributed to significant financial losses. Risk mitigations failed to safeguard financial outcomes in both the normal (p=0.52) and lagged models (p=0.587), highlighting a potential gap in Kusile's conventional risk management frameworks when handling systemic financial shocks.

The Mann-Whitney test's conclusion of "no effect" dramatically underestimated the disruption. The regression analysis (findings of a sharp immediate (p=0.023) and lagged financial impacts (peaking at 4 months, p=0.012-0.084), which can account for time and the compounding nature of risk, revealed a severe, prolonged crisis. This confirms the value of time-series regression for financial analysis; without it, the delayed and complex effects (like liquidations or slow payment cycles) would be completely lost in simple mean comparisons, leading to dangerously inaccurate conclusions about financial resilience.

Active COVID-19 case numbers showed marginal predictive value for financial distress in regression (p=0.066-0.095), a relationship non-parametric tests could not assess. Both methods agreed risk mitigation failed financially; regression precisely quantified this failure (p=0.519) highlighting a critical gap in traditional risk frameworks.

Gamil and Alhager (2020) do emphasise that recovery from such financial disruptions is not instantaneous, noting that the impacts can persist over time, affecting the stability and operations of construction companies even after the initial crisis has subsided, which this study supports.

Kisi and Sulbaran (2022) reported cost escalations of approximately 4-11%, however the study did not identify the delayed financial shock pattern found in this research. The studies by Adepu et al (2023) and Timilsina et al (2021) identified government

budget reduction, the deteriorating financial situation of the contractors, late payments as reasons for the immediate financial impact during the pandemic (Adepu et al., 2023; Timilsina et al., 2021), however the lagged effects found in this study suggests deeper disruptions that have not been sufficiently highlighted in these studies.

The complete failure of conventional risk mitigation strategies to safeguard financial performance represents a major contextual finding. While Ogunnusi et al.'s (2021) reported improved financial control across several regions during the COVID-19 pandemic (largely due to reductions in overhead costs such as travel and administration) Kusile experienced the opposite trend. This divergence suggests that the structural inflexibility inherent in Eskom's mega-project contracts and cost-control policies constrained its capacity to adapt. The risk framework appeared to frame the pandemic primarily as a technical scheduling problem rather than a systemic financial shock requiring contractual or strategic reconfiguration. Moreover, risk mitigation efforts seemed to prioritise asset creation continuity and health and safety compliance over financial efficiency, reflecting the operational imperatives of a state-owned utility under crisis conditions. Additional external economic shocks, including inflationary pressures and supply chain disruptions, may have further undermined the effectiveness of financial controls. Collectively, these dynamics reveal potential shortcomings in the design and practical application of financial risk mitigation strategies within large-scale infrastructure projects such as Kusile.

Overall, the analysis reveals that financial performance suffered immediate and delayed declines (statistically significant) due to COVID-19 presence and lockdowns, exacerbated by staffing and incident costs. Mitigation strategies showed minimal direct financial benefits. Thus, Null Hypothesis (H_0) COVID-19 had no significant effect on financial performance is rejected.

4.2.3 *Objective 3 – Analyse, assess and evaluate the impact of COVID-19 on Overall Asset Creation Performance during a black swan event*

Asset creation performance presented a contrasting profile of pandemic resilience. COVID-19's immediate negative effect was evident in regression model 1 across all models (i.e. p = 0.055 in base models), but unlike financial metrics, these impacts did

not intensify over time in lagged analyses (regression model 2). In regression model 3 and 4 the negative impact (though not significant) persisted.

Lockdowns showed insignificant negative trends (too weak to conclude real harm ($p > 0.10$) in the normal and lagged regression models (3 and 2), with coefficients remaining statistically insignificant across all models, suggesting no direct impairments. Asset performance has decreased, on average, in all lockdown levels except in level 4 (regression 3), with limited change noted in regression 4.

Operational incidents emerged as a persistent secondary threat ($p=0.029 – 0.077$ in the normal model – negative coefficients, and $p=0.009$-0.039 – positive coefficient across lagged models), independent of pandemic conditions, suggesting that baseline operational risks remained relevant even during extraordinary disruptions. This performance dimension uniquely demonstrated the value of existing risk protocols when properly implemented. The analysis reveals a time-dependent duality in how incidents and risk mitigation strategies affect asset performance. In the short term, incidents significantly reduce productivity ($\beta=-0.075$, $p = 0.029$), while risk mitigation strategies, although also negatively associated with performance ($\beta=-0.161$, $p=0.077$), may reflect the cost or operational trade-offs of implementing controls during disruptions. However, the 4-month lagged model presents a notable reversal where past incidents are positively associated with asset performance ($\beta=0.082$, $p=0.039$), likely reflecting organisational learning and operational improvements implemented in response to earlier disruptions. Similarly, lagged risk mitigation strategies show a positive but only marginally significant relationship with performance ($\beta=0.104$, $p=0.072$), suggesting that proactive mitigation efforts may yield longer-term benefits, though the evidence is not statistically strong. Therefore, risk mitigation appears to benefit long-term asset performance, likely by preventing defects or breakdowns. However, these strategies come at a cost, both financially and in terms of schedule efficiency — possibly due to the added procedures, resource constraints, or downtime required for implementation. The trade-off shows we may attain better assets, but they are more expensive and potentially slows execution. Risk mitigation strategies are investments which may appear costly or disruptive at the outset but generate positive returns over time, especially when aligned with organisational learning and adaptation. This shift highlights the importance of evaluating both the immediate and delayed effects of resilience strategies within asset-intensive environments.

While ANOVA and t-tests provided initial insights into pandemic-related performance differences, regression analysis revealed more nuanced relationships after accounting for operational and risk factors, some notable insights are discussed below. COVID-19's direct effect was significant in ANOVA however after COVID-19 there appeared to be some lagged effects, the significance was confirmed in the regression analysis however the impact in the 4 months lagged regression was partly mediated by secondary factors and risk mitigations. The apparent improvement in performance linked to operational incidents (from comparative tests) reversed in regression, suggesting that other project characteristics initially masked their true negative effect. Risk mitigation strategies, which appeared ineffective in simple mean comparisons, emerged as highly significant when controlling for pandemic disruptions and other variables in the long-term. Thus, the immediate COVID-19 impact on asset performance with successful mitigation over time, supports Gamil and Alhagar's (2020) findings about proactive preparation through interventions and strategies to prepare for the worst-case scenario during the planning stage of construction projects.

The persistent initial incident (INCID) effects ($p=0.029$ - 0.077) align with Musonda and Rakolote's (2021) findings shown in (Table 1) that identifies operational challenges (workforce, supply chains, and other routine problems) as a contributor to delays. The marginally significant improvement in asset performance in the lagged model ($p=0.072$) indicates that risk mitigation strategies yield delayed, rather than immediate, benefits. This temporal shift from initial performance costs to later positive effects underscores the importance of sustaining mitigation efforts over time, especially in mega-project environments where operational gains may only materialise after some time.

The contrasting resilience of asset creation, where impacts did not intensify over time, is likely due to the non-negotiable nature of quality assurance on a project of this scale. Unlike schedule or finance, asset integrity is governed by strict, inflexible technical codes. This suggests that the core quality assurance processes at Kusile (inspections, material checks) were structurally more resilient to the external shock than the flexible, human-intensive systems of scheduling and cost management. This provides evidence that processes governed by rigid technical standards are more resistant to black swan failure.

The successful separation of asset creation performance from traditional schedule metrics represents a unique contribution. The finding that mitigation efforts were ineffective financially and marginally negative on schedule, yet showed positive lagged benefits for asset creation, proves that these dimensions respond asymmetrically. This calls for a refinement of mega-project reporting, advocating for the isolation of asset quality as a distinct, resilient KPI to prevent it from being sacrificed in the face of schedule and cost pressures.

Thus, Null Hypothesis (H_0) COVID-19 had no significant effect on asset creation performance is rejected, although the immediate COVID-19 effect is marginal (p = 0.055), it is close enough to suggest an impact. Furthermore, effective mitigation response to COVID-19 impact supports the rejection of the null hypothesis.

4.3 Conclusion

The research successfully addressed all three original objectives while revealing important asymmetries in how different project performance dimensions respond to black swan events. Schedule disruptions proved most sensitive to policy responses rather than viral spread itself, financial performance suffered from both immediate and delayed impacts with no mitigation from standard approaches, while asset creation showed the most resilience and responsiveness to risk management interventions in the long-term. The findings suggest that mega-project resilience could be improved with specific and targeted strategies that address the unique dynamics and vulnerabilities of each performance metric, as opposed to a one-size fits all approach.

CHAPTER 5. CONCLUSIONS, LIMITATIONS AND RECOMENDATIONS

5.1 Conclusion

5.1.1 *Summary of findings*

This study reveals that challenges experienced in the construction industry were not only immediate, but that prolonged effects became apparent over time. The lagged impact of COVID-19 however did vary across the project performance metrics.

Project Schedule Performance (PSCHP) did not experience significant immediate effects from COVID-19, however there were delayed impacts. Further delays were driven by workforce size and lockdown policies showing minor disruptions to schedules in lagged models, with risk mitigation strategies having no significant impact. This indicates that regulatory responses and not the virus directly caused schedule disruptions.

Project Financial Performance (PFP) experienced an immediate and significant delayed effect due to COVID-19 presence, exacerbated by staffing costs and/or inefficiencies. The introduction of risk mitigation strategies did however weaken this effect but overall showed minimal direct financial benefits.

Project Asset Creation Performance (PACP) experienced an immediate negative effect from COVID-19 and incidents, but mitigation strategies yielded long-term improvements. In addition, unlike the Project Financial Performance (PFP) the lagged effect was negligible.

The success that risk mitigation strategies (RMSTRA) had in counteracting the impact of COVID-19 on performance measures varied. In the non-lagged models, mitigation measures failed to buffer the asset, financial and schedule impacts whilst in lagged models, RMSTRA's impact was even weaker, offering only long-term benefit and improvement to PACP and no meaningful mitigation for PFP or PSCHP. Although risk mitigation strategies (RMSTRA) significantly improved asset creation performance ($\beta = 0.104^*$, $p = 0.072$), the interaction with the independent variables i.e. COVID-19,

lockdown levels, and case numbers was not statistically significant ($p > 0.05$ for these variables). Thus, while RMSTRA enhances outcomes, it does not appear to moderate the impact of pandemic-related disruptions.

Furthermore, active COVID cases (ACTCASA) never showed true significance across the models, reinforcing that case numbers alone did not drive delays. Based on the analysis, the theory of lagged Black Swan effects holds true for financial and schedule performance but not entirely for asset creation. These findings suggest that post-pandemic recovery planning should account for delayed financial shocks while prioritising immediate operational resilience and post-lockdown.

Overall, the regression analysis confirms that COVID-19 presence exerted a statistically significant negative influence on financial and asset creation performance, consistent with findings by Kisi and Sulbaran (2022) and Adepu et al. (2023)). This outcome supports complexity theory, as it reflects how systemic interdependencies amplified disruption effects across the project lifecycle. However, the lagged improvements observed in asset creation performance align with resilience theory, indicating adaptive recovery once mitigation strategies stabilised resource flows. These results illustrate that while black swan events initially erode performance, organisational resilience mechanisms can gradually restore productivity over time.

This study makes a distinct contribution by empirically quantifying the impact of a black swan event using audited longitudinal project data — a methodological gap in existing construction management literature. The findings demonstrate that while immediate performance metrics deteriorate during crises, adaptive strategies embedded within organisational processes can restore long-term resilience. The study thus offers a replicable framework for crisis-resilient project management in developing economies.

5.1.2 *Limitations*

This study experienced several limitations that should be addressed in future research.

- ✓ The 4-month lag may not have captured the long-term effects sufficiently.
- ✓ The June 2020 schedule re-baselining introduced another limitation, which reduced the observable pandemic impacts on schedule performance.

- ✓ Risk mitigation strategies were treated broadly i.e. as a single variable, thus identifying the specific strategies that were effective was not possible.
- ✓ The binary nature of RMSTRA (present/absent) may have been too coarse to detect nuanced interaction effects.
- ✓ COVID presence and lockdown levels showed a high correlation, however both assessment areas were retained in the regression analysis due to their importance to the objective of the study.
- ✓ The construction of Kusile PS, though critical to South Africa's energy sector, may limit generalisability to other project types.

5.2 Recommendations

5.2.1 *Practical Recommendations*

The study reveals the strong link between schedule delays and workforce size, thus in the event of a black swan event optimising resources through staggered shifts and modular team structures are strategies that may limit the impact of the number of people working to the overall productivity and schedule delays, as suggested by Kisi and Sulbaran's (2022) findings on labour disruptions.

The lagged financial shocks support the outcomes of Musonda and Rakalote (2021) and Ogunnusi *et al.* (2020) studies that the force majeure, standard forms of contract and contingency plans must be revised to deal with current and future pandemics.

This analysis reveals that asset performance is uniquely resilient to disruptions, while incidents cause immediate harm, they can indirectly drive improvement. Risk mitigation strategies, however, flatten this curve by addressing root causes over time. These findings highlight the importance of balancing mitigation with adaptive learning in project management during black swan events.

While risk mitigations aided operational resilience, it served a limited role in the financial and schedule recovery, highlighting the need for more adaptive, data-driven approaches that distinguish between different types of disruptions and their potential pathways of impact on complex projects in future crises.

The findings imply that Eskom's reliance on rigid contractual frameworks limited agility during crisis periods. Future project designs should incorporate flexible contracting, modular workforce structures, and digital coordination platforms to sustain operations during systemic shocks. Integrating digital performance dashboards and hybrid coordination systems will enhance response speed during disruptions. For industry practitioners, these insights underline the necessity of embedding resilience indicators within performance monitoring systems. Policymakers should revise force majeure and procurement guidelines to include pandemic-specific clauses, ensuring that national infrastructure projects remain resilient to global crises.

5.2.2 *Future research*

The following future research is proposed to gain a deeper understanding of disruption impacts and the effectiveness of mitigations, with consideration of the findings and limitations of the study:

Future studies should explore distributed lag models with extended lag periods beyond four months to better capture delayed responses in financial and schedule performance. The present study identified time-varying effects, where cost and schedule disruptions persisted after asset creation had stabilised. Longer-horizon models could therefore clarify the temporal dynamics of post-shock recovery.

Risk-mitigation strategies should be decomposed into specific intervention categories—for instance, supply-chain restructuring, workforce rotation, or digital monitoring—and quantitatively related to individual performance metrics. This would make it possible to assess which measures most effectively moderate black swan impacts.

Cross-sectoral and comparative case analyses of mega-projects in energy, transport, and construction sectors—before, during, and after the pandemic—would extend the generalisability of this study's findings. Such comparisons could illuminate how organisational and contextual differences influence resilience outcomes.

Integrating primary qualitative research through interviews or focus groups with project managers, engineers, and policymakers could provide deeper insight into the behavioural and leadership dimensions of adaptive responses observed in the quantitative data. Combining statistical and experiential evidence would enrich theoretical explanations of resilience.

Future work could re-examine schedule-performance data by reverting to the original pre-June 2020 baseline. This would allow a more accurate assessment of COVID-19's true schedule impact, uncontaminated by post-crisis re-baselining. The June 2020 schedule re-baseline could be reverted to the original timelines and all analysis related to schedule performance be re-evaluated accordingly, this will provide a more accurate depiction of the impact of COVID-19.

Finally, extending this study's quantitative approach into a predictive modelling framework could transform descriptive results into actionable forecasting tools for organisational resilience, addressing critical gaps while leveraging this study's foundational insights about the differential, time-varying impacts of black swan events across project performance dimensions.

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Appendix A: Chapter 1

A1: Background of the study

Black Swan Events and COVID-19

There are generally two differing perspectives amongst researchers regarding managing Black Swan events, one approach focuses on predicting the event, while the other emphasizes dealing with the consequences if the event occurs (Hajikazemia et al., 2016). Some researchers argue that Black Swan events are inherently unpredictable, making it impossible to foresee them, conversely, others believe that some specific strategies and methodologies enable project managers and stakeholders to proactively manage and mitigate the potential impacts of Black Swan events (Hajikazemia et al., 2016). The pandemic significantly affected all sectors of the global economy, halting many industrial activities (Gamil & Alhagar, 2020).

A2: Research questions

Does a Black Swan event like Covid 19 result in a decreased project performance in terms of schedule delays, increased costs, and decreased construction progress on a mega-structure project?

a. What is the impact of a black swan event (COVID-19) on the schedule performance of Eskom's mega-project: Kusile PS?
b. What is the impact of a black swan event (COVID-19) on the financial performance of Eskom's mega-project: Kusile PS?
c. What is the impact of a black swan event (COVID-19) on the overall asset creation performance of Eskom's mega-project: Kusile PS?

Appendix B: Chapter 2

B1: Comparative analysis - methodologies

Different approaches were explored in similar studies to better understand the relationship between the COVID-19 pandemic and the construction business:

In Musonda and Rakolote (2021) study, the impact of COVID-19 on the project life cycle framework was evaluated and data was collected through a mixed-methods approach: online panel discussions and structured questionnaires and assessed both qualitatively and quantitatively (Musonda & Rakolote, 2021). Timilsina et al (2021) used primary data gathered through semi-structured interviews focused on the impact of the COVID-19 pandemic on the construction business and analysed the data through thematic analysis. The study was based on an inductive analysis of participants' lived experiences through a qualitative research approach. (Shaikh et al., 2023) used questionnaire surveys to collect data from the employees working on building projects in Pakistan. Lagat et al (2023): Examined the effects on the Kenyan construction sector using a cross-sectional survey design, looking at data from a population at one specific time, and utilising a quantitative analysis.

Gomes et al (2022) evaluated COVID-19's impact on the restaurant industry (profitability, efficiency, and indebtedness) during the pandemic using secondary data and performed a quantitative analysis. Alu et al (2024) conducted a qualitative survey to evaluate the challenges encountered by project managers in managing project costs within the Nigerian construction industry. Appiah et al (2022) undertook a bibliometric and thematic review of literature to understand the impact that the pandemic had on performance. Furthermore, the recommendation for future research entailed understanding how the pandemic affected the performance of specific firms and/or sectors with potentially different growth perspectives (Appiah et al., 2022).

B2: Comparative analysis of COVID-19 impacts on construction projects

The comparative analysis across different studies is shown in Table 28 below.

Table 28: Comparative analysis of COVID-19 impacts on construction projects (authors' construction)

Region	Impact	Challenges	Mitigation Strategy
South Africa (Musonda & Rakolote, 2021)	The pandemic negative effects on the construction industry were exacerbated especially in developing countries such as South Africa (SA). The full-scale impact in SA is not known. The significant disruptions due to the national lockdown led to an increased project delivery period, increased labour disputes, contractual claims, and disputes.	Inadequate assessment of risks and preparedness for black swan events leading to labour shortages, contractual issues and supply chain disruptions. Adaptability to enable the adoption of digital technologies and remote work solutions.	Integrated project delivery, collaboration and adoption of technology i.e. digital procurement methods allowing for speedier delivery, collaboration, and more owner involvement. Modification of rules especially on health and safety, contingency plans, definition of force majeure, and standard forms of agreements should be considered.
Pakistan (Shaikh et al., 2023)	Experienced unsafe working conditions, labour shortages, escalating project costs, time, schedule, government-mandated shutdowns and reduced budgets, new safety requirements and protocols, supply chain disruptions, and limitations on work hours and site access resulting in delays in the completion of projects within the contracted budgeted cost.	The Pakistan industry faced significant disruptions in labour availability and supply chains.	Mitigation strategies to modify or amend the contract clause regarding for pandemic situation and incorporate the identified factors in the contract that should be considered by stakeholders to save the time and cost of the projects.
Nepal (Timilsina et al., 2021)	The construction sector in Nepal faced financial, operational, and institutional impacts, including reduced government budgets, deteriorating contractor finances, overdue payments, cost overruns, delays in project completion, supply chain issues, workforce management difficulties, and health and safety challenges.	Financial constraints and institutional weaknesses were more pronounced compared to South Africa in Musonda and Rakolote (2021) study.	The study emphasized the importance of financial support and institutional reforms to mitigate the impacts.
Kenya (Lagat et al., 2023)	Experienced project delays and cost overruns due to the pandemic. Struggled with similar issues as those in South Africa, such as labour shortages, finance and supply chain challenges. An average of 32% of	The challenges were consistent with those observed in Musonda and Rakolote's (2021) study on South Africa, including labour and financial issues.	The study suggested the need for better contingency and continuity planning.

Region	Impact	Challenges	Mitigation Strategy
	the projects were suspended, and 16% were terminated with a notable delay in commencing new projects.		
Nigeria (Alu et al., 2024)	Project managers in Nigeria faced challenges in managing project costs, with the pandemic exacerbating existing issues related to cost control.	Like South Africa, the Nigerian construction industry struggled with cost overruns and project delays.	The study recommended enhancing project cost control practices and improving financial management and risk management strategies.
Malaysia (Gamil & Alhagar, 2020)	The most severe effects included suspension of projects, labour impact and job loss, time overrun, cost overrun, and financial implications, uncertainty about business survival, and effects on research and technology.	Reduction of number of workers on-site - encouraging offsite work, contractors faced legal issues due to the nonconformity of contractual terms which is caused by the suspension of the project and sudden fluctuation of material price.	Preparation for the worst-case scenario during the planning stage of the construction projects.
Global Perspective (Appiah et al., 2022)	A bibliometric and thematic review of the literature revealed that the pandemic had a widespread impact on construction project performance globally, affecting timelines, costs, and overall efficiency.	The challenges were consistent across different regions, including labour shortages, supply chain disruptions, and financial constraints.	The study recommended future research to focus on understanding the long-term impacts of specific firms and/or sectors and developing robust mitigation strategies.
Global Perspective (Ogunnusi et al., 2021)	Surveys conducted across five continents using artificial intelligence analytics to analyse the data qualitatively, with specific focus on the lessons learned during the COVID-19 pandemic and the positive and negative impacts for future-proofing the construction sector.	The positive impacts noted were reduction in overhead costs, increased focus on health and safety, remote working environment, improved productivity and sustainability goals. The negative impacts included construction output and payment delays, low business turnover, loss of jobs and difficulties working from home.	Lessons learnt were noted as improved supply chain and construction project management, focus on health and safety and effective virtual working environment.

Region	Impact	Challenges	Mitigation Strategy
Global Perspective (Adepu et al., 2023)	A systematic literature review with a thematic analysis to identify and categorise challenges and mitigations.	The review revealed 26 challenges – some the more frequent challenges included labour shortages, force majeure confusion, suspension or slowing of ongoing projects, and safety concerns at the workplace.	Strategies cited included workforce investment, supplier management, transparent communication, and legal consultation, for managing the challenges encountered.
United States of America Kisi and Sulbaran (2022)	A quantitative approach with surveys completed by executives of construction companies.	COVID-19 pandemic impacted project schedule, increased cost, and disrupted the supply chain of building materials.	To mitigate cost and schedule impacts, as well as supply chain disruptions during future pandemics, construction companies should prioritise early procurement, expand material storage capacity, allow for longer lead times, and increase contingency planning.

B3: Relationship between variables in the study

The variables relevant to the study are shown in the table below.

Table 29: Variables of the research study (authors' construction)

Independent Variables	Dependent Variables	Moderating Variable	Control Variables
○ COVID-19 Presence ○ COVID-19 Cases in South Africa ○ Lockdown Level	○ Project Overall Performance - Asset Creation (KPIs) ○ Project Financial Performance (KPIs) ○ Project Schedule Performance (Actual schedule progress)	Risk Mitigation Strategies	○ Contractor Claims (related to COVID-19) ○ Number of People on Site ○ Major Incidents

A risk mitigation strategy will serve as a moderating variable as it influences the strength direction of the relationship between an independent variable (IV) and a dependent variable (DV). If the presence of a robust risk-mitigating strategy reduces the negative impact of COVID-19 on financial performance, then the strategy is moderating the relationship. Effective risk mitigation strategies might strengthen the positive impact of a low lockdown level on project performance by ensuring that even minimal disruptions are well-managed. Conversely, if risk mitigation strategies are poor, the negative impact of high COVID-19 cases on project performance might be exacerbated. Risk mitigation strategies might change the direction of the relationship i.e., a high number of COVID-19 cases may lead to poor project performance, but with robust risk mitigation strategies, the project might still perform well.

Introducing control variables such as the number of people on site, contractor claims, and major incidents (e.g., operating/maintenance issues, termination of contracts, unavailability of spares, etc.) is crucial to account for additional factors that might influence the relationship between the IVs and DVs. The number of people on site can significantly impact project performance, as a reduced workforce due to COVID-19 restrictions or health concerns can lead to delays and reduced productivity. Managing the workforce is also essential for maintaining health and safety standards, which can affect project schedules and overall performance. Contractor claims for delays, additional costs, or other issues can have a substantial financial impact on the project,

and controlling for this variable helps isolate the effect of COVID-19-related disruptions from other financial claims. Additionally, incidents such as operating, or maintenance issues can cause significant disruptions to project schedules and performance. Controlling for these incidents helps to isolate the specific impact of Covid-19. The unavailability of spares and other materials can delay project timelines and increase costs, especially during a pandemic when supply chains are often disrupted. Finally, the termination of contracts can lead to project delays and financial losses, and controlling for this variable helps to understand the specific impact of COVID-19 on project performance without the confounding effect of contract terminations.

There are interrelationships among IVs and DVs that could also be considered. The presence of COVID-19 is related to the number of cases. An increase in COVID-19 cases indicates the presence and spread of the virus. The number of COVID-19 cases influenced the lockdown level. Higher cases led to stricter lockdown measures. Regarding the dependent variable interrelationships, delays in the project schedule can lead to increased costs, affecting financial performance. Conversely, financial constraints can cause delays. Financial performance is a critical component of overall performance. Poor financial health or schedule delays can negatively impact the overall project KPIs. Similarly, there could be collective impacts such as an increase in COVID-19 cases might lead to stricter lockdown measures, which could disrupt project schedules and increase costs, thereby affecting financial performance and overall KPIs. Delays caused by stricter lockdowns could lead to increased costs, impacting the project’s financial performance and overall success.

Appendix C – Chapter 3

C1: Analytical framework

The positivism philosophy entails focusing on pure data and facts and is typically uninfluenced by human bias or interpretation (Saunders et al., 2019). This philosophy posits a single, objective reality, emphasizes measurable facts and scientific methods, and requires researchers to remain detached and neutral. (Saunders et al., 2019). The methods related to this type of study are typically quantitative, and very structured, consisting of large samples (Saunders et al., 2019). The approach of deduction entails formulating a theory through a series of hypotheses, specifying existing conditions from literature where the theory holds, collecting data to test the proposition, and performing an analysis to identify if the premise is indeed true or false (Saunders et al., 2019). The research philosophy for this study shall be positivism and the approach to theory development shall be deduction

C2: Research instrument

Secondary data consists of numeric and non-numeric data i.e., qualitative, and quantitative data, which may be raw, compiled, structured or unstructured (Saunders et al., 2019). Based on Figure 10, this research will use both documentary and multiple data sources which include Eskom databases, media accounts and government publications regarding Covid-19 statistics.

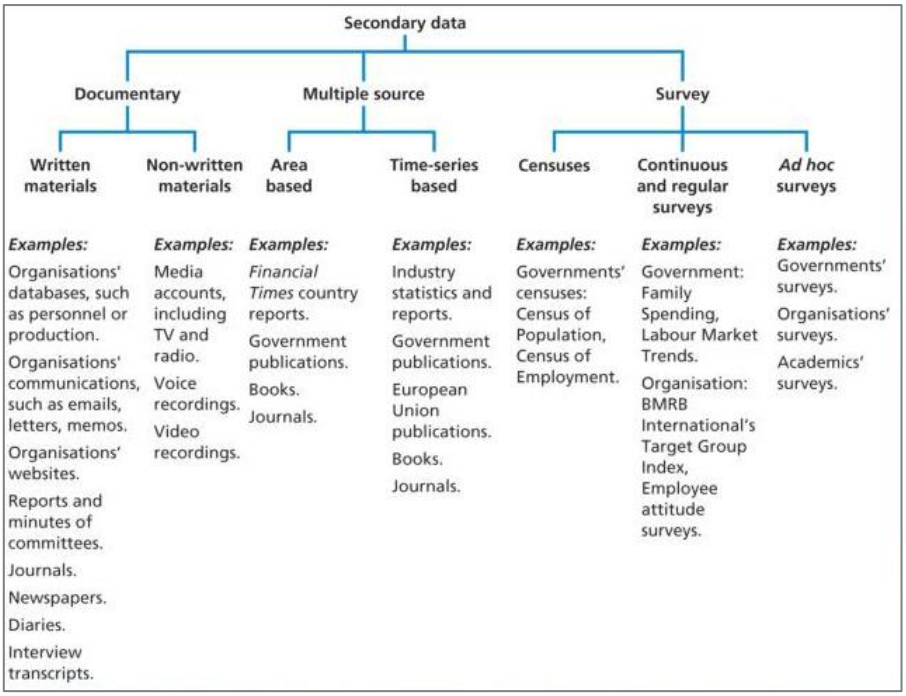


Figure 10: Types and examples of secondary data (Saunders et al., 2019)

The available secondary data was assessed using Figure 11 to ensure the data can assist in answering the research questions, adequately covers the population and period in question, has valid and reliable collection methods, is not distorted, and the associated costs of acquiring data bring substantial benefit.

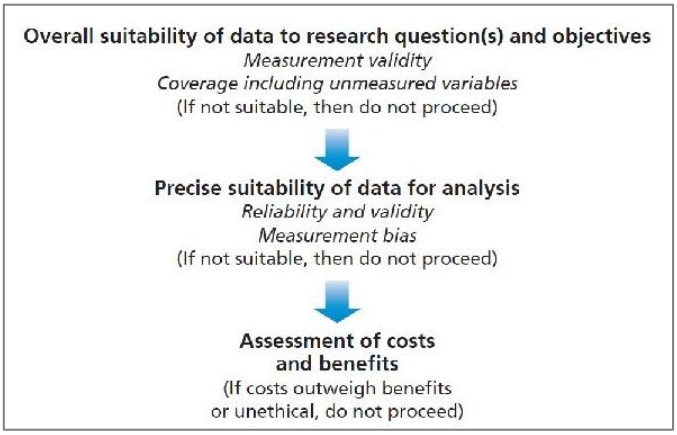


Figure 11: Evaluating potential secondary data sources (Saunders et al., 2019)

Table 30: Data collection advantages and disadvantages (authors' construction)

Advantages	Disadvantages
1. Data is available from diverse data sources. 2. Focus on specific metrics to aid in precise correlations and conclusions. 3. Data is accessible as I am employed at Kusile PS. 4. Data is reliable, accurate and relevant – internally and externally audited. 5. Permission to use data has been granted – provided data is disassociated from any contractor. 6. Statistics can be used to verify data through quantitative analysis. 7. Potential trends and patterns can be identified over time.	1. The data is collected from various sources on the project so data integrity or quality may vary. 2. Available data is in different formats and over different periods - managing multiple data sources could be complex. 3. There may be external factors not accounted for in data sources which may influence the outcomes, making it challenging to isolate the impact of black swan events specifically.

Table 31: Secondary Data used for Analysis – All Variables

Variables			Independent				Dependent			Control Variable			Moderating
Years	Covid Status	Data Code:	Covid-19 Presence	Covid-19 Cases in South Africa	Lockdown Level	Project Schedule Performance	Change in Schedule Performance	Project Financial Performance	Overall Project Asset Creation Performance	Contractor Claims	Incidents	Number of People on site	Risk Mitigation Strategy
			Dichotomous (0 or 1)	Continuous	Discrete (1-5)	Discrete (1-5)		Discrete (1-5)	Continuous	Dichotomous (0 or 1)	Dichotomous (0 or 1)	Continuous	Dichotomous (0 or 1)
Year 1	Before Covid	Apr-18	0	0	0	0.8699	0.0043	3.373	3.205	0	1	17742	0
		May-18	0	0	0	0.8718	0.0019	4.177	3.205	0	1	16683	0
		Jun-18	0	0	0	0.8758	0.0040	3.654	3.205	0	1	15733	0
		Jul-18	0	0	0	0.8840	0.0082	4.013	3.205	0	1	15258	0
		Aug-18	0	0	0	0.8870	0.0030	4.731	3.231	0	1	15259	0
		Sep-18	0	0	0	0.8935	0.0065	4.530	3.231	0	1	14113	0
		Oct-18	0	0	0	0.8995	0.0060	4.035	3.231	0	1	14134	0
		Nov-18	0	0	0	0.9009	0.0014	2.754	3.231	0	1	14340	0
		Dec-18	0	0	0	0.9030	0.0022	3.314	3.238	0	0	11763	0
		Jan-19	0	0	0	0.9048	0.0017	2.387	3.235	0	0	10327	0
		Feb-19	0	0	0	0.9073	0.0025	2.658	3.227	0	0	13703	0
		Mar-19	0	0	0	0.9109	0.0036	3.533	1.871	0	0	12626	0
Year 2		Apr-19	0	0	0	0.9112	0.0003	2.433	3.074	0	0	11914	0
		May-19	0	0	0	0.9524	0.0412	3.081	3.074	0	0	11588	0
		Jun-19	0	0	0	0.9548	0.0023	3.059	3.074	0	0	11355	0
		Jul-19	0	0	0	0.9561	0.0013	3.068	3.074	0	0	11426	0
		Aug-19	0	0	0	0.9587	0.0026	2.457	3.065	0	1	11020	0
		Sep-19	0	0	0	0.9604	0.0017	2.425	3.054	0	1	10528	0
		Oct-19	0	0	0	0.9623	0.0019	2.741	3.043	0	1	10058	0

		Nov-19	0	0	0	0.9641	0.0017	2.478	2.262	0	1	9757	0
		Dec-19	0	0	0	0.9657	0.0016	2.198	3.155	0	1	9548	0
		Jan-20	0	0	0	0.9657	0.0000	2.198	3.114	0	0	6595	0
		Feb-20	0	0	0	0.9665	0.0008	2.198	2.155	0	0	8662	0
	During Covid	Mar-20	1	1323	5	0.9679	0.0015	2.260	2.287	1	0	8737	1
Year 3		Apr-20	1	3191	5	0.9689	0.0009	2.511	3.111	1	0	2025	1
		May-20	1	15275	4	0.9689	0.0000	2.590	3.111	1	0	2004	1
		Jun-20	1	75418	3	0.9689	0.0000	3.424	3.111	1	0	3894	1
		Jul-20	1	166514	3	0.9689	0.0000	3.813	3.150	1	0	7132	1
		Aug-20	1	72575	3	0.9740	0.0050	3.455	2.483	1	0	6599	1
		Sep-20	1	49342	2	0.9752	0.0012	3.418	2.486	0	0	6792	1
		Oct-20	1	51913	1	0.9761	0.0009	3.648	2.307	0	0	7088	1
		Nov-20	1	37007	1	0.9769	0.0008	3.160	2.280	0	0	7037	1
		Dec-20	1	143953	1	0.9785	0.0015	1.956	2.266	0	0	5935	1
		Jan-21	1	110656	3	0.9785	0.0000	2.741	2.266	0	0	5815	1
		Feb-21	1	33456	3	0.9795	0.0010	2.352	2.275	0	0	6352	1
		Mar-21	1	21137	1	0.9806	0.0012	2.406	3.109	0	0	6164	1
Year 4		Apr-21	1	21400	1	0.9817	0.0011	3.242	3.210	0	0	6035	1
		May-21	1	49847	1	0.9825	0.0008	2.547	3.210	0	0	5819	1
		Jun-21	1	155192	3	0.9834	0.0009	3.782	3.245	0	0	5776	1
		Jul-21	1	154070	4	0.9858	0.0024	3.118	3.293	0	0	5978	1
		Aug-21	1	158132	3	0.9863	0.0004	3.853	3.293	0	0	5844	1
		Sep-21	1	42002	2	0.9874	0.0011	2.661	3.293	0	1	5582	1
		Oct-21	1	18828	1	0.9880	0.0006	3.802	3.293	0	1	5091	1
		Nov-21	1	28151	1	0.9885	0.0005	2.740	3.328	0	1	5374	1
		Dec-21	1	196574	1	0.9891	0.0006	2.858	2.696	0	1	5239	1
		Jan-22	1	65299	1	0.9901	0.0010	3.484	2.699	0	0	4659	1
		Feb-22	1	31521	1	0.9904	0.0003	2.321	2.699	0	0	4607	1
		Mar-22	1	13699	1	0.9906	0.0002	2.064	2.760	0	0	4615	1
Year 5	After Co	Apr-22	0	42731	1	0.9907	0.0002	3.375	3.000	0	0	4026	1

		May-22	0	45730	0	0.9908	0.0001	2.664	3.602	0	0	4040	1
		Jun-22	0	11580	0	0.9912	0.0004	3.403	3.659	0	0	3804	1
		Jul-22	0	5531	0	0.9913	0.0001	3.100	3.659	0	0	3566	1
		Aug-22	0	5316	0	0.9917	0.0004	3.572	3.659	0	0	3296	1
		Sep-22	0	7319	0	0.9920	0.0003	3.937	3.659	0	1	3146	1
		Oct-22	0	13491	0	0.9923	0.0002	3.904	3.657	0	1	3438	1
		Nov-22	0	26511	0	0.9929	0.0006	3.466	3.646	0	1	3373	1
		Dec-22	0	34128	0	0.9931	0.0002	3.902	3.630	0	1	2452	1
		Jan-23	0	40865	0	0.9931	0.0000	3.856	3.454	0	1	3412	1
		Feb-23	0	48136	0	0.9932	0.0001	3.067	3.173	0	1	3556	1
		Mar-23	0	58106	0	0.9933	0.0001	3.664	3.073	0	1	3408	1
Year 6		Apr-23	0	61362	0	0.9937	0.0004	3.665	3.000	0	1	3452	1
		May-23	0	61362	0	0.9937	0.0000	3.757	3.000	0	1	3761	1
		Jun-23	0	0	0	0.9938	0.0000	3.932	3.000	0	1	4133	1
		Jul-23	0	0	0	0.9939	0.0001	3.644	3.000	0	1	3945	0
		Aug-23	0	0	0	0.9939	0.0000	4.028	3.000	0	1	4271	0
		Sep-23	0	0	0	0.9940	0.0001	3.987	3.000	0	1	3450	0
		Oct-23	0	0	0	0.9944	0.0003	4.206	3.005	0	1	3297	0
		Nov-23	0	0	0	0.9946	0.0002	3.797	2.845	0	0	3625	0
		Dec-23	0	0	0	0.9948	0.0002	3.941	2.647	0	0	2486	0
		Jan-24	0	0	0	0.9948	0.0000	4.522	2.633	0	0	3041	0
		Feb-24	0	0	0	0.9948	0.0001	4.076	2.633	0	0	3385	0
		Mar-24	0	0	0	0.9949	0.0000	4.212	2.631	0	0	3360	0

Table 32: Secondary Data used for Analysis - Risk Mitigation

Data Code:	Risk Mitigation Present (1 -Yes, 0 - No)	Risk Description	Cause	Treatment Plan	Start	Finish	Additional Mitigations
Apr-18	0	None					
May-18	0	None					
Jun-18	0	None					
Jul-18	0	None					
Aug-18	0	None					
Sep-18	0	None					
Oct-18	0	None					
Nov-18	0	None					
Dec-18	0	None					
Jan-19	0	None					
Feb-19	0	None					
Mar-19	0	None					
Apr-19	0	None					
May-19	0	None					
Jun-19	0	None					
Jul-19	0	None					
Aug-19	0	None					
Sep-19	0	None					
Oct-19	0	None					
Nov-19	0	None					
Dec-19	0	None					
Jan-20	0	None					
Feb-20	0	None					
Mar-20	1	Global Virus Outbreak of the Coronavirus	Coronavirus human to human transmission (Contagious flu like virus •Breathalyzer testing at the gates may be contaminated •Finger biometrics at the turnstile may be contaminated •Contamination of the rail handles during the 3 point contact system when climbing scaffolding •Unavailability of facilities to detect infected individuals	Ongoing awareness through information sharing •Suspect will be kept in isolation room at onsite clinic until referral to nearest hospital as per Department of Health Standard Operating Procedure •Appropriate clothing shall be worn by all involved in taking care of suspects - paramedics and OHP •Strict health and hygiene measures shall be followed at all times •All Eskom travelling and in contact with Expatriates to contact the medical center prior to travelling •Using alternative measures to conduct alcohol testing at all gate access •Spraying of confined spaces with 'air-purification'	20-03-2020	31-03-2020	Work-from Home - Shift to online engagement platforms Reduction of non-critical staff on site Refocus on critical path activities and limited construction Increased hygiene protocols and Social Distancing
Apr-20	1	COVID-19 National/Provincial lockdown impacting schedule performance (Unit 2 Optimizing schedule)	Lack of hygiene • International, National & Provincial Travel • Lack of social distancing	National/provincial lockdown • Temperature screening Ongoing awareness through information sharing •Affected employee will be kept in isolation room at onsite clinic until referral to nearest hospital as per Department of Health Standard Operating Procedure •Appropriate clothing shall be worn by all involved in taking care of affected employee - paramedics and OHP •Strict health and hygiene measures shall be followed at all times •All Eskom employees travelling and in contact with Expatriates to contact the medical center prior to travelling •Using alternative measures to conduct alcohol testing at all gate access •Spraying of confined spaces with 'air-purification' K3, K4, K5, K6 on preservation due to COVID-19 BOP Construction on-hold ue to Covid-19	20-03-2020	31-05-2020	Work-from Home - Shift to online engagement platforms Covid19 PPE procured Reduction of non-critical staff on site Refocus on critical path activities and limited construction Increased hygiene protocols and Social Distancing

Data Code:	Risk Mitigation Present (1 -Yes, 0 - No)	Risk Description	Cause	Treatment Plan	Start	Finish	Additional Mitigations
May-20	1	COVID-19 National/Provincial lockdown impacting schedule performance (Unit 2 Optimizing schedule)	COVID 19 National Lockdown level 4 Regulations	Recovery plans and Strategy discussions in progress K3, K4, K5, K6 on preservation due to COVID-19 BOP Construction on-hold ue to Covid-19	20-03-2020	30-06-2020	Work-from Home - Shift to online engagement platforms Increased hygiene protocols and Social Distancing Reduction of non-critical staff on site Refocus on critical path activities and limited construction Covid19 PPE procured
Jun-20	1	COVID-19 National/Provincial lockdown impacting schedule performance (Unit 2 Optimizing schedule)	Lack of hygiene • International, National & Provincial Travel • Lack of social distancing	• Only use North gate • Temp. screening at North gate • Social Distancing K3, K4, K5, K6 on preservation due to COVID-19 BOP Construction on-hold ue to Covid-19	20-03-2020	31-07-2020	Work-from Home - Shift to online engagement platforms Increased hygiene protocols and Social Distancing Reduction of non-critical staff on site Refocus on critical path activities and limited construction Covid19 PPE procured
Jul-20	1	COVID-19 National/Provincial lockdown impacting schedule performance (Unit 2 Optimizing schedule)	COVID 19 National Lockdown level 4 Regulations	Recovery plans and Strategy discussions in progress	20-03-2020	31-10-2020	Work-from Home - Shift to online engagement platforms Increased hygiene protocols and Social Distancing Reduction of non-critical staff on site Refocus on critical path activities and limited construction Covid19 PPE procured
Aug-20	1	COVID-19 National/Provincial lockdown impacting schedule performance (Unit 2 Optimizing schedule) Inability to contain and reduce the spread of the Global Coronavirus (Covid19) may lead to work stoppage and loss of lives	•Coronavirus - human to human transmission (Contagious flu like virus) •Breathalyzer testing at the gates may be contaminated •Finger biometrics at the turnstiles may be contaminated •Contamination of the rail handles during the 3 point contact system when climbing scaffolding •Limited facilities to detect and treat infected individuals	National/provincial lockdown • Temperature screening • Risk Assessment concluded in preparation for Level 2 return to site •Recovery plans and Strategy discussions in progress •National/provincial lockdown Ongoing awareness through information sharing •Affected employee will be kept in isolation room at onsite clinic until referral to nearest hospital as per Department of Health Standard Operating Procedure •Appropriate clothing shall be worn by all involved in taking care of affected employee - paramedics and OHP •Strict health and hygiene measures shall be followed at all times •All Eskom employees travelling and in contact with Expatriates to contact the medical center prior to travelling •Using alternative measures to conduct alcohol testing at all gate access •Continuous disinfection of confined spaces and office spaces as and when the need arise •Onsite temperature screening tests conducted	27/03/20 27/03/20 18/08/20	31/10/20 31/10/20 31/12/20	Work-from Home - Shift to online engagement platforms Increased hygiene protocols and Social Distancing Reduction of non-critical staff on site Refocus on critical path activities and limited construction Covid19 PPE procured
Sep-20	1	COVID-19 National/Provincial lockdown impacting schedule performance (Unit 2 Optimizing schedule) Inability to contain and reduce the spread of the Global Coronavirus (Covid19) may lead to work stoppage and loss of lives	•Coronavirus - human to human transmission (Contagious flu like virus) •Breathalyzer testing at the gates may be contaminated •Finger biometrics at the turnstiles may be contaminated •Contamination of the rail handles during the 3 point contact system when climbing scaffolding •Limited facilities to detect and treat infected individuals	National/provincial lockdown • Temperature screening • Risk Assessment concluded in preparation for Level 2 return to site •Recovery plans and Strategy discussions in progress •National/provincial lockdown Ongoing awareness through information sharing •Affected employee will be kept in isolation room at onsite clinic until referral to nearest hospital as per Department of Health Standard Operating Procedure •Appropriate clothing shall be worn by all involved in taking care of affected employee - paramedics and OHP •Strict health and hygiene measures shall be followed at all times •All Eskom employees travelling and in contact with Expatriates to contact the medical center prior to travelling •Using alternative measures to conduct alcohol testing at all gate access •Continuous disinfection of confined spaces and office spaces as and when the need arise •Onsite temperature screening tests conducted	27/03/20 27/03/20 18/08/20	31/10/20 31/10/20 31/12/20	Work-from Home - Shift to online engagement platforms Increased hygiene protocols and Social Distancing Reduction of non-critical staff on site Refocus on critical path activities and limited construction Covid19 PPE procured

Data Code:	Risk Mitigation Present (1 -Yes, 0 - No)	Risk Description	Cause	Treatment Plan	Start	Finish	Additional Mitigations
Oct-20	1	COVID-19 National/Provincial lockdown impacting schedule performance (Unit 2 Optimizing schedule) Inability to contain and reduce the spread of the Global Coronavirus (Covid19) may lead to work stoppage and loss of lives	•Coronavirus - human to human transmission (Contagious flu like virus) •Breathalyzer testing at the gates may be contaminated •Finger biometrics at the turnstiles may be contaminated •Contamination of the rail handles during the 3 point contact system when climbing scaffolding •Limited facilities to detect and treat infected individuals	National/provincial lockdown • Temperature screening •Risk Assessments concluded in preparation for Level 2 return to site. •Covid19 PPE distributed to each employee onsite •Each employee and contractors must go through Covid19 induction prior to commence work onsite •Recovery plans and Strategy discussions in progress •National/provincial lockdown Ongoing awareness through information sharing •Affected employee will be kept in isolation room at onsite clinic until referral to nearest hospital as per Department of Health Standard Operating Procedure •Appropriate clothing shall be worn by all involved in taking care of affected employee - paramedics and OHP •Strict health and hygiene measures shall be followed at all times •All Eskom employees travelling and in contact with Expatriates to contact the medical center prior to travelling •Using alternative measures to conduct alcohol testing at all gate access •Continuous disinfection of confined spaces and office spaces as and when the need arise •Onsite temperature screening tests conducted	27/03/20 27/03/20 18/08/20	31/10/20 31/10/20 31/12/20	Work-from Home - Shift to online engagement platforms Increased hygiene protocols and Social Distancing Reduction of non-critical staff on site Refocus on critical path activities and limited construction Covid19 PPE procured
Nov-20	1	COVID-19 National/Provincial lockdown impacting schedule performance (Unit 2 Optimizing schedule) Inability to contain and reduce the spread of the Global Coronavirus (Covid19) may lead to work stoppage and loss of lives	•Coronavirus - human to human transmission (Contagious flu like virus) •Breathalyzer testing at the gates may be contaminated •Finger biometrics at the turnstiles may be contaminated •Contamination of the rail handles during the 3 point contact system when climbing scaffolding •Limited facilities to detect and treat infected individuals	National/provincial lockdown • Temperature screening • Risk Assessment concluded in preparation for Level 2 return to site •Recovery plans and Strategy discussions in progress •National/provincial lockdown Ongoing awareness through information sharing •Affected employee will be kept in isolation room at onsite clinic until referral to nearest hospital as per Department of Health Standard Operating Procedure •Appropriate clothing shall be worn by all involved in taking care of affected employee - paramedics and OHP •Strict health and hygiene measures shall be followed at all times •All Eskom employees travelling and in contact with Expatriates to contact the medical center prior to travelling •Using alternative measures to conduct alcohol testing at all gate access •Continuous disinfection of confined spaces and office spaces as and when the need arise •Onsite temperature screening tests conducted	27/03/20 27/03/20 27/03/20 27/03/20	31/10/20 31/10/20 31/12/20	Work-from Home - Shift to online engagement platforms Increased hygiene protocols and Social Distancing Reduction of non-critical staff on site Refocus on critical path activities and limited construction Covid19 PPE procured
Dec-20	1	COVID-19 National/Provincial lockdown impacting schedule performance (Unit 2 Optimizing schedule) Inability to contain and reduce the spread of the Global Coronavirus (Covid19) may lead to work stoppage and loss of lives	•Coronavirus - human to human transmission (Contagious flu like virus) •Breathalyzer testing at the gates may be contaminated •Finger biometrics at the turnstiles may be contaminated •Contamination of the rail handles during the 3 point contact system when climbing scaffolding •Limited facilities to detect and treat infected individuals	National/provincial lockdown • Temperature screening • Risk Assessment concluded in preparation for Level 2 return to site •Recovery plans and Strategy discussions in progress •National/provincial lockdown Ongoing awareness through information sharing •Affected employee will be kept in isolation room at onsite clinic until referral to nearest hospital as per Department of Health Standard Operating Procedure •Appropriate clothing shall be worn by all involved in taking care of affected employee - paramedics and OHP •Strict health and hygiene measures shall be followed at all times •All Eskom employees travelling and in contact with Expatriates to contact the medical center prior to travelling •Using alternative measures to conduct alcohol testing at all gate access •Continuous disinfection of confined spaces and office spaces as and when the need arise •Onsite temperature screening tests conducted	27/03/20 27/03/20 27/03/20 27/03/20	31/10/20 31/10/20 31/12/20 28/02/21	Work-from Home - Shift to online engagement platforms Increased hygiene protocols and Social Distancing Reduction of non-critical staff on site Refocus on critical path activities and limited construction Covid19 PPE procured Risk assessments concluded in preparation for Level 1return to site Risk assessments done in preparation for Level 2 return to site

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Jan-21	1	COVID-19 National/Provincial lockdown impacting schedule performance (Unit 2 Optimizing schedule) Inability to contain and reduce the spread of the Global Coronavirus (Covid19) may lead to work stoppage and loss of lives	•Coronavirus - human to human transmission (Contagious flu like virus) •Breathalyzer testing at the gates may be contaminated •Finger biometrics at the turnstiles may be contaminated •Contamination of the rail handles during the 3 point contact system when climbing scaffolding •Limited facilities to detect and treat infected individuals	National/provincial lockdown • Temperature screening • Risk Assessment concluded in preparation for Level 2 return to site •Recovery plans and Strategy discussions in progress •National/provincial lockdown Ongoing awareness through information sharing •Affected employee will be kept in isolation room at onsite clinic until referral to nearest hospital as per Department of Health Standard Operating Procedure •Appropriate clothing shall be worn by all involved in taking care of affected employee - paramedics and OHP •Strict health and hygiene measures shall be followed at all times •All Eskom employees travelling and in contact with Expatriates to contact the medical center prior to travelling •Using alternative measures to conduct alcohol testing at all gate access •Continuous disinfection of confined spaces and office spaces as and when the need arise •Onsite temperature screening tests conducted	27/03/20 27/03/20 27/03/20 27/03/20	31/10/20 31/10/20 31/12/20 28/02/21	Work-from Home - Shift to online engagement platforms Increased hygiene protocols and Social Distancing Reduction of non-critical staff on site Refocus on critical path activities and limited construction Covid19 PPE procured Risk assessments concluded in preparation for Level 1return to site Risk assessments done in preparation for Level 2 return to site
Feb-21	1	COVID-19 National/Provincial lockdown impacting schedule performance (Unit 2 Optimizing schedule) Inability to contain and reduce the spread of the Global Coronavirus (Covid19) may lead to work stoppage and loss of lives	•Coronavirus - human to human transmission (Contagious flu like virus) •Breathalyzer testing at the gates may be contaminated •Finger biometrics at the turnstiles may be contaminated •Contamination of the rail handles during the 3 point contact system when climbing scaffolding •Limited facilities to detect and treat infected individuals	National/provincial lockdown • Temperature screening • Risk Assessment concluded in preparation for Level 2 return to site •Recovery plans and Strategy discussions in progress •National/provincial lockdown Ongoing awareness through information sharing •Affected employee will be kept in isolation room at onsite clinic until referral to nearest hospital as per Department of Health Standard Operating Procedure •Appropriate clothing shall be worn by all involved in taking care of affected employee - paramedics and OHP •Strict health and hygiene measures shall be followed at all times •All Eskom employees travelling and in contact with Expatriates to contact the medical center prior to travelling •Using alternative measures to conduct alcohol testing at all gate access •Continuous disinfection of confined spaces and office spaces as and when the need arise •Onsite temperature screening tests conducted Phase one of the country's vaccine rollout programme began on 17 February.	27/03/20 27/03/20 27/03/20 27/03/20	31/10/20 31/10/20 31/12/20 28/02/21	Work-from Home - Shift to online engagement platforms Increased hygiene protocols and Social Distancing Reduction of non-critical staff on site Refocus on critical path activities and limited construction Covid19 PPE procured Risk assessments concluded in preparation for Level 1return to site Risk assessments done in preparation for Level 2 return to site Phase one of the country's vaccine rollout programme began on 17 February.
Mar-21	1	COVID-19 National/Provincial lockdown impacting schedule performance (Unit 2 Optimizing schedule) Inability to contain and reduce the spread of the Global Coronavirus (Covid19) may lead to work stoppage and loss of lives	•Coronavirus - human to human transmission (Contagious flu like virus) •Breathalyzer testing at the gates may be contaminated •Finger biometrics at the turnstiles may be contaminated •Contamination of the rail handles during the 3 point contact system when climbing scaffolding •Limited facilities to detect and treat infected individuals	National/provincial lockdown • Temperature screening • Risk Assessment concluded in preparation for Level 2 return to site •Recovery plans and Strategy discussions in progress •National/provincial lockdown Ongoing awareness through information sharing •Affected employee will be kept in isolation room at onsite clinic until referral to nearest hospital as per Department of Health Standard Operating Procedure •Appropriate clothing shall be worn by all involved in taking care of affected employee - paramedics and OHP •Strict health and hygiene measures shall be followed at all times •All Eskom employees travelling and in contact with Expatriates to contact the medical center prior to travelling •Using alternative measures to conduct alcohol testing at all gate access •Continuous disinfection of confined spaces and office spaces as and when the need arise •Onsite temperature screening tests conducted	27/03/20 27/03/20 27/03/20 27/03/20 27/03/20	31/10/20 31/10/20 31/12/20 28/02/21 30/04/21	Work-from Home - Shift to online engagement platforms Increased hygiene protocols and Social Distancing Reduction of non-critical staff on site Refocus on critical path activities and limited construction Covid19 PPE procured Risk assessments concluded in preparation for Level 1return to site Risk assessments done in preparation for Level 2 return to site Phase one of the country's vaccine rollout programme began on 17 February.

Data Code:	Risk Mitigation Present (1 -Yes, 0 - No)	Risk Description	Cause	Treatment Plan	Start	Finish	Additional Mitigations
Apr-21	1	COVID-19 National/Provincial lockdown impacting schedule performance (Unit 2 Optimizing schedule) Inability to contain and reduce the spread of the Global Coronavirus (Covid19) may lead to work stoppage and loss of lives	•Coronavirus - human to human transmission (Contagious flu like virus) •Breathalyzer testing at the gates may be contaminated •Finger biometrics at the turnstiles may be contaminated •Contamination of the rail handles during the 3 point contact system when climbing scaffolding •Limited facilities to detect and treat infected individuals	National/provincial lockdown • Temperature screening • Risk Assessment concluded in preparation for Level 2 return to site •Recovery plans and Strategy discussions in progress •National/provincial lockdown Ongoing awareness through information sharing •Affected employee will be kept in isolation room at onsite clinic until referral to nearest hospital as per Department of Health Standard Operating Procedure •Appropriate clothing shall be worn by all involved in taking care of affected employee - paramedics and OHP •Strict health and hygiene measures shall be followed at all times •All Eskom employees travelling and in contact with Expatriates to contact the medical center prior to travelling •Using alternative measures to conduct alcohol testing at all gate access •Continuous disinfection of confined spaces and office spaces as and when the need arise •Onsite temperature screening tests conducted	27/03/20 27/03/20 27/03/20 27/03/20 27/03/20	31/10/20 31/10/20 31/12/20 28/02/21 30/04/21	Work-from Home - Shift to online engagement platforms Increased hygiene protocols and Social Distancing Reduction of non-critical staff on site Refocus on critical path activities and limited construction Covid19 PPE procured Risk assessments concluded in preparation for Level 1return to site Risk assessments done in preparation for Level 2 return to site Phase one of the country's vaccine rollout programme began on 17 February.
May-21	1	COVID-19 National/Provincial lockdown impacting schedule performance (Unit 2 Optimizing schedule) Inability to contain and reduce the spread of the Global Coronavirus (Covid19) may lead to work stoppage and loss of lives	•Coronavirus - human to human transmission (Contagious flu like virus) •Breathalyzer testing at the gates may be contaminated •Finger biometrics at the turnstiles may be contaminated •Contamination of the rail handles during the 3 point contact system when climbing scaffolding •Limited facilities to detect and treat infected individuals	National/provincial lockdown • Temperature screening • Risk Assessment concluded in preparation for Level 2 return to site •Recovery plans and Strategy discussions in progress •National/provincial lockdown Ongoing awareness through information sharing •Affected employee will be kept in isolation room at onsite clinic until referral to nearest hospital as per Department of Health Standard Operating Procedure •Appropriate clothing shall be worn by all involved in taking care of affected employee - paramedics and OHP •Strict health and hygiene measures shall be followed at all times •All Eskom employees travelling and in contact with Expatriates to contact the medical center prior to travelling •Using alternative measures to conduct alcohol testing at all gate access •Continuous disinfection of confined spaces and office spaces as and when the need arise •Onsite temperature screening tests conducted	27/03/20 27/03/20 27/03/20 27/03/20 27/03/20 27/03/20	31/10/20 31/10/20 31/12/20 28/02/21 30/04/21 31/07/21	Work-from Home - Shift to online engagement platforms Increased hygiene protocols and Social Distancing Reduction of non-critical staff on site Refocus on critical path activities and limited construction Covid19 PPE procured Risk assessments concluded in preparation for Level 1return to site Risk assessments done in preparation for Level 2 return to site Phase two of the country's vaccine rollout Phase one of the country's vaccine rollout programme began on 17 May
Jun-21	1	COVID-19 National/Provincial lockdown impacting schedule performance (Unit 2 Optimizing schedule) Inability to contain and reduce the spread of the Global Coronavirus (Covid19) may lead to work stoppage and loss of lives	•Coronavirus - human to human transmission (Contagious flu like virus) •Breathalyzer testing at the gates may be contaminated •Finger biometrics at the turnstiles may be contaminated •Contamination of the rail handles during the 3 point contact system when climbing scaffolding •Limited facilities to detect and treat infected individuals	National/provincial lockdown • Temperature screening • Risk Assessment concluded in preparation for Level 2 return to site •Recovery plans and Strategy discussions in progress •National/provincial lockdown Ongoing awareness through information sharing •Affected employee will be kept in isolation room at onsite clinic until referral to nearest hospital as per Department of Health Standard Operating Procedure •Appropriate clothing shall be worn by all involved in taking care of affected employee - paramedics and OHP •Strict health and hygiene measures shall be followed at all times •All Eskom employees travelling and in contact with Expatriates to contact the medical center prior to travelling •Using alternative measures to conduct alcohol testing at all gate access •Continuous disinfection of confined spaces and office spaces as and when the need arise •Onsite temperature screening tests conducted	27/03/20 27/03/20 27/03/20 27/03/20 27/03/20 27/03/20	31/10/20 31/10/20 31/12/20 28/02/21 30/04/21 31/07/22	Work-from Home - Shift to online engagement platforms Increased hygiene protocols and Social Distancing Reduction of non-critical staff on site Refocus on critical path activities and limited construction Covid19 PPE procured Risk assessments concluded in preparation for Level 1return to site Risk assessments done in preparation for Level 2 return to site Phase two of the country's vaccine rollout Phase one of the country's vaccine rollout programme began on 17 May

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Jul-21	1	COVID-19 National/Provincial lockdown impacting schedule performance (Unit 2 Optimizing schedule) Inability to contain and reduce the spread of the Global Coronavirus (Covid19) may lead to work stoppage and loss of lives	•Coronavirus - human to human transmission (Contagious flu like virus) •Breathalyzer testing at the gates may be contaminated •Finger biometrics at the turnstiles may be contaminated •Contamination of the rail handles during the 3 point contact system when climbing scaffolding •Limited facilities to detect and treat infected individuals	National/provincial lockdown • Temperature screening • Risk Assessment concluded in preparation for Level 2 return to site •Recovery plans and Strategy discussions in progress •National/provincial lockdown Ongoing awareness through information sharing •Affected employee will be kept in isolation room at onsite clinic until referral to nearest hospital as per Department of Health Standard Operating Procedure •Appropriate clothing shall be worn by all involved in taking care of affected employee - paramedics and OHP •Strict health and hygiene measures shall be followed at all times •All Eskom employees travelling and in contact with Expatriates to contact the medical center prior to travelling •Using alternative measures to conduct alcohol testing at all gate access •Continuous disinfection of confined spaces and office spaces as and when the need arise •Onsite temperature screening tests conducted	27/03/20 27/03/20 27/03/20 27/03/20 27/03/20 27/03/20	31/10/20 31/10/20 31/12/20 28/02/21 30/04/21 31/07/23	Work-from Home - Shift to online engagement platforms Increased hygiene protocols and Social Distancing Reduction of non-critical staff on site Refocus on critical path activities and limited construction Covid19 PPE procured Risk assessments concluded in preparation for Level 1return to site Risk assessments done in preparation for Level 2 return to site Phase two of the country's vaccine rollout Phase one of the country's vaccine rollout programme began on 17 May
Aug-21	1	Inability to contain and reduce the spread of the Global Coronavirus (Covid19) due to new variant, may lead to LOSS OF LIVES and work stoppage	•Coronavirus - human to human transmission (Contagious flu like virus) •Breathalyzer testing at the gates may be contaminated •Finger biometrics at the turnstiles may be contaminated •Contamination of the rail handles during the 3 point contact system when climbing scaffolding •Limited facilities to detect and treat infected individuals	National/provincial lockdown • Temperature screening • Risk Assessment concluded in preparation for Level 2 return to site •Recovery plans and Strategy discussions in progress •National/provincial lockdown Ongoing awareness through information sharing •Affected employee will be kept in isolation room at onsite clinic until referral to nearest hospital as per Department of Health Standard Operating Procedure •Appropriate clothing shall be worn by all involved in taking care of affected employee - paramedics and OHP •Strict health and hygiene measures shall be followed at all times •All Eskom employees travelling and in contact with Expatriates to contact the medical center prior to travelling •Using alternative measures to conduct alcohol testing at all gate access •Continuous disinfection of confined spaces and office spaces as and when the need arise •Onsite temperature screening tests conducted	27/03/20 27/03/20 27/03/20 27/03/20 27/03/20 27/03/20 27/03/20	31/10/20 31/10/20 31/12/20 28/02/21 30/04/21 31/07/23 31/12/21	Work-from Home - Shift to online engagement platforms Increased hygiene protocols and Social Distancing Reduction of non-critical staff on site Refocus on critical path activities and limited construction Covid19 PPE procured Risk assessments concluded in preparation for Level 1return to site Risk assessments done in preparation for Level 2 return to site Phase two of the country's vaccine rollout Phase one of the country's vaccine rollout programme began on 01 August 2021
Sep-21	1	Third wave of COVID-19 infections increase evident (Level 2)	numerous cases reported on site,		27/03/20 27/03/20 27/03/20 27/03/20 27/03/20 27/03/20 27/03/20	31/10/20 31/10/20 31/12/20 28/02/21 30/04/21 31/07/23 31/12/21	Work-from Home - Shift to online engagement platforms Increased hygiene protocols and Social Distancing Reduction of non-critical staff on site Refocus on critical path activities and limited construction Covid19 PPE procured Risk assessments concluded in preparation for Level 1return to site Risk assessments done in preparation for Level 2 return to site Phase two of the country's vaccine rollout Phase one of the country's vaccine rollout programme began on 01 August 2021

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Oct-21	1	Inability to contain and reduce the spread of the Global Coronavirus (Covid19) due to new variant, may lead to LOSS OF LIVES and work stoppage	•Coronavirus - human to human transmission (Contagious flu like virus) •Breathalyzer testing at the gates may be contaminated •Finger biometrics at the turnstiles may be contaminated •Contamination of the rail handles during the 3 point contact system when climbing scaffolding •Limited facilities to detect and treat infected individuals	National/provincial lockdown • Temperature screening • Risk Assessment concluded in preparation for Level 2 return to site •Recovery plans and Strategy discussions in progress •National/provincial lockdown Ongoing awareness through information sharing •Affected employee will be kept in isolation room at onsite clinic until referral to nearest hospital as per Department of Health Standard Operating Procedure •Appropriate clothing shall be worn by all involved in taking care of affected employee - paramedics and OHP •Strict health and hygiene measures shall be followed at all times •All Eskom employees travelling and in contact with Expatriates to contact the medical center prior to travelling •Using alternative measures to conduct alcohol testing at all gate access •Continuous disinfection of confined spaces and office spaces as and when the need arise •Onsite temperature screening tests conducted	27/03/20 27/03/20 27/03/20 27/03/20 27/03/20 27/03/20 27/03/20	31/10/20 31/10/20 31/12/20 28/02/21 30/04/21 31/07/23 31/12/21	Work-from Home - Shift to online engagement platforms Increased hygiene protocols and Social Distancing Reduction of non-critical staff on site Refocus on critical path activities and limited construction Covid19 PPE procured Risk assessments concluded in preparation for Level 1return to site Risk assessments done in preparation for Level 2 return to site Phase two of the country's vaccine rollout Phase one of the country's vaccine rollout programme began on 01 August 2021
Nov-21	1	Inability to contain and reduce the spread of the Global Coronavirus (Covid19) due to new variant, may lead to LOSS OF LIVES and work stoppage	•Coronavirus - human to human transmission (Contagious flu like virus) •Breathalyzer testing at the gates may be contaminated •Finger biometrics at the turnstiles may be contaminated •Contamination of the rail handles during the 3 point contact system when climbing scaffolding •Limited facilities to detect and treat infected individuals	National/provincial lockdown • Temperature screening • Risk Assessment concluded in preparation for Level 2 return to site •Recovery plans and Strategy discussions in progress •National/provincial lockdown Ongoing awareness through information sharing •Affected employee will be kept in isolation room at onsite clinic until referral to nearest hospital as per Department of Health Standard Operating Procedure •Appropriate clothing shall be worn by all involved in taking care of affected employee - paramedics and OHP •Strict health and hygiene measures shall be followed at all times •All Eskom employees travelling and in contact with Expatriates to contact the medical center prior to travelling •Using alternative measures to conduct alcohol testing at all gate access •Continuous disinfection of confined spaces and office spaces as and when the need arise •Onsite temperature screening tests conducted	27/03/20 27/03/20 27/03/20 27/03/20 27/03/20 27/03/20 27/03/20	31/10/20 31/10/20 31/12/20 28/02/21 30/04/21 31/07/23 31/12/21	Work-from Home - Shift to online engagement platforms Increased hygiene protocols and Social Distancing Reduction of non-critical staff on site Refocus on critical path activities and limited construction Covid19 PPE procured Risk assessments concluded in preparation for Level 1return to site Risk assessments done in preparation for Level 2 return to site Phase two of the country's vaccine rollout Phase one of the country's vaccine rollout programme began on 01 August 2021
Dec-21	1	Inability to contain and reduce the spread of the Global Coronavirus (Covid19) due to new variant, may lead to LOSS OF LIVES and work stoppage	•Coronavirus - human to human transmission (Contagious flu like virus) •Breathalyzer testing at the gates may be contaminated •Finger biometrics at the turnstiles may be contaminated •Contamination of the rail handles during the 3 point contact system when climbing scaffolding •Limited facilities to detect and treat infected individuals	National/provincial lockdown • Temperature screening • Risk Assessment concluded in preparation for Level 2 return to site •Recovery plans and Strategy discussions in progress •National/provincial lockdown Ongoing awareness through information sharing •Affected employee will be kept in isolation room at onsite clinic until referral to nearest hospital as per Department of Health Standard Operating Procedure •Appropriate clothing shall be worn by all involved in taking care of affected employee - paramedics and OHP •Strict health and hygiene measures shall be followed at all times •All Eskom employees travelling and in contact with Expatriates to contact the medical center prior to travelling •Using alternative measures to conduct alcohol testing at all gate access •Continuous disinfection of confined spaces and office spaces as and when the need arise •Onsite temperature screening tests conducted	27/03/20 27/03/20 27/03/20 27/03/20 27/03/20 27/03/20 27/03/20	31/10/20 31/10/20 31/12/20 28/02/21 30/04/21 31/07/23 31/12/21	Work-from Home - Shift to online engagement platforms Increased hygiene protocols and Social Distancing Reduction of non-critical staff on site Refocus on critical path activities and limited construction Covid19 PPE procured Risk assessments concluded in preparation for Level 1return to site Risk assessments done in preparation for Level 2 return to site Phase two of the country's vaccine rollout Phase one of the country's vaccine rollout programme began on 01 August 2021

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Jan-22	1	Inability to contain and reduce the spread of the Global Coronavirus (Covid19) due to new variant, may lead to LOSS OF LIVES and work stoppage	•Coronavirus - human to human transmission (Contagious flu like virus) •Breathalyzer testing at the gates may be contaminated •Finger biometrics at the turnstiles may be contaminated •Contamination of the rail handles during the 3 point contact system when climbing scaffolding •Limited facilities to detect and treat infected individuals	National/provincial lockdown • Temperature screening • Risk Assessment concluded in preparation for Level 2 return to site •Recovery plans and Strategy discussions in progress •National/provincial lockdown Ongoing awareness through information sharing •Affected employee will be kept in isolation room at onsite clinic until referral to nearest hospital as per Department of Health Standard Operating Procedure •Appropriate clothing shall be worn by all involved in taking care of affected employee - paramedics and OHP •Strict health and hygiene measures shall be followed at all times •All Eskom employees travelling and in contact with Expatriates to contact the medical center prior to travelling •Using alternative measures to conduct alcohol testing at all gate access •Continuous disinfection of confined spaces and office spaces as and when the need arise •Onsite temperature screening tests conducted	27/03/20 27/03/20 27/03/20 27/03/20 27/03/20 27/03/20 27/03/20 27/03/20	31/10/20 31/10/20 31/12/20 28/02/21 30/04/21 31/07/23 31/12/21 31/03/22	COVID-19 Regulations (wearing of masks, social distancing, sanitization, adhering to procedures, vulnerable employee procedure) COVID-19 Vaccination role out plan by Eskom Holdings in progress
Feb-22	1	Inability to contain and reduce the spread of the Global Coronavirus (Covid19) due to new variant, may lead to LOSS OF LIVES and work stoppage	•Coronavirus - human to human transmission (Contagious flu like virus) •Breathalyzer testing at the gates may be contaminated •Finger biometrics at the turnstiles may be contaminated •Contamination of the rail handles during the 3 point contact system when climbing scaffolding •Limited facilities to detect and treat infected individuals	National/provincial lockdown • Temperature screening • Risk Assessment concluded in preparation for Level 2 return to site •Recovery plans and Strategy discussions in progress •National/provincial lockdown Ongoing awareness through information sharing •Affected employee will be kept in isolation room at onsite clinic until referral to nearest hospital as per Department of Health Standard Operating Procedure •Appropriate clothing shall be worn by all involved in taking care of affected employee - paramedics and OHP •Strict health and hygiene measures shall be followed at all times •All Eskom employees travelling and in contact with Expatriates to contact the medical center prior to travelling •Using alternative measures to conduct alcohol testing at all gate access •Continuous disinfection of confined spaces and office spaces as and when the need arise •Onsite temperature screening tests conducted	27/03/20 27/03/20 27/03/20 27/03/20 27/03/20 27/03/20 27/03/20 27/03/20	31/10/20 31/10/20 31/12/20 28/02/21 30/04/21 31/07/23 31/12/21 31/03/22	
Mar-22	1	Inability to contain and reduce the spread of the Global Coronavirus (Covid19) due to new variant, may lead to LOSS OF LIVES and work stoppage	•Coronavirus - human to human transmission (Contagious flu like virus) •Breathalyzer testing at the gates may be contaminated •Finger biometrics at the turnstiles may be contaminated •Contamination of the rail handles during the 3 point contact system when climbing scaffolding •Limited facilities to detect and treat infected individuals	National/provincial lockdown • Temperature screening • Risk Assessment concluded in preparation for Level 2 return to site •Recovery plans and Strategy discussions in progress •National/provincial lockdown Ongoing awareness through information sharing •Affected employee will be kept in isolation room at onsite clinic until referral to nearest hospital as per Department of Health Standard Operating Procedure •Appropriate clothing shall be worn by all involved in taking care of affected employee - paramedics and OHP •Strict health and hygiene measures shall be followed at all times •All Eskom employees travelling and in contact with Expatriates to contact the medical center prior to travelling •Using alternative measures to conduct alcohol testing at all gate access •Continuous disinfection of confined spaces and office spaces as and when the need arise •Onsite temperature screening tests conducted	27/03/20 27/03/20 27/03/20 27/03/20 27/03/20 27/03/20 27/03/20 27/03/20	31/10/20 31/10/20 31/12/20 28/02/21 30/04/21 31/07/23 31/12/21 31/03/22	

Data Code:	Risk Mitigation Present (1 -Yes, 0 - No)	Risk Description	Cause	Treatment Plan	Start	Finish	Additional Mitigations
Apr-22	1	Global Virus Outbreak of the Corona virus - Covid19 Inability to contain and reduce the spread of the Global Coronavirus (Covid19) due to new variant, may lead to LOSS OF LIVES and work stoppage	Coronavirus - human to human transmission (Contagious flu like virus) Breathalyzer testing at the gates may be contaminated Finger biometrics at the turnstiles may be contaminated Contamination of the rail handles during the 3 point contact system when climbing scaffolding Limited facilities to detect and treat infected individuals Possible 3rd wave due to new variance Delayed vaccination	Vaccination rollout to achieve 80% herd immunity Implementation of working from home policy GCD SHEQ steer- com meeting held 25 February 2022 have re-evaluated COVID 19 risk exposure. Rating reduced	27/03/20 27/03/20 27/03/20 27/03/20 27/03/20 27/03/20 27/03/20 27/03/20	31/10/20 31/10/20 31/12/20 28/02/21 30/04/21 31/07/23 31/12/21 31/03/22	
May-22	1	Global Virus Outbreak of the Corona virus - Covid19 Inability to contain and reduce the spread of the Global Coronavirus (Covid19) due to new variant, may lead to LOSS OF LIVES and work stoppage	Coronavirus - human to human transmission (Contagious flu like virus) Breathalyzer testing at the gates may be contaminated Finger biometrics at the turnstiles may be contaminated Contamination of the rail handles during the 3 point contact system when climbing scaffolding Limited facilities to detect and treat infected individuals Possible 3rd wave due to new variance Delayed vaccination	Vaccination rollout to achieve 80% herd immunity Implementation of working from home policy GCD SHEQ steer- com meeting held 25 February 2022 have re-evaluated COVID 19 risk exposure. Rating reduced	27/03/20 27/03/20 27/03/20 27/03/20 27/03/20 27/03/20 27/03/20 27/03/20	31/10/20 31/10/20 31/12/20 28/02/21 30/04/21 31/07/23 31/12/21 31/03/22	
Jun-22	1	Global Virus Outbreak of the Corona virus - Covid19 Inability to contain and reduce the spread of the Global Coronavirus (Covid19) due to new variant, may lead to LOSS OF LIVES and work stoppage	Coronavirus - human to human transmission (Contagious flu like virus) Breathalyzer testing at the gates may be contaminated Finger biometrics at the turnstiles may be contaminated Contamination of the rail handles during the 3 point contact system when climbing scaffolding Limited facilities to detect and treat infected individuals Possible 3rd wave due to new variance Delayed vaccination	Vaccination rollout to achieve 80% herd immunity Implementation of working from home policy GCD SHEQ steer- com meeting held 25 February 2022 have re-evaluated COVID 19 risk exposure. Rating reduced	27/03/20 27/03/20 27/03/20 27/03/20 27/03/20 27/03/20 27/03/20 27/03/20	31/10/20 31/10/20 31/12/20 28/02/21 30/04/21 31/07/23 31/12/21 31/03/22	
Jul-22	1	Global Virus Outbreak of the Corona virus - Covid19 Inability to contain and reduce the spread of the Global Coronavirus (Covid19) due to new variant, may lead to LOSS OF LIVES and work stoppage	Coronavirus - human to human transmission (Contagious flu like virus) Breathalyzer testing at the gates may be contaminated Finger biometrics at the turnstiles may be contaminated Contamination of the rail handles during the 3 point contact system when climbing scaffolding Limited facilities to detect and treat infected individuals Possible 5th wave due to new variance Delayed vaccination	Ongoing awareness through information sharing Affected employee will be kept in isolation room at onsite clinic until referral to nearest hospital as per Department of Health Standard Operating Procedure All Eskom employees travelling and in contact with Expatriates to contact the medical center prior to travelling Continuous disinfection of confined spaces and office spaces as and when the need arise Onsite temperature screening tests conducted Risk Management policy in place and implemented Further PPE to be delivered to site Each employee and contractor must go through Covid19 induction prior to commencement of work onsite Vaccination rollout to achieve 80% herd immunity Population immunity Management of vulnerable people (i.e. comorbidities, over 60, pregnant woman, etc.) Implementation of working from home policy GCD SHEQ steer- com meeting have re-evaluated COVID 19 risk exposure. Rating reduced	27/03/20 27/03/20 27/03/20 27/03/20 27/03/20 27/03/20 27/03/20 27/03/20	31/10/20 31/10/20 31/12/20 28/02/21 30/04/21 31/07/23 31/12/21 31/03/22	

Data Code:	Risk Mitigation Present (1 -Yes, 0 - No)	Risk Description	Cause	Treatment Plan	Start	Finish	Additional Mitigations
Aug-22	1	Global Virus Outbreak of the Corona virus - Covid19 Inability to contain and reduce the spread of the Global Coronavirus (Covid19) due to new variant, may lead to LOSS OF LIVES and work stoppage	Coronavirus - human to human transmission (Contagious flu like virus) Breathalyzer testing at the gates may be contaminated Finger biometrics at the turnstiles may be contaminated Contamination of the rail handles during the 3 point contact system when climbing scaffolding Limited facilities to detect and treat infected individuals Possible 5th wave due to new variance Delayed vaccination	Ongoing awareness through information sharing Affected employee will be kept in isolation room at onsite clinic until referral to nearest hospital as per Department of Health Standard Operating Procedure All Eskom employees travelling and in contact with Expatriates to contact the medical center prior to travelling Continuous disinfection of confined spaces and office spaces as and when the need arise Onsite temperature screening tests conducted Risk Management policy in place and implemented Further PPE to be delivered to site Each employee and contractor must go through Covid19 induction prior to commencement of work onsite Vaccination rollout to achieve 80% herd immunity Population immunity Management of vulnerable people (i.e. comorbidities, over 60, pregnant woman, etc.) Implementation of working from home policy GCD SHEQ steer- com meeting have re-evaluated COVID 19 risk exposure. Rating reduced	27/03/20 27/03/20 27/03/20 27/03/20 27/03/20 27/03/20 27/03/20 27/03/20	31/10/20 31/10/20 31/12/20 28/02/21 30/04/21 31/07/23 31/12/21 31/03/22	
Sep-22	1	Global Virus Outbreak of the Corona virus - Covid19 Inability to contain and reduce the spread of the Global Coronavirus (Covid19) due to new variant, may lead to LOSS OF LIVES and work stoppage	Coronavirus - human to human transmission (Contagious flu like virus) Breathalyzer testing at the gates may be contaminated Finger biometrics at the turnstiles may be contaminated Contamination of the rail handles during the 3 point contact system when climbing scaffolding Limited facilities to detect and treat infected individuals Possible 5th wave due to new variance Delayed vaccination	Ongoing awareness through information sharing Affected employee will be kept in isolation room at onsite clinic until referral to nearest hospital as per Department of Health Standard Operating Procedure All Eskom employees travelling and in contact with Expatriates to contact the medical center prior to travelling Continuous disinfection of confined spaces and office spaces as and when the need arise Onsite temperature screening tests conducted Risk Management policy in place and implemented Further PPE to be delivered to site Each employee and contractor must go through Covid19 induction prior to commencement of work onsite Vaccination rollout to achieve 80% herd immunity Population immunity Management of vulnerable people (i.e. comorbidities, over 60, pregnant woman, etc.) Implementation of working from home policy GCD SHEQ steer- com meeting have re-evaluated COVID 19 risk exposure. Rating reduced	27/03/20 27/03/20 27/03/20 27/03/20 27/03/20 27/03/20 27/03/20 27/03/20	31/10/20 31/10/20 31/12/20 28/02/21 30/04/21 31/07/23 31/12/21 31/03/22	
Oct-22	1	Global Virus Outbreak of the Corona virus - Covid19 Inability to contain and reduce the spread of the Global Coronavirus (Covid19) due to new variant, may lead to LOSS OF LIVES and work stoppage	Coronavirus - human to human transmission (Contagious flu like virus) Breathalyzer testing at the gates may be contaminated Finger biometrics at the turnstiles may be contaminated Contamination of the rail handles during the 3 point contact system when climbing scaffolding Limited facilities to detect and treat infected individuals Possible 5th wave due to new variance Delayed vaccination	Ongoing awareness through information sharing Affected employee will be kept in isolation room at onsite clinic until referral to nearest hospital as per Department of Health Standard Operating Procedure All Eskom employees travelling and in contact with Expatriates to contact the medical center prior to travelling Continuous disinfection of confined spaces and office spaces as and when the need arise Onsite temperature screening tests conducted Risk Management policy in place and implemented Further PPE to be delivered to site Each employee and contractor must go through Covid19 induction prior to commencement of work onsite Vaccination rollout to achieve 80% herd immunity Population immunity Management of vulnerable people (i.e. comorbidities, over 60, pregnant woman, etc.) Implementation of working from home policy GCD SHEQ steer- com meeting have re-evaluated COVID 19 risk exposure. Rating reduced	27/03/20 27/03/20 27/03/20 27/03/20 27/03/20 27/03/20 27/03/20 27/03/20	31/10/20 31/10/20 31/12/20 28/02/21 30/04/21 31/07/23 31/12/21 31/03/22	

Data Code:	Risk Mitigation Present (1 -Yes, 0 - No)	Risk Description	Cause	Treatment Plan	Start	Finish	Additional Mitigations
Nov-22	1	Global Virus Outbreak of the Corona virus - Covid19 Inability to contain and reduce the spread of the Global Coronavirus (Covid19) due to new variant, may lead to LOSS OF LIVES and work stoppage	Coronavirus - human to human transmission (Contagious flu like virus) Breathalyzer testing at the gates may be contaminated Finger biometrics at the turnstiles may be contaminated Contamination of the rail handles during the 3 point contact system when climbing scaffolding Limited facilities to detect and treat infected individuals Possible 5th wave due to new variance Delayed vaccination	Ongoing awareness through information sharing Affected employee will be kept in isolation room at onsite clinic until referral to nearest hospital as per Department of Health Standard Operating Procedure All Eskom employees travelling and in contact with Expatriates to contact the medical center prior to travelling Continuous disinfection of confined spaces and office spaces as and when the need arise Onsite temperature screening tests conducted Risk Management policy in place and implemented Further PPE to be delivered to site Each employee and contractor must go through Covid19 induction prior to commencement of work onsite Vaccination rollout to achieve 80% herd immunity Population immunity Management of vulnerable people (i.e. comorbidities, over 60, pregnant woman, etc.) Implementation of working from home policy GCD SHEQ steer- com meeting have re-evaluated COVID 19 risk exposure. Rating reduced	27/03/20 27/03/20 27/03/20 27/03/20 27/03/20 27/03/20 27/03/20 27/03/20	31/10/20 31/10/20 31/12/20 28/02/21 30/04/21 31/07/23 31/12/21 31/03/22	
Dec-22	1	Global Virus Outbreak of the Corona virus - Covid19 Inability to contain and reduce the spread of the Global Coronavirus (Covid19) due to new variant, may lead to LOSS OF LIVES and work stoppage	Coronavirus - human to human transmission (Contagious flu like virus) Breathalyzer testing at the gates may be contaminated Finger biometrics at the turnstiles may be contaminated Contamination of the rail handles during the 3 point contact system when climbing scaffolding Limited facilities to detect and treat infected individuals Possible 5th wave due to new variance Delayed vaccination	Ongoing awareness through information sharing Affected employee will be kept in isolation room at onsite clinic until referral to nearest hospital as per Department of Health Standard Operating Procedure All Eskom employees travelling and in contact with Expatriates to contact the medical center prior to travelling Continuous disinfection of confined spaces and office spaces as and when the need arise Onsite temperature screening tests conducted Risk Management policy in place and implemented Further PPE to be delivered to site Each employee and contractor must go through Covid19 induction prior to commencement of work onsite Vaccination rollout to achieve 80% herd immunity Population immunity Management of vulnerable people (i.e. comorbidities, over 60, pregnant woman, etc.) Implementation of working from home policy GCD SHEQ steer- com meeting have re-evaluated COVID 19 risk exposure. Rating reduced	27/03/20 27/03/20 27/03/20 27/03/20 27/03/20 27/03/20 27/03/20 27/03/20	31/10/20 31/10/20 31/12/20 28/02/21 30/04/21 31/07/23 31/12/21 31/03/22	
Jan-23	1	Monitoring					
Feb-23	1	Monitoring					
Mar-23	1	COVID 19 Pandemic	The spread of COVID 19 Pandemic that led to a National Lockdown	National Recovery Plans and Strategy •National/Provincial Lockdown •Screening/Vaccinations Note: Termination of National State of Disaster but increase in COVID 19 cases	27-03-2020	30-06-2023	
Apr-23	1	COVID 19 Pandemic	The spread of COVID 19 Pandemic that led to a National Lockdown	National Recovery Plans and Strategy •National/Provincial Lockdown •Screening/Vaccinations Note: Termination of National State of Disaster but increase in COVID 19 cases	27-03-2020	30-06-2023	
May-23	1	COVID 19 Pandemic	The spread of COVID 19 Pandemic that led to a National Lockdown	National Recovery Plans and Strategy •National/Provincial Lockdown •Screening/Vaccinations Note: Termination of National State of Disaster but increase in COVID 19 cases	27-03-2020	30-06-2023	
Jun-23	1	COVID 19 Pandemic	The spread of COVID 19 Pandemic that led to a National Lockdown	National Recovery Plans and Strategy •National/Provincial Lockdown •Screening/Vaccinations Note: Termination of National State of Disaster but increase in COVID 19 cases	27-03-2020	30-06-2023	
Jul-23	0	Monitoring					

Data Code:	Risk Mitigation Present (1 -Yes, 0 - No)	Risk Description	Cause	Treatment Plan	Start	Finish	Additional Mitigations
Aug-23	0	Monitoring					
Sep-23	0	Monitoring					
Oct-23	0	Monitoring					
Nov-23	0	Monitoring					
Dec-23	0	Monitoring					
Jan-24	0	Monitoring					
Feb-24	0	Monitoring					
Mar-24	0	Monitoring					

Table 33: Secondary Data used for Analysis - Incidents

		Major Incidents affecting Overall project performance - key milestones, schedule, finances													
Data Code:	Incident Present	K1 and common	K2	K3	K4				K5				K6	Overall	
Apr-18	1	None	Gas Air Heater fire Start: 13-10-17 End: 31-08-2018	None	None				None				None	None	
May-18	1	None	Gas Air Heater fire - Repairs in progress - 24/7 schedule implemented - Weekly meetings with Contractor Start: 13-10-17 End: 09-11-18	Contractor informed that DCS commissioning activities that will take 140 days to complete before the start of Chemical Clean. 140 days delay to chemical clean readiness pushes Synchronization to Feb 2019 Start: 05/05/18 End:06/15/18	None				None				None	None	
Jun-18	1	None	Gas Air Heater fire - Repairs in progress - 24/7 schedule implemented - Weekly meetings with Contractor Start: 13-10-17 End: 09-11-18	Contractor informed that DCS commissioning activities that will take 140 days to complete before the start of Chemical Clean. 140 days delay to chemical clean readiness pushes Synchronization to Feb 2019 Start: 05/05/18 End:06/15/19	None				None				None	None	
Jul-18	1	None	Gas Air Heater fire - Repairs in progress - 24/7 schedule implemented - Weekly meetings with Contractor Start: 13-10-17 End: 09-11-18	None	None				None				None	None	
Aug-18	1	None	Gas Air Heater fire - Repairs in progress - 24/7 schedule implemented - Weekly meetings with Contractor Start: 13-10-17 End: 09-11-18	None	None				None				None	None	
Sep-18	1	None	Gas Air Heater fire - Repairs in progress - 24/7 schedule implemented - Weekly meetings with Contractor Start: 13-10-17 End: 09-11-18	None	None				None				None	None	

		Major Incidents affecting Overall project performance - key milestones, schedule, finances													
Data Code:	Incident Present	K1 and common	K2	K3	K4				K5				K6	Overall	
Oct-18	1	None	Gas Air Heater fire - Repairs in progress - 24/7 schedule implemented - Weekly meetings with Contractor Start: 13-10-17 End: 09-11-18	None	None				None				None	None	
Nov-18	1	None	Gas Air Heater fire - Repairs in progress - 24/7 schedule implemented - Weekly meetings with Contractor Start: 13-10-17 End: 09-11-18	None	None				None				None	None	
Dec-18	0	None	None	None	None				None				None	None	
Jan-19	0	None	None	None	Contractor commercial issues will have an impact on overall construction progress									Liquidity of Contractors - Contractor (Fly Ash) - Contractor Underground facilities - Contractor (ACC)	No Immediate impact due to start date and end date of activities for Contractor
Feb-19	0	None	None	None	None				None				None	Liquidity of Contractors - Contractor (Fly Ash) - Contractor Underground facilities - Contractor (ACC))	No Immediate impact due to start date and end date of activities for Contractor
Mar-19	0	None	None	None	None				None				None	Liquidity of Contractors - Contractor (Fly Ash) - Contractor Underground facilities - Contractor (ACC) - Contractor (Civil)	No Immediate impact due to start date and end date of activities for Contractor
Apr-19	0	None	None	None	None				None				None	Liquidity of Contractors - Contractor (Fly Ash) - Contractor Underground facilities - Contractor (ACC) - Contractor (Civil) - Contractor(Buildings)	No Immediate impact due to start date and end date of activities for Contractor
May-19	0	None	None	None	None				None				None	Liquidity of Contractors - Contractor (Fly Ash) - Contractor Underground facilities - Contractor (ACC) - Contractor (Civil) - Contractor(Buildings)	No Immediate impact due to start date and end date of activities for Contractor
Jun-19	0	None	None	None	None				None				None	Liquidity of Contractors - Contractor (Fly Ash) - Contractor (ACC) - Contractor (Civil) - Contractor (Buildings) - Contractor (BOP)	No Immediate impact due to start date and end date of activities for Contractor

		Major Incidents affecting Overall project performance - key milestones, schedule, finances													
Data Code:	Incident Present	K1 and common	K2	K3	K4				K5				K6	Overall	
Jul-19	0	None	None	None	Inability to complete scope (Fly Ash) due to Contractor offsite (Business Rescue) Start: 05/07/19 End: 30/11/19				None				None	Liquidity of Contractors - Contractor (Fly Ash) - Contractor (ACC) - Contractor (Buildings) - Contractor (BOP)	Contractor mitigation - Utilize vacuum trucks for dust removal (temporary)
Aug-19	1	None	ID Fans Incident - Delayed CO date - Impacts Optimization by contractors - Availability of new equipment Start: 02/07/19 End: 31/12/19	None	Inability to complete scope (Fly Ash) due to Contractor offsite (Business Rescue) Start: 05/07/19 End: 30/11/19				None				None	Liquidity of Contractors - Contractor (Fly Ash) - Contractor (ACC) - Contractor (Buildings) - Contractor (BOP)	Contractor mitigation - Utilize vacuum trucks for dust removal (temporary)
Sep-19	1	None	ID Fans Incident - Delayed CO date - Impacts Optimization by contractors - Availability of new equipment Start: 02/07/19 End: 31/12/19	None	Inability to complete scope (Fly Ash) due to Contractor offsite (Business Rescue) Start: 05/07/19 End: 30/11/19				None				None	Liquidity of Contractors - Contractor (Fly Ash) - Contractor (ACC) - Contractor (Buildings) - Contractor (BOP)	Contractor mitigation - Utilize vacuum trucks for dust removal (temporary)
Oct-19	1	None	ID Fans Incident - Delayed CO date - Impacts Optimization by contractors - Availability of new equipment Start: 02/07/19 End: 31/12/19	None	Inability to complete scope (Fly Ash) due to Contractor offsite (Business Rescue) Start: 05/07/19 End: 30/11/19								None	Liquidity of Contractors - Contractor (Fly Ash) - Contractor (ACC) - Contractor (Buildings) - Contractor (BOP)	Contractor mitigation - Utilize vacuum trucks for dust removal (temporary)
Nov-19	1	None	ID Fans Incident - Delayed CO date - Impacts Optimization by contractors - Availability of new equipment Start: 02/07/19 End: 31/12/19	None	Inability to complete scope (Fly Ash) due to Contractor offsite (Business Rescue) Start: 05/07/19 End: 30/11/19				None				None	Liquidity of Contractors - Contractor (Fly Ash) - Contractor (ACC) - Contractor (Buildings) - Contractor (BOP)	Contractor mitigation - Utilize vacuum trucks for dust removal (temporary)
Dec-19	1	None	ID Fans Incident - Delayed CO date - Impacts Optimization by contractors - Availability of new equipment Start: 02/07/19 End: 31/12/19	None	Inability to complete scope (Fly Ash) due to Contractor offsite (Business Rescue) Start: 05/07/19 End: 30/11/19 (extended)				Contractor offsite due to Business rescue may lead to delays (DHP, Silos, PJFF) which has an impact on Chem. clean, FOF milestones Start: 15/12/19 End: 31/03/20				None	Liquidity of Contractors - Contractor (Fly Ash) - Contractor (ACC) - Contractor (Buildings) - Contractor (BOP)	Contractor mitigation - Utilize vacuum trucks for dust removal (temporary)

		Major Incidents affecting Overall project performance - key milestones, schedule, finances													
Data Code:	Incident Present	K1 and common	K2	K3	K4				K5				K6	Overall	
Jan-20	0	None		None	Inability to complete scope (Fly Ash) due to Contractor offsite (Business Rescue) Start: 05/07/19 End: 30/11/19 (extended)				Contractor offsite due to Business rescue may lead to delays (DHP, Silos, PJFF) which has an impact on Chem. clean, FOF milestones Start: 15/12/19 End: 31/03/21				None	Liquidity of Contractors - Contractor (Fly Ash) - Contractor (ACC) - Contractor (Buildings) - Contractor (BOP)	Contractor mitigation - Utilize vacuum trucks for dust removal (temporary)
Feb-20	0	None		None	Inability to complete scope (Fly Ash) due to Contractor offsite (Business Rescue) Start: 05/07/19 End: 30/11/19 (extended)				Contractor offsite due to Business rescue may lead to delays (DHP, Silos, PJFF) which has an impact on Chem. clean, FOF milestones Start: 15/12/19 End: 31/03/22				None	Liquidity of Contractors - Contractor (Fly Ash) - Contractor (ACC) - Contractor (Buildings) - Contractor (BOP)	Contractor mitigation - Utilize vacuum trucks for dust removal (temporary)
Mar-20	0	None		None	Inability to complete scope (Fly Ash) due to Contractor offsite (Business Rescue) Start: 05/07/19 End: 30/11/19 (extended)				Contractor offsite due to Business rescue may lead to delays (DHP, Silos, PJFF) which has an impact on Chem. clean, FOF milestones Start: 15/12/19 End: 31/03/23				None	Liquidity of Contractors - Contractor (Fly Ash) - Contractor (ACC) - Contractor (Buildings) - Contractor (BOP)	Contractor mitigation - Utilize vacuum trucks for dust removal (temporary)
Apr-20	0	None		None	Inability to complete scope (Fly Ash) due to Contractor offsite (Business Rescue) Start: 05/07/19 End: 30/11/19 (extended)				Contractor offsite due to Business rescue may lead to delays (DHP, Silos, PJFF) which has an impact on Chem. clean, FOF milestones Start: 15/12/19 End: 31/03/23 (extended)				None	Liquidity of Contractors - Contractor (Fly Ash) - Contractor (ACC) - Contractor (Buildings) - Contractor (BOP)	Contractor mitigation - Utilize vacuum trucks for dust removal (temporary)
May-20	0	None		None	Inability to complete scope (Fly Ash) due to Contractor offsite (Business Rescue) Start: 05/07/19 End: 30/11/19 (extended)				Contractor offsite due to Business rescue may lead to delays (DHP, Silos, PJFF) which has an impact on Chem. clean, FOF milestones Start: 15/12/19 End: 31/03/23 (extended)				None	Liquidity of Contractors - Contractor (Fly Ash) - Contractor (ACC) - Contractor (Buildings) - Contractor (BOP)	Contractor mitigation - Utilize vacuum trucks for dust removal (temporary)
Jun-20	0	None		None	Inability to complete scope (Fly Ash) due to Contractor offsite (Business Rescue) Start: 05/07/19 End: 30/11/19 (extended)				Contractor offsite due to Business rescue may lead to delays (DHP, Silos, PJFF) which has an impact on Chem. clean, FOF milestones Start: 15/12/19 End: 31/03/23 (extended)				None	Liquidity of Contractors (State of construction Industry) Contractor (Buildings) Contractor (BOP)	Contractor mitigation - Utilize vacuum trucks for dust removal (temporary)
Jul-20	0	None		None	Inability to complete scope (Fly Ash) due to Contractor offsite (Business Rescue) Start: 05/07/19 End: 30/11/19 (extended)				Contractor offsite due to Business rescue may lead to delays (DHP, Silos, PJFF) which has an impact on Chem. clean, FOF milestones Start: 15/12/19 End: 31/03/23 (extended)				None	Liquidity of Contractors (State of construction Industry) Contractor (Buildings) Contractor (BOP) Contractor unable to fund the project/scope to complete	Contractor mitigation - Utilize vacuum trucks for dust removal (temporary) Contractor risk mitigated by repackaging scope and submitting to other contractors

		Major Incidents affecting Overall project performance - key milestones, schedule, finances													
Data Code:	Incident Present	K1 and common	K2	K3	K4				K5				K6	Overall	
Aug-20	0	None	None	None	Inability to complete scope (Fly Ash) due to Contractor offsite (Business Rescue) Start: 05/07/19 End: 30/11/19 (extended)				Contractor offsite due to Business rescue may lead to delays (DHP, Silos, PJFF) which has an impact on Chem. clean, FOF milestones Start: 15/12/19 End: 31/10/20 (extended)				None	Liquidity of Contractors (State of construction Industry) Contractor (Buildings) Contractor (BOP) Contractor unable to fund the project/scope to complete	Contractor mitigation - Utilize vacuum trucks for dust removal (temporary) •Negotiate with other suppliers present on site. Contractor risk mitigated by repackaging scope and submitting to other contractors
Sep-20	0	None		None	Inability to complete scope (Fly Ash) due to Contractor offsite (Business Rescue) Start: 05/07/19 End: 30/11/19 (extended)				Contractor offsite due to Business rescue may lead to delays (DHP, Silos, PJFF) which has an impact on Chem. clean, FOF milestones Start: 15/12/19 End: 31/10/20 (extended)				None	Liquidity of Contractors (State of construction Industry) Contractor (Buildings) Contractor (BOP) Contractor unable to fund the project/scope to complete	Contractor mitigation - Utilize vacuum trucks for dust removal (temporary) •Negotiate with other suppliers present on site. Contractor risk mitigated by repackaging scope and submitting to other contractors
Oct-20	0	None	None	None	-Fly Ash Systems commercial issues has impacted the schedule milestones from Chemical clean up to Synchronization, package procurement processes in progress.				Contractor offsite due to Business rescue may lead to delays (DHP, Silos, PJFF) which has an impact on Chem. clean, FOF milestones Start: 15/12/19 End: 31/10/20 (extended)				None	Liquidity of Contractors (State of construction Industry) Contractor (Buildings) Contractor (BOP) Contractor unable to fund the project/scope to complete Late replacements of construction components used as spares for the operational units to support the grid may lead to project delays	Contractor mitigation - Utilize vacuum trucks for dust removal (temporary) •Negotiate with other suppliers present on site. Contractor risk mitigated by repackaging scope and submitting to other contractors
Nov-20	0	None	None	None	Dust Handling Plant commercial issues has impacted the schedule milestones from Chemical Clean up to Synchronization, package procurement processes in progress.	Contractor has been put under Business Rescue. Contractor work delayed on pending Milestones for LCM System, TCT Bellow Start: 02/11/2020 End: 31/12/2020			Contractor offsite due to Business rescue may lead to delays (DHP, Silos, PJFF) which has an impact on Chem. clean, FOF milestones Start: 15/12/19 End: 31/01/210 (extended)				None	Liquidity of Construction contractors (State of construction Industry) Contractor unable to fund the project/scope to complete Late replacements of construction components used as spares for the operational units to support the grid may lead to project delays	Contractor mitigation: •Appoint new contractor •Reallocate scope to the Main contractor Contractor mitigation - Utilize vacuum trucks for dust removal (temporary) •Negotiate with other suppliers present on site. (Ongoing negotiations with ERI) Contractor risk mitigated by repackaging scope and submitting to

		Major Incidents affecting Overall project performance - key milestones, schedule, finances													
Data Code:	Incident Present	K1 and common	K2	K3	K4				K5				K6	Overall	
															other contractors. Contractor has mobilized additional resources for Aux-bay 5 buildings
Dec-20	0	None	None	None	Dust Handling Plant commercial issues has impacted the schedule milestones from Chemical Clean up to Synchronization, package procurement processes in progress.	Contractor has been put under Business Rescue. Contractor work delayed on pending Milestones for LCM System, TCT Bellow Start: 02/11/2020 End: 28/02/2021 (extended)			Contractor offsite due to Business rescue may lead to delays (DHP, Silos, PJFF) which has an impact on Chem. clean, FOF milestones Start: 15/12/19 End: 31/01/21(extended)				None	Liquidity of Construction contractors (State of construction Industry) Contractor unable to fund the project/scope to complete Late replacements of construction components used as spares for the operational units to support the grid may lead to project delays	Contractor mitigation: •Appoint new contractor •Reallocate scope to the Main contractor Contractor mitigation - Utilize vacuum trucks for dust removal (temporary) •Negotiate with other suppliers present on site. (Ongoing negotiations with ERI) Contractor risk mitigated by repackaging scope and submitting to other contractors. Contractor has mobilized additional resources for Aux-bay 5 buildings
Jan-21	0	None	None	None	Dust Handling Plant commercial issues has impacted the schedule milestones from Chemical Clean up to Synchronization, package procurement processes in progress.	Contractor has been put under Business Rescue. Contractor work delayed on pending Milestones for LCM System, TCT Bellow Start: 02/11/2020 End: 31/03/21 (extended)			Contractor offsite due to Business rescue may lead to delays (DHP, Silos, PJFF) which has an impact on Chem. clean, FOF milestones Start: 15/12/19 End: 31/01/21(extended)				None	Liquidity of Construction contractors (State of construction Industry) Contractor unable to fund the project/scope to complete Late replacements of construction components used as spares for the operational units to support the grid may lead to project delays	Contractor mitigation: •Appoint new contractor •Reallocate scope to the Main contractor Contractor mitigation - Utilize vacuum trucks for dust removal (temporary) •Negotiate with other suppliers present on site. (Ongoing negotiations with ERI) Contractor risk mitigated by repackaging scope and submitting to other contractors. Contractor has mobilized additional resources for Aux-bay 5 buildings

		Major Incidents affecting Overall project performance - key milestones, schedule, finances													
Data Code:	Incident Present	K1 and common	K2	K3	K4				K5				K6	Overall	
Feb-21	0	None	None	None	Dust Handling Plant commercial issues has impacted the schedule milestones from Chemical Clean up to Synchronization, package procurement processes in progress.	Contractor has been put under Business Rescue. Contractor work delayed on pending Milestones for LCM System, TCT Bellow Start: 02/11/2020 End: 31/03/21 (extended)			Contractor offsite due to Business rescue may lead to delays (DHP, Silos, PJFF) which has an impact on Chem. clean, FOF milestones Start: 15/12/19 End: 31/03/21(extended)				None	Liquidity of Construction contractors (State of construction Industry) Contractor unable to fund the project/scope to complete Late replacements of construction components used as spares for the operational units to support the grid may lead to project delays	Contractor mitigation: •Appoint new contractor •Reallocate scope to the Main contractor Contractor mitigation - Utilize vacuum trucks for dust removal (temporary) •Negotiate with other suppliers present on site. (Ongoing negotiations with ERI) Contractor risk mitigated by repackaging scope and submitting to other contractors. Contractor has mobilized additional resources for Aux-bay 5 buildings
Mar-21	0	None	None	None	Dust Handling Plant commercial issues has impacted the schedule milestones from Chemical Clean up to Synchronization, package procurement processes in progress.	Contractor has been put under Business Rescue. Contractor work delayed on pending Milestones for LCM System, TCT Bellow Start: 02/11/2020 End:30/04/21 (extended)			Contractor offsite due to Business rescue may lead to delays (DHP, Silos, PJFF) which has an impact on Chem. clean, FOF milestones Start: 15/12/19 End:31/05/21 (extended)				None	Liquidity of Construction contractors (State of construction Industry) Contractor unable to fund the project/scope to complete Late replacements of construction components used as spares for the operational units to support the grid may lead to project delays	Contractor mitigation: •Appoint new contractor •Reallocate scope to the Main contractor Contractor mitigation - Utilize vacuum trucks for dust removal (temporary) •Negotiate with other suppliers present on site. (Ongoing negotiations with ERI) Contractor risk mitigated by repackaging scope and submitting to other contractors. Contractor has mobilized additional resources for Aux-bay 5 buildings

		Major Incidents affecting Overall project performance - key milestones, schedule, finances													
Data Code:	Incident Present	K1 and common	K2	K3	K4				K5				K6	Overall	
Apr-21	0	None	None	None	P11A- ACC commercial issues has impacted Synchronization milestones forecast date and the date moved from December 2021 to 14 August 2022	Contractor has been put under Business Rescue. Contractor work delayed on pending Milestones for LCM System, TCT Bellow Start: 02/11/2020 End:30/04/21 (extended)			Contractor offsite due to Business rescue may lead to delays (DHP, Silos, PJFF) which has an impact on Chem. clean, FOF milestones Start: 15/12/19 End:31/05/21 (extended)				None	Liquidity of Construction contractors (State of construction Industry) Contractor unable to fund the project/scope to complete Late replacements of construction components used as spares for the operational units to support the grid may lead to project delays	Contractor mitigation: •Appoint new contractor •Reallocate scope to the Main contractor. Talks were held with a current contractor on site so to complete the outstanding scope. Contractor mitigation - The contract was awarded to ERI. Contractor risk mitigated by repackaging scope and submitting to other contractors. Contractor has mobilized additional resources for Aux-bay 5 buildings
May-21	0	None	None	None	P11A- ACC commercial issues has impacted Synchronization milestones forecast date and the date moved from December 2021 to 14 August 2022	Contractor has been put under Business Rescue. Contractor work delayed on pending Milestones for LCM System, TCT Bellow Start: 02/11/2020 End:31/07/21 (extended)			None				None	Liquidity of Construction contractors (State of construction Industry) Contractor unable to fund the project/scope to complete Late replacements of construction components used as spares for the operational units to support the grid may lead to project delays	Contractor mitigation: •Appoint new contractor •Reallocate scope to the Main contractor Contractor mitigation - The contract was awarded to ERI. Contractor risk mitigated by repackaging scope and submitting to other contractors. Contractor has mobilized additional resources for Aux-bay 5 buildings
Jun-21	0	None	None	None	Dust Handling Plant (DHP) Commercial issues has impacted the Schedule Milestones from Chemical Clean up to Synchronization. DHP system Construction in progress.	Contractor has been put under Business Rescue. Contractor work delayed on pending Milestones for LCM System, TCT Bellow Start: 02/11/2020 End:31/07/21 (extended)			None				None	Liquidity of Construction contractors (State of construction Industry) Contractor unable to fund the project/scope to complete Late replacements of construction components used as spares for the operational units to support the grid may lead to project delays	Contractor mitigation: •Appoint new contractor •Reallocate scope to the Main contractor Contractor risk mitigated by repackaging scope and submitting to other contractors. Contractor has mobilized additional

		Major Incidents affecting Overall project performance - key milestones, schedule, finances													
Data Code:	Incident Present	K1 and common	K2	K3	K4				K5				K6	Overall	
															resources for Aux-bay 5 buildings
Jul-21	0	None	None	None	Dust Handling Plant (DHP) Commercial issues has impacted the Schedule Milestones from Chemical Clean up to Synchronization. DHP system Construction in progress.	Contractor has been put under Business Rescue. Contractor work delayed on pending Milestones for LCM System, TCT Bellow Start: 02/11/2020 End:31/07/21 (extended)			None				None	Liquidity of Construction contractors (State of construction Industry) Contractor unable to fund the project/scope to complete Late replacements of construction components used as spares for the operational units to support the grid may lead to project delays	Contractor mitigation: •Appoint new contractor •Reallocate scope to the Main contractor Contractor risk mitigated by repackaging scope and submitting to other contractors. Contractor has mobilized additional resources for Aux-bay 5 buildings
Aug-21	0	None	None	None	Dust Handling Plant (DHP) Commercial issues has impacted the Schedule Milestones from Chemical Clean up to Synchronization. DHP system Construction in progress.	Contractor has been put under Business Rescue. Contractor work delayed on pending Milestones for LCM System, TCT Bellow Start: 02/11/2020 End:31/12/21 (extended)			Contractor has been put under Business Rescue. Contractor work delayed on pending Milestones for LCM System, TCT Bellow Start: 02/11/2020 End:31/12/21 (extended)				Contractor has been put under Business Rescue. Contractor work delayed on pending Milestones for LCM System, TCT Bellow Start: 02/11/2020 End:31/12/21 (extended)	Liquidity of Construction contractors (State of construction Industry) Contractor unable to fund the project/scope to complete Late replacements of construction components used as spares for the operational units to support the grid may lead to project delays	Contractor mitigation: •Appoint new contractor •Reallocate scope to the Main contractor Contractor risk mitigated by repackaging scope and submitting to other contractors. Contractor has mobilized additional resources for Aux-bay 5 buildings
Sep-21	1	None	None	None	Dust Handling Plant (DHP) Commercial issues has impacted the Schedule Milestones from Chemical Clean up to Synchronization. DHP system Construction in progress.	Contractor has been put under Business Rescue. Contractor work delayed on pending Milestones for LCM System, TCT Bellow Start: 02/11/2020 End:31/12/21 (extended)	Water Management/Demin Water, Fuel Oil Availability, Aux Steam Availability, Commercial Units taking Priority has impacted the Schedule Milestones		Contractor has been put under Business Rescue. Contractor work delayed on pending Milestones for LCM System, TCT Bellow Start: 02/11/2020 End:31/12/21 (extended)				Contractor has been put under Business Rescue. Contractor work delayed on pending Milestones for LCM System, TCT Bellow Start: 02/11/2020 End:31/12/21 (extended)	Liquidity of Construction contractors (State of construction Industry) Contractor unable to fund the project/scope to complete Late replacements of construction components used as spares for the operational units to support the grid may lead to project delays	Contractor mitigation: •Appoint new contractor •Reallocate scope to the Main contractor Contractor risk mitigated by repackaging scope and submitting to other contractors. Contractor has mobilized additional resources for Aux-bay 5 buildings

		Major Incidents affecting Overall project performance - key milestones, schedule, finances												
Data Code:	Incident Present	K1 and common	K2	K3	K4				K5				K6	Overall	
Oct-21	1	None	None	None	Dust Handling Plant (DHP) Commercial issues has impacted the Schedule Milestones up to Synchronization. DHP and Silo system Construction and Safety Clearance Complete {Hot Commissioning in progress)	Contractor has been put under Business Rescue. Contractor work delayed on pending Milestones for LCM System, TCT Bellow Start: 02/11/2020 End:31/12/21 (extended)	Water Management/Demin Water, Fuel Oil Availability, Aux Steam Availability, Commercial Units taking Priority has impacted the Schedule Milestones	LP Turbine/Barring Gear investigations causing major schedule slippaContractor towards First Synch Milestone	Contractor has been put under Business Rescue. Contractor work delayed on pending Milestones for LCM System, TCT Bellow Start: 02/11/2020 End:31/12/21 (extended)				Contractor has been put under Business Rescue. Contractor work delayed on pending Milestones for LCM System, TCT Bellow Start: 02/11/2020 End:31/12/21 (extended)	Liquidity of Construction contractors (State of construction Industry) Contractor unable to fund the project/scope to complete Late replacements of construction components used as spares for the operational units to support the grid may lead to project delays	Contractor mitigation: •Appoint new contractor •Reallocate scope to the Main contractor Contractor risk mitigated by repackaging scope and submitting to other contractors. Contractor has mobilized additional resources for Aux-bay 5 buildings
Nov-21	1	None	None	None	Dust Handling Plant (DHP) Commercial issues has impacted the Schedule Milestones up to Synchronization. DHP and Silo system Construction and Safety Clearance Complete {Hot Commissioning in progress)	Contractor has been put under Business Rescue. Contractor work delayed on pending Milestones for LCM System, TCT Bellow Start: 02/11/2020 End:31/12/21 (extended)	Water Management/Demin Water, Fuel Oil Availability, Aux Steam Availability, Commercial Units taking Priority has impacted the Schedule Milestones	LP Turbine/Barring Gear investigations causing major schedule slippaContractor towards First Synch Milestone	Contractor has been put under Business Rescue. Contractor work delayed on pending Milestones for LCM System, TCT Bellow Start: 02/11/2020 End:31/12/21 (extended)				Contractor has been put under Business Rescue. Contractor work delayed on pending Milestones for LCM System, TCT Bellow Start: 02/11/2020 End:31/12/21 (extended)	Liquidity of Construction contractors (State of construction Industry) Contractor unable to fund the project/scope to complete Late replacements of construction components used as spares for the operational units to support the grid may lead to project delays	Contractor mitigation: •Appoint new contractor •Reallocate scope to the Main contractor Contractor risk mitigated by repackaging scope and submitting to other contractors. Contractor has mobilized additional resources for Aux-bay 5 buildings
Dec-21	1	None	None	None	Dust Handling Plant (DHP) Commercial issues has impacted the Schedule Milestones up to Synchronization. DHP and Silo system Construction and Safety Clearance Complete {Hot Commissioning in progress)	Contractor has been put under Business Rescue. Contractor work delayed on pending Milestones for LCM System, TCT Bellow Start: 02/11/2020 End:31/12/21 (extended)	Water Management/Demin Water, Fuel Oil Availability, Aux Steam Availability, Commercial Units taking Priority has impacted the Schedule Milestones	LP Turbine/Barring Gear investigations causing major schedule slippaContractor towards First Synch Milestone	Contractor has been put under Business Rescue. Contractor work delayed on pending Milestones for LCM System, TCT Bellow Start: 02/11/2020 End:31/12/21 (extended)				Contractor has been put under Business Rescue. Contractor work delayed on pending Milestones for LCM System, TCT Bellow Start: 02/11/2020 End:31/12/21 (extended)	Liquidity of Construction contractors (State of construction Industry) Contractor unable to fund the project/scope to complete Late replacements of construction components used as spares for the operational units to support the grid may lead to project delays	Contractor mitigation: •Appoint new contractor •Reallocate scope to the Main contractor Contractor risk mitigated by repackaging scope and submitting to other contractors. Contractor has mobilized additional resources for Aux-bay 5 buildings

		Major Incidents affecting Overall project performance - key milestones, schedule, finances													
Data Code:	Incident Present	K1 and common	K2	K3	K4				K5				K6	Overall	
Jan-22	0	None	None	None		Contractor has been put under Business Rescue. Contractor work delayed on pending Milestones for LCM System, TCT Bellow Start: 02/11/2020 End:31/03/22 (extended)			Contractor has been put under Business Rescue. Contractor work delayed on pending Milestones for LCM System, TCT Bellow Start: 02/11/2020 End:31/03/22 (extended)				Contractor has been put under Business Rescue. Contractor work delayed on pending Milestones for LCM System, TCT Bellow Start: 02/11/2020 End:31/03/22 (extended)	Contractor unable to fund the project/scope to complete Late replacements of construction components used as spares for the operational units to support the grid may lead to project delays Liquidity and cashflow of Construction contractors (State of construction Industry)	Contractor mitigation: •Appoint new contractor •Reallocate scope to the Main contractor. Talks were held with a current contractor on site so to complete the outstanding scope. Contractor risk mitigated by repackaging scope and submitting to other contractors. Contractor has mobilized additional resources for Aux-bay 5 buildings An agreement has been reached
Feb-22	0	None	None	None	None	Contractor has been put under Business Rescue. Contractor work delayed on pending Milestones for LCM System, TCT Bellow Start: 02/11/2020 End:31/03/22 (extended)			Contractor has been put under Business Rescue. Contractor work delayed on pending Milestones for LCM System, TCT Bellow Start: 02/11/2020 End:31/03/22 (extended)				Contractor has been put under Business Rescue. Contractor work delayed on pending Milestones for LCM System, TCT Bellow Start: 02/11/2020 End:31/03/22 (extended)	Late replacements of construction components used as spares for the operational units to support the grid may lead to project delays Liquidity and cashflow of Construction contractors (State of construction Industry)	Contractor mitigation: •Appoint new contractor •Reallocate scope to the Main contractor. Talks were held with a current contractor on site so to complete the outstanding scope. Using support from Gx and ERI
Mar-22	0	None	None	None	None	Contractor has been put under Business Rescue. Contractor work delayed on pending Milestones for LCM System, TCT Bellow Start: 02/11/2020 End:31/03/22 (extended)			Contractor has been put under Business Rescue. Contractor work delayed on pending Milestones for LCM System, TCT Bellow Start: 02/11/2020 End:31/03/22 (extended)	DHP completion in time for ACC steam clean date of September 2022 Start: 08/08/19 End:31/07/22	Termination of the Contractor X contract. Delayed completion of the construction works of the conveyor systems to support First fires Start: 28/03/22 End:30/06/22		Contractor has been put under Business Rescue. Contractor work delayed on pending Milestones for LCM System, TCT Bellow Start: 02/11/2020 End:31/03/22 (extended)	Late replacements of construction components used as spares for the operational units to support the grid may lead to project delays Liquidity and cashflow of Construction contractors (State of construction Industry)	Contractor mitigation: •Appoint new contractor •Reallocate scope to the Main contractor. Talks were held with a current contractor on site so to complete the outstanding scope. Using support from Gx and ERI. A way forward agreement being discussed with Contractor - Discussions with Contractor in final stages Contractor X contract termination: The works being done inhouse with seconded

		Major Incidents affecting Overall project performance - key milestones, schedule, finances													
Data Code:	Incident Present	K1 and common	K2	K3	K4				K5				K6	Overall	
															employees from ERI
Apr-22	0	None	None	None	None				Contractor work delayed on pending Milestones for LCM System, TCT Bellow Start: 02/11/2020 End:31/05/22(extended)	DHP completion in time for ACC steam clean date of September 2022 Start: 08/08/19 End:31/07/22	Termination of the Contractor X contract. Delayed completion of the construction works of the conveyor systems to support First fires Start: 28/03/22 End:30/06/22		Contractor has been put under Business Rescue. Contractor work delayed on pending Milestones for LCM System, TCT Bellow Start: 02/11/2020 End:31/08/22 (extended)	Late replacements of construction components used as spares for the operational units to support the grid may lead to project delays Liquidity and cashflow of Construction contractors (State of construction Industry)	Contractor mitigation: •Appoint new contractor •Reallocate scope to the Main contractor. Talks were held with a current contractor on site so to complete the outstanding scope. Using support from Gx and ERI. A way forward agreement being discussed with Contractor - Discussions with Contractor in final stages Contractor X contract termination: The works being done inhouse with seconded employees from ERI
May-22	0	None	None	None	None				Contractor work delayed on pending Milestones for LCM System, TCT Bellow Start: 02/11/2020 End:31/05/22(extended)	DHP completion in time for ACC steam clean date of September 2022 Start: 08/08/19 End:31/07/22	Termination of the Contractor X contract. Delayed completion of the construction works of the conveyor systems to support First fires Start: 28/03/22 End:30/06/22		Contractor has been put under Business Rescue. Contractor work delayed on pending Milestones for LCM System, TCT Bellow Start: 02/11/2020 End:31/08/22 (extended)	Late replacements of construction components used as spares for the operational units to support the grid may lead to project delays Liquidity and cashflow of Construction contractors (State of construction Industry)	Contractor mitigation: •Appoint new contractor •Reallocate scope to the Main contractor. Talks were held with a current contractor on site so to complete the outstanding scope. Using support from Gx and ERI. A way forward agreement being discussed with Contractor - Discussions with Contractor in final stages Contractor X contract termination: The works being done inhouse with seconded employees from ERI

		Major Incidents affecting Overall project performance - key milestones, schedule, finances													
Data Code:	Incident Present	K1 and common	K2	K3	K4				K5				K6	Overall	
Jun-22	0	None	None	None	None	Contractor liquidated No replacement contract yet Start: 02/11/2020 End:31/07/22			Contractor work delayed on pending Milestones for LCM System, TCT Bellow Start: 02/11/2020 End:31/07/22(extended)	DHP completion in time for ACC steam clean date of September 2022 Start: 08/08/19 End:31/07/22	Termination of the Contractor X contract. Delayed completion of the construction works of the conveyor systems to support First fires Start: 28/03/22 End:30/06/22		Contractor work delayed on pending Milestones for LCM System, TCT Bellow Start: 02/11/2020 End:31/08/22 (extended)	Late replacements of construction components used as spares for the operational units to support the grid may lead to project delays Liquidity and cashflow of Construction contractors (State of construction Industry) Contractor liquidated No replacement contract yet Start: 05/01/2020 End: 31/07/2022	Contractor mitigation: •Appoint new contractor •Reallocate scope to the Main contractor. Talks were held with a current contractor on site so to complete the outstanding scope. Using support from Gx and ERI. A way forward agreement being discussed with Contractor - Discussions with Contractor in final stages Contractor X contract termination: The works being done inhouse with seconded employees from ERI
Jul-22	0	None	None	None	None	Contractor liquidated No replacement contract yet Start: 02/11/2020 End:31/07/22			Contractor work delayed on pending Milestones for LCM System, TCT Bellow Start: 02/11/2020 End:31/07/22(extended)	DHP completion in time for ACC steam clean date of September 2022 Start: 08/08/19 End:31/09/22	Termination of the Contractor X contract. Delayed completion of the construction works of the conveyor systems to support First fires Start: 28/03/22 End:31/09/22		Contractor work delayed on pending Milestones for LCM System, TCT Bellow Start: 02/11/2020 End:31/08/22 (extended)	Late replacements of construction components used as spares for the operational units to support the grid may lead to project delays Liquidity and cashflow of Construction contractors (State of construction Industry) Contractor liquidated Start: 05/01/2020 End: 31/07/2022	Contractor mitigation: Contract signed with Contractor to complete scope (work not started yet due to contractual issues) Contractor X contract termination: The works being done inhouse with seconded employees from ERI
Aug-22	0	None	None	None	None	Contractor liquidated No replacement contract yet Start: 02/11/2020 End:31/09/22 (extended)			Contractor liquidated No replacement contract yet Start: 02/11/2020 End:31/09/22(extended)	DHP completion in time for ACC steam clean date of September 2022 Start: 08/08/19 End:31/09/22	Termination of the Contractor X contract. Delayed completion of the construction works of the conveyor systems to support First fires Start: 28/03/22 End:31/09/22		Contractor work delayed on pending Milestones for LCM System, TCT Bellow Start: 02/11/2020 End:31/08/22 (extended)	Contractor liquidated Start: 05/01/2020 End: 31/08/2022 (extended)	Contractor mitigation: Contract signed with Contractor to complete scope (work not started yet due to contractual issues) Contractor X contract termination: The works being done inhouse with seconded employees from ERI

		Major Incidents affecting Overall project performance - key milestones, schedule, finances												
Data Code:	Incident Present	K1 and common	K2	K3	K4			K5				K6	Overall	
Sep-22	1	None	None	None	None	Contractor liquidated No replacement contract yet Start: 02/11/2020 End:31/09/22 (extended)		Gas Heater Fire	Contractor liquidated No replacement contract yet Start: 02/11/2020 End:31/09/22(extended)	DHP completion in time for ACC steam clean date of September 2022 Start: 08/08/19 End:31/09/22	Termination of the Contractor X contract. Delayed completion of the construction works of the conveyor systems to support First fires Start: 28/03/22 End:31/09/22	Longoutage due to the GAH fire incident Start: 27/09/2022 End: 31/12/2021	Contractor work delayed on pending Milestones for LCM System, TCT Bellow Start: 02/11/2020 End:31/08/22 (extended)	Late replacements of construction components used as spares for the operational units to support the grid may lead to project delays Liquidity and cashflow of Construction contractors (State of construction Industry) Contractor liquidated Start: 05/01/2020 End: 31/08/2022 (extended)	Contractor mitigation: Contract signed with Contractor to complete scope (work not started yet due to contractual issues) Contractor X contract termination: The works being done inhouse with seconded employees from ERI
Oct-22	1	None	None	None	None				Contractor liquidated No replacement contract yet Start: 02/11/2020 End:31/10/22(extended)	DHP completion in time for ACC steam clean date of September 2022 Start: 08/08/19 End:31/11/22	Termination of the Contractor X contract. Delayed completion of the construction works of the conveyor systems to support First fires Start: 28/03/22 End:31/11/22	Longoutage due to the GAH fire incident Start: 27/09/2022 End: 31/12/2022	Contractor work delayed on pending Milestones for LCM System, TCT Bellow Start: 02/11/2020 End:31/12/22 (extended)	Late replacements of construction components used as spares for the operational units to support the grid may lead to project delays Liquidity and cashflow of Construction contractors (State of construction Industry) Contractor liquidated Start: 05/01/2020 End: 31/11/2022 (extended)	Contractor mitigation: Contract signed with Contractor to complete scope (work not started yet due to contractual issues) Contractor X contract termination: The works being done inhouse with seconded employees from
Nov-22	1	None	None	None	None				Longoutage due to the GAH fire incident Start: 27/09/2022 End: 31/12/2022				Contractor work delayed on pending Milestones for LCM System, TCT Bellow Start: 02/11/2020 End:31/12/22 (extended)	Late replacements of construction components used as spares for the operational units to support the grid may lead to project delays Liquidity and cashflow of Construction contractors (State of construction Industry)	Contractor mitigation: Contract signed with Contractor to complete scope (work STARTED ON 5, NOT ON 6 YET)

		Major Incidents affecting Overall project performance - key milestones, schedule, finances													
Data Code:	Incident Present	K1 and common	K2	K3	K4				K5				K6	Overall	
Dec-22	1	None	None	None	None				Longoutage due to the GAH fire incident Start: 27/09/2022 End: 31/12/2022				Contractor work delayed on pending Milestones for LCM System, TCT Bellow Start: 02/11/2020 End:31/12/22 (extended)	Late replacements of construction components used as spares for the operational units to support the grid may lead to project delays Liquidity and cashflow of Construction contractors (State of construction Industry)	Contractor mitigation: Contract signed with Contractor to complete scope (work STARTED ON 5, NOT ON 6 YET)
Jan-23	1	None	None	None	None				Longoutage due to the GAH fire incident - Repair schedule received from the contractor. Works in progress Start: 27/09/2022 End: 31/05/2023 (extended)				Contractor work delayed on pending Milestones for LCM System, TCT Bellow Start: 02/11/2020 End:31/04/23 (extended)	Late replacements of construction components used as spares for the operational units to support the grid may lead to project delays Liquidity and cashflow of Construction contractors (State of construction Industry)	Contractor mitigation: Contract signed with Contractor to complete scope (work STARTED ON 5, NOT ON 6 YET)
Feb-23	1	None	None	None	None				Longoutage due to the GAH fire incident - Repair schedule received from the contractor. Works in progress Start: 27/09/2022 End: 31/05/2023 (extended)				Contractor work delayed on pending Milestones for LCM System, TCT Bellow Start: 02/11/2020 End:31/04/23 (extended)	Late replacements of construction components used as spares for the operational units to support the grid may lead to project delays Liquidity and cashflow of Construction contractors (State of construction Industry)	Contractor mitigation: Contract signed with Contractor to complete scope (Work has started on Unit 6)
Mar-23	1	None	None	None	None				Longoutage due to the GAH fire incident - Repair schedule received from the contractor. Works in progress Start: 27/09/2022 End: 31/05/2023 (extended)				Contractor work delayed on pending Milestones for LCM System, TCT Bellow Start: 02/11/2020 End:31/04/23 (extended)	Late replacements of construction components used as spares for the operational units to support the grid may lead to project delays Liquidity and cashflow of Construction contractors (State of construction Industry)	Contractor mitigation: Contract signed with Contractor to complete scope (Work has started on Unit 6)

		Major Incidents affecting Overall project performance - key milestones, schedule, finances													
Data Code:	Incident Present	K1 and common	K2	K3	K4				K5				K6	Overall	
Apr-23	1	None	None	None	None				Longoutage due to the GAH fire incident - Repair schedule received from the contractor. Works in progress Start: 27/09/2022 End: 31/05/2023 (extended)				Contractor work delayed on pending Milestones for LCM System, TCT Bellow Start: 02/11/2020 End:31/06/23 (extended)	Late replacements of construction components used as spares for the operational units to support the grid may lead to project delays Liquidity and cashflow of Construction contractors (State of construction Industry)	Contractor mitigation: Contract signed with Contractor to complete scope (Work has started on Unit 6)
May-23	1	None	None	None	None				Longoutage due to the GAH fire incident - Repair schedule received from the contractor. Works in progress Start: 27/09/2022 End: 31/05/2023 (extended)				Contractor work delayed on pending Milestones for LCM System, TCT Bellow Start: 02/11/2020 End:31/06/23 (extended)	Late replacements of construction components used as spares for the operational units to support the grid may lead to project delays Liquidity and cashflow of Construction contractors (State of construction Industry)	Contractor mitigation: Contract signed with Contractor to complete scope (Work has started on Unit 6)
Jun-23	1	None	None	None	None				Longoutage due to the GAH fire incident - Repair schedule received from the contractor. Works in progress Start: 27/09/2022 End: 31/07/2023 (extended)				Contractor work delayed on pending Milestones for LCM System, TCT Bellow Start: 02/11/2020 End:31/06/23 (extended)	Late replacements of construction components used as spares for the operational units to support the grid may lead to project delays Liquidity and cashflow of Construction contractors (State of construction Industry)	Contractor mitigation: Contract signed with Contractor to complete scope (Work has started on Unit 6)
Jul-23	1	None	None	None	None				Longoutage due to the GAH fire incident - Repair schedule received from the contractor. Works in progress Start: 27/09/2022 End: 31/10/2023 (extended)				None	Late replacements of construction components used as spares for the operational units to support the grid may lead to project delays Liquidity and cashflow of Construction contractors (State of construction Industry)	
Aug-23	1	None	None	None	None				Longoutage due to the GAH fire incident - Repair schedule received from the contractor. Works in progress Start: 27/09/2022 End: 31/10/2023 (extended)				None	Late replacements of construction components used as spares for the operational units to support the grid may lead to project delays Liquidity and cashflow of Construction	

		Major Incidents affecting Overall project performance - key milestones, schedule, finances													
Data Code:	Incident Present	K1 and common	K2	K3	K4				K5				K6	Overall	
														contractors (State of construction Industry)	
Sep-23	1	None	None	None	None				Longoutage due to the GAH fire incident - Repair schedule received from the contractor. Works in progress Start: 27/09/2022 End: 31/10/2023 (extended)				None	Late replacements of construction components used as spares for the operational units to support the grid may lead to project delays Liquidity and cashflow of Construction contractors (State of construction Industry)	
Oct-23	1	None	None	None	None				Longoutage due to the GAH fire incident - Repair schedule received from the contractor. Works in progress Start: 27/09/2022 End: 31/10/2023 (extended)				None	Late replacements of construction components used as spares for the operational units to support the grid may lead to project delays Liquidity and cashflow of Construction contractors (State of construction Industry)	
Nov-23	0	None	None	None	None				None				None	Late replacements of construction components used as spares for the operational units to support the grid may lead to project delays	
Dec-23	0	None	None	None	None				None				None	Late replacements of construction components used as spares for the operational units to support the grid may lead to project delays	
Jan-24	0	None	None	None	None				None				None	Late replacements of construction components used as spares for the operational units to support the grid may lead to project delays	
Feb-24	0	None	None	None	None				None				None	Late replacements of construction components used as spares for the operational units to support the grid may lead to project delays	
Mar-24	0	None	None	None	None				None				None	Late replacements of construction components used as spares for the operational units to support the grid may lead to project delays	

C5: Data analysis methodology

- **Correlation** - understand the relationship, strength, and direction, between the variables by computing the correlation coefficient. The correlation ranges from -1 to 1 with a higher value (independent of the sign) indicating a stronger relationship (Salkind & Frey, 2020). Pearson's r will be used for normal data or Spearman's rho for non-normal data.
- **Comparison** - there is an opportunity to conduct a comparison test before, during and after the pandemic on financial, schedule and overall performance. Conduct t-tests or ANOVA for normally distributed data, or Wilcoxon/Kruskal-Wallis tests for non-normal data (Salkind & Frey, 2020).

  Conduct a comparison test before, during and after the pandemic on financial, schedule and overall asset creation performance.

  - Before: April 2018-February 2020
  - During: March 2020 – March 2022
  - After: April 2022 – March 2024

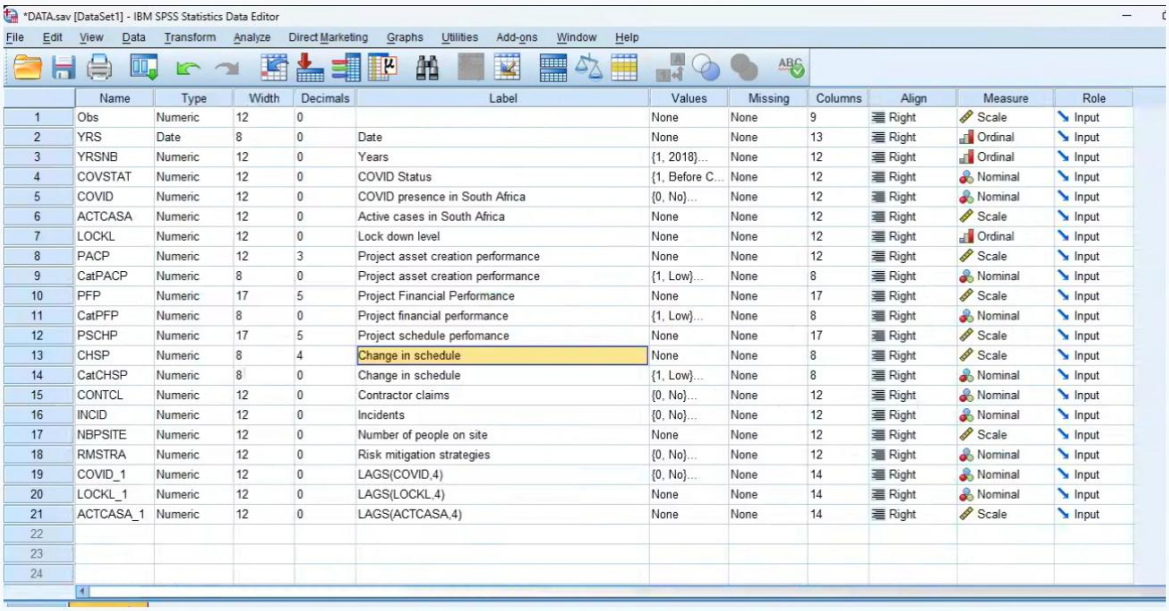
Conduct Wilcoxon or Kruskal-Wallis tests due to non-normal data distribution to:

1. Compare the means across the 3 periods.
2. Identify trends over time by comparing performance metrics across different periods (before, during, after Covid-19).

- **Regression Analysis** - Linear regression analysis (using data as per Figure 12 and Table 34) will be used to predict the relationship between two or more variables and explain the variation of the dependent variable that is caused by a change in the independent variable (Salkind & Frey, 2020).

Thereafter, models shall be compared:

- Compare the R-squared values, coefficients, and significance levels across models to understand the impact of adding control and moderating variables.
- Compare models with and without control and moderating variables to understand their impact on the relationships.



	Name	Type	Width	Decimals	Label	Values	Missing	Columns	Align	Measure	Role
1	Obs	Numeric	12	0		None	None	9	Right	Scale	Input
2	YRS	Date	8	0	Date	None	None	13	Right	Ordinal	Input
3	YRSNB	Numeric	12	0	Years	{1, 2018}...	None	12	Right	Ordinal	Input
4	COVSTAT	Numeric	12	0	COVID Status	{1, Before C...	None	12	Right	Nominal	Input
5	COVID	Numeric	12	0	COVID presence in South Africa	{0, No}...	None	12	Right	Nominal	Input
6	ACTCASA	Numeric	12	0	Active cases in South Africa	None	None	12	Right	Scale	Input
7	LOCKL	Numeric	12	0	Lock down level	None	None	12	Right	Ordinal	Input
8	PACP	Numeric	12	3	Project asset creation performance	None	None	12	Right	Scale	Input
9	CatPACP	Numeric	8	0	Project asset creation performance	{1, Low}...	None	8	Right	Nominal	Input
10	PFP	Numeric	17	5	Project Financial Performance	None	None	17	Right	Scale	Input
11	CatPFP	Numeric	8	0	Project financial performance	{1, Low}...	None	8	Right	Nominal	Input
12	PSCHP	Numeric	17	5	Project schedule perfomance	None	None	17	Right	Scale	Input
13	CHSP	Numeric	8	4	Change in schedule	None	None	8	Right	Scale	Input
14	CatCHSP	Numeric	8	0	Change in schedule	{1, Low}...	None	8	Right	Nominal	Input
15	CONTCL	Numeric	12	0	Contractor claims	{0, No}...	None	12	Right	Nominal	Input
16	INCID	Numeric	12	0	Incidents	{0, No}...	None	12	Right	Nominal	Input
17	NBPSITE	Numeric	12	0	Number of people on site	None	None	12	Right	Scale	Input
18	RMSTRA	Numeric	12	0	Risk mitigation strategies	{0, No}...	None	12	Right	Nominal	Input
19	COVID_1	Numeric	12	0	LAGS(COVID,4)	{0, No}...	None	14	Right	Nominal	Input
20	LOCKL_1	Numeric	12	0	LAGS(LOCKL,4)	None	None	14	Right	Nominal	Input
21	ACTCASA_1	Numeric	12	0	LAGS(ACTCASA,4)	None	None	14	Right	Scale	Input
22											
23											
24											

Figure 12: SPSS Data representation (authors construction)

Table 34: Regression analysis equations (authors' construction)

Hypothesis	**Equation components:**	**Linear Regression Equation:** $y = mx + c$
Hypothesis 1: Impact on Delivery Timelines	DV – Delivery Timeline/ financial performance/ overall performance IV – COVID-19 β0 – the expected value of the dependent variable. β1 – change in the dependent variable for a one-unit change in the independent variable. ∈ - random error in the model that captures the influence of other factors not included in the model.	Delivery Timelines $= \beta_1 \times Covid - 19 + \beta_0 + \in$
Hypothesis 2: Impact on Financial Performance		Financial Performance $= \beta_1 \times Covid - 19 + \beta_0 + \in$
Hypothesis 3: Impact on overall Performance		Overall Performance $= \beta_1 \times Covid - 19 + \beta_0 + \in$

Appendix D: Chapter 4

D1: Frequency distribution

Figure 13 and Figure 14 indicate the distributions of COVID-19 status and presence in South Africa, respectively. The distribution of COVID status is almost the same before (32%), during (35%), and after (33%) with COVID-19 only present in 25 periods of the 72 selected in the sample.

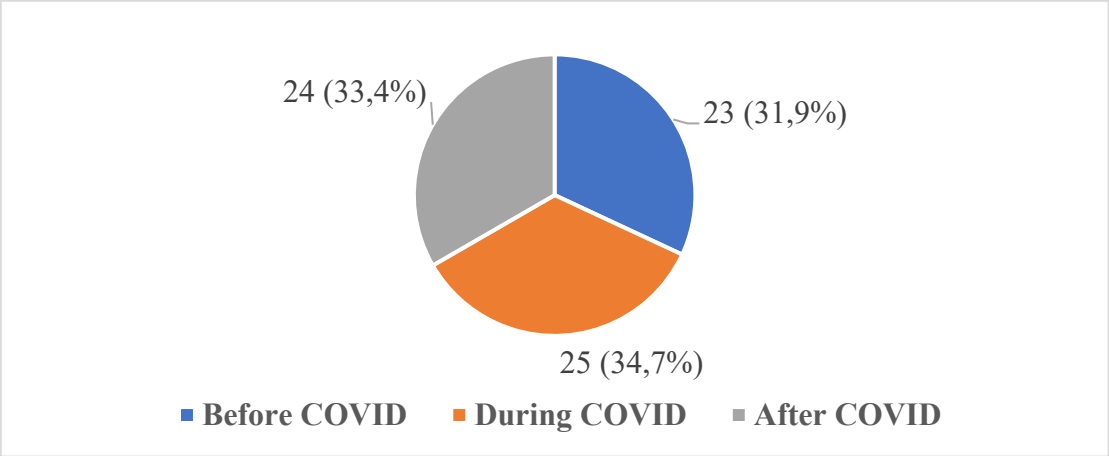


Figure 13: Frequency distribution of COVID-19 status

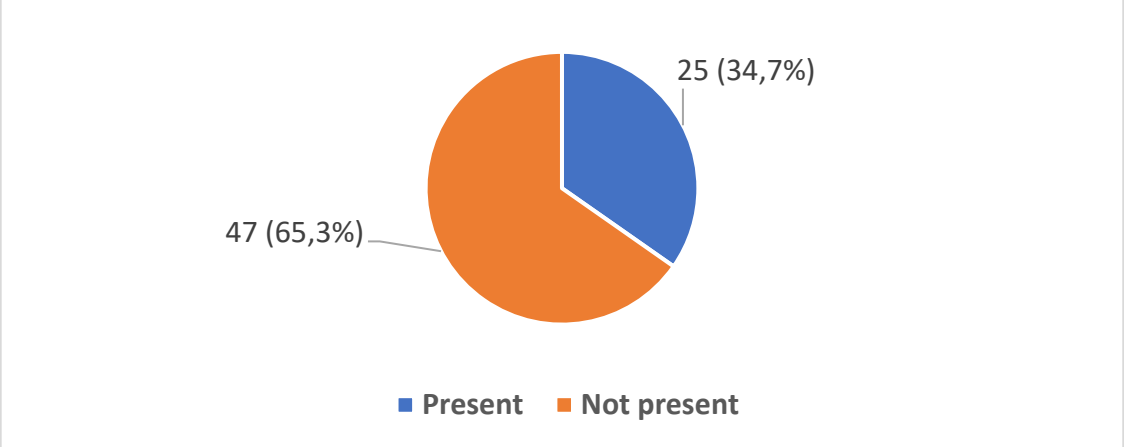


Figure 14: Frequency distribution of COVID-19 presence in South Africa

Figure 15 illustrates how often various lockdown levels occurred. Of the 25 periods of COVID-19 selected in the sample of the study, 13 (18%) were during lockdown level 1, 7 (10%) during lockdown level 3, 6 (9%) during lockdown levels 2, 4, and 5 combined. This reflects the intensity and duration of government

restrictions that have the potential to influence project activities and the workforce.

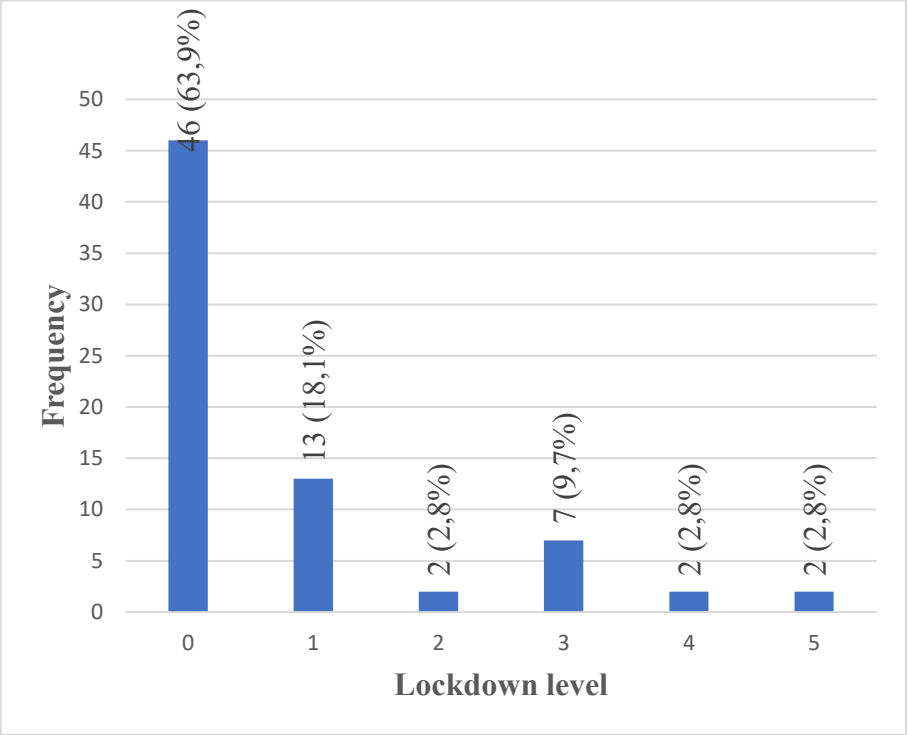


Figure 15: Frequency of different lockdown levels

Figure 16 and Figure 17 show, respectively, the presence or not of contractor claims and incidents. During the period of the study, claims or disputes from contractors specifically related to the pandemic were apparent over 6 periods (8%) (Figure 4), and incidents (not related to the pandemic) were recorded over 31 periods (43%).

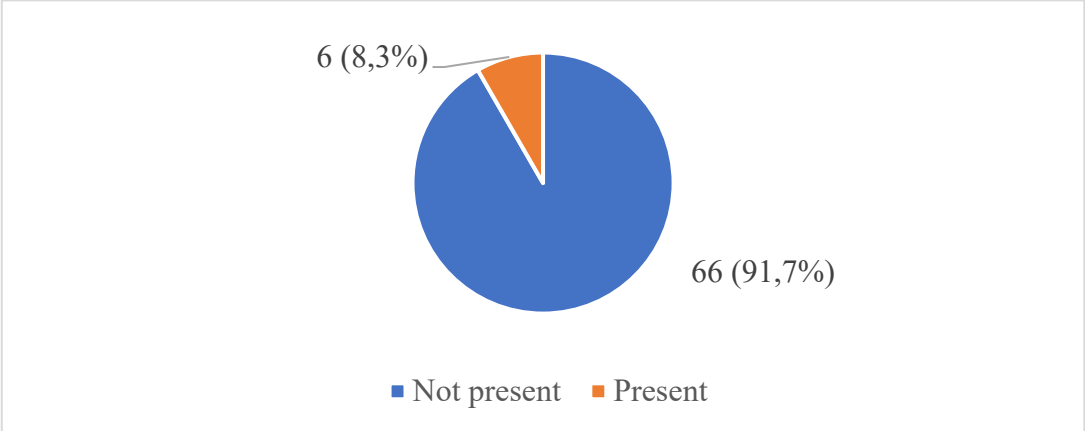


Figure 16: Frequency distribution of the presence of contractor claims

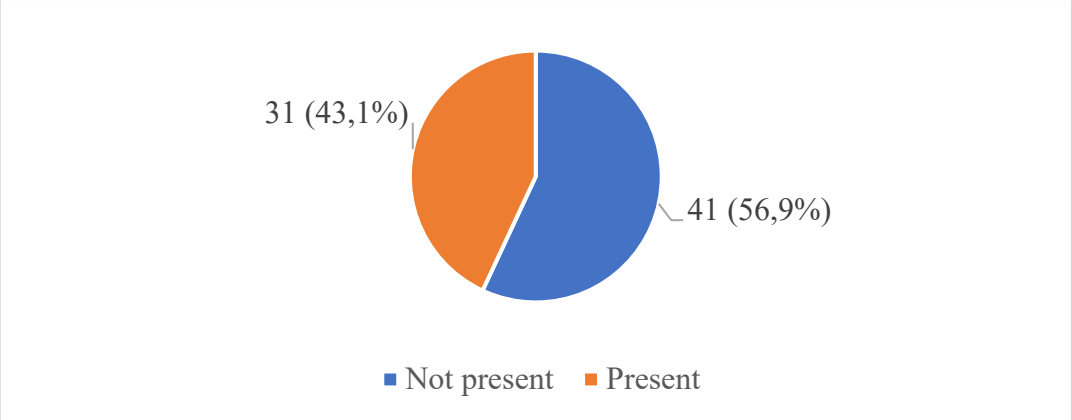


Figure 17: Frequency distribution of the presence of incidents

The frequency distribution of risk mitigation strategies implemented is shown in Figure 18. Eskom, Kusile PS executed risk mitigation strategies over 40 periods (56%) to manage the associated risks of the pandemic.

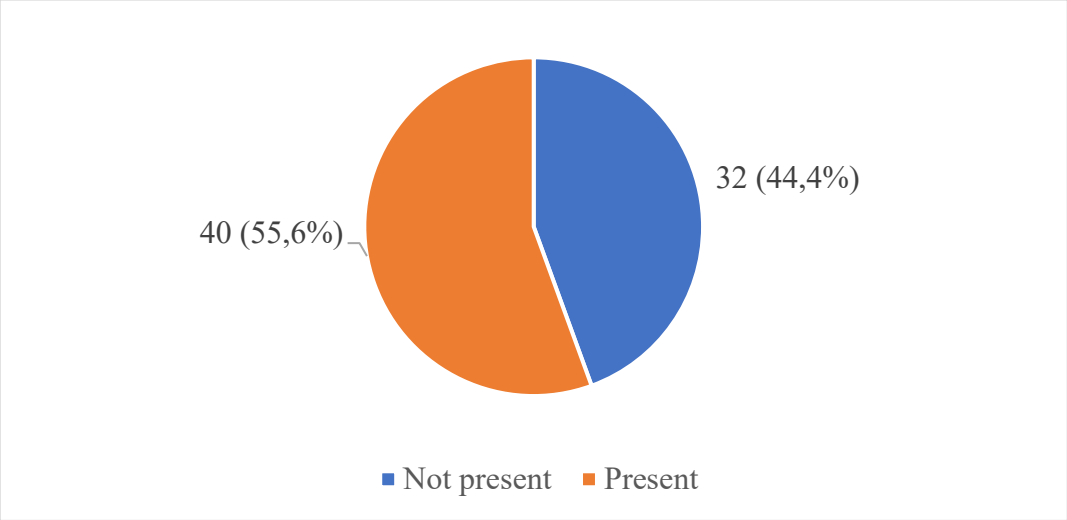


Figure 18: Frequency distribution of the presence of risk mitigation strategies

D2: Descriptive statistics - histograms of continuous variables

The histograms (Figure 19 - Figure 23) show the frequency distributions of the continuous variables in the sample of 72 observations grouped in different ranges depending on the values of each variable.

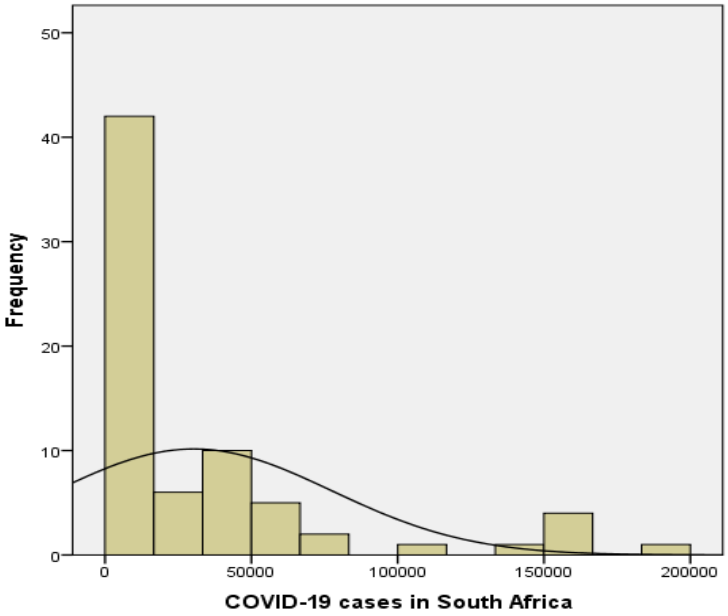


Figure 19: Histogram of COVID-19 cases in South Africa

Figure 19 represents the frequency distribution of the COVID-19 cases in South Africa. The distribution is right-skewed, that is, the frequency distribution is horizontally stretched to the right, and that there are more values to the left than to the right. This can also be observed from Table 8 above, with a huge difference between the median (5,424) and the mean (30 259). The mean is farther in the direction of the long tail than the median. The distribution of the COVID-19 cases in South Africa is therefore not normally distributed.

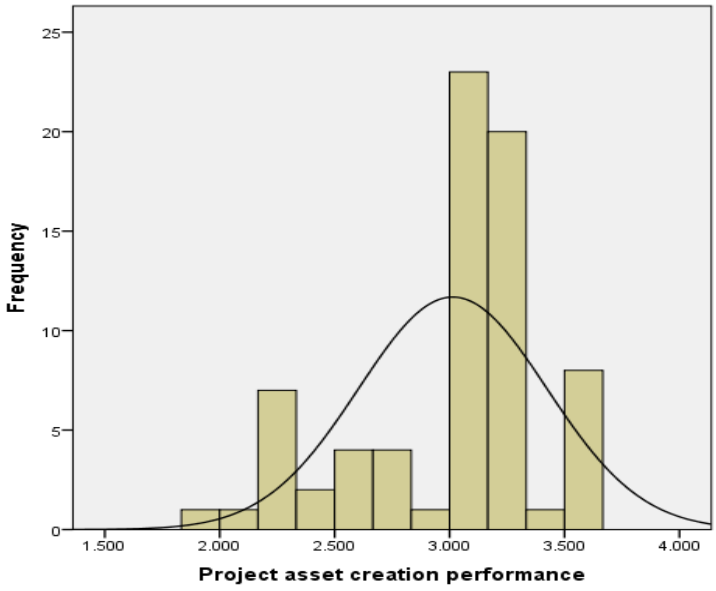


Figure 20: Histogram of project asset creation performance

The distribution of the project asset creation performance is depicted in Figure 20. This distribution is not stretched horizontally to one side or the other, so that one tail of observations is longer and has more observations than the other tail. The mean (3,014), the mode (3,000), and the median (3,091), Table 1, are close to each other. So, this distribution can be approximated by a normal distribution.

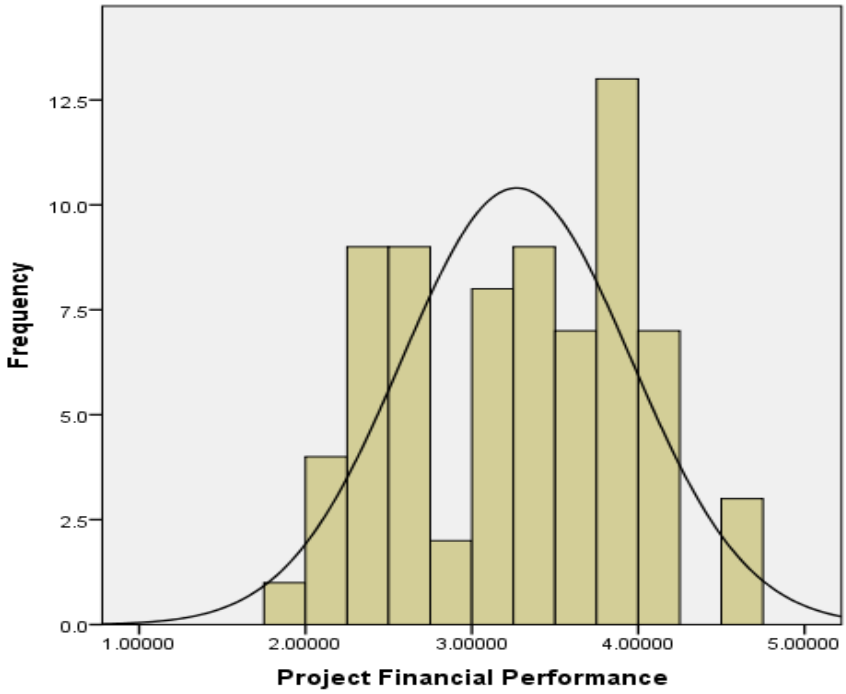


Figure 21: Histogram of project financial performance

Figure 21 shows the frequency distribution of the project financial performance. The distribution does not look skewed to any side. But from Table 8, it can be noticed that the mean (3,2691), the median (3,2887), and the mode (2,1979) are not that close to each other. This suggests that the distribution is not normal.

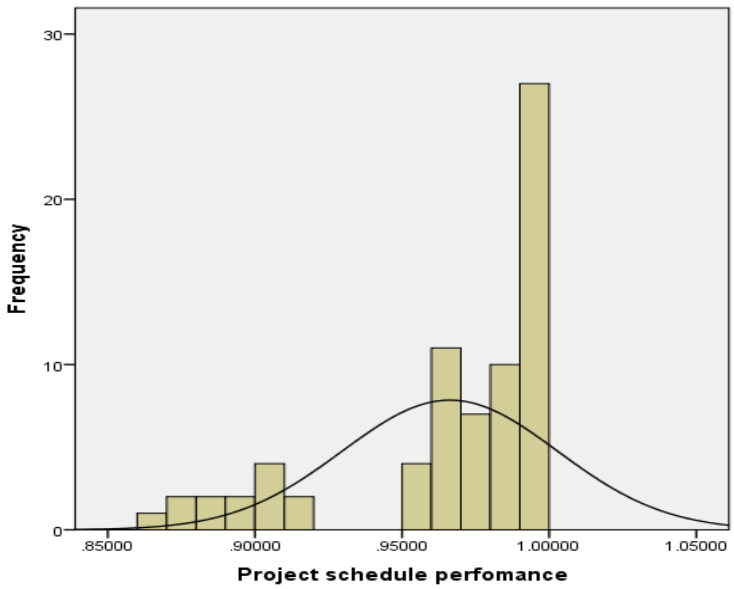


Figure 22: Histogram of project schedule performance

The distribution of the project schedule performance, as shown in Figure 22, indicates a slight skewness to the left. The mean of 0,96624 compared to the mode (0,96888) and the median (0,98118), Table 8, is slightly to the left of the distribution. So, this distribution is not normal as it is left-skewed.

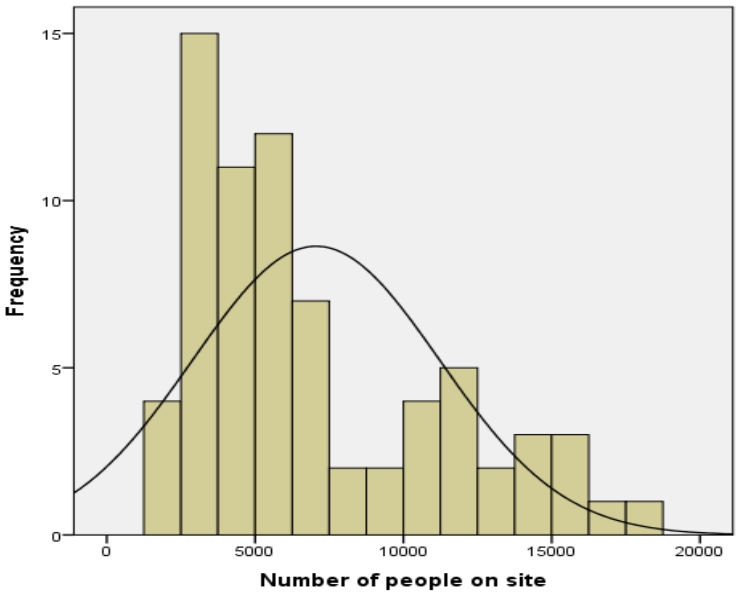


Figure 23: Histogram of the number of people on site

Figure 23 illustrates the frequency distribution of the number of people on site. The distribution is right-skewed, that is, the frequency distribution is horizontally stretched to the right, and that there are more values to the left than to the right.

Table 8 indicates a huge difference between the median (5 817), the mode (2 004), and the mean (7 056). The mean is farther in the direction of the long tail than the median. The distribution of the number of people on site is therefore not normally distributed.

D3: Comparison of project financial performance across different levels of categorical variables

Table 35, Table 36 and Table 37 present the results of the Mann-Whitney tests of the difference in the medians of project financial performance across the two levels of contractor claims, incident, and risk mitigation strategies, respectively. None of the three categorical variables has an impact on project financial performance as their respective p-values, 0,670, 0,057, and 0,813, are greater than 0,05. Therefore, the null hypothesis of no difference cannot be rejected at a 5% significance level in all three tests.

Table 35: Comparison of project financial performance when contractors' claims are present and not

	Contractor claims	Mean	Median	Range	Standard Deviation	P-value
Project Financial Performance	No	3,2928	3,3887	2,7749	0,6948	0,670
	Yes	3,0085	3,0066	1,5521	0,6326	

Table 36: Comparison of project financial performance when there is an incident or not

	Incidents	Mean	Median	Range	Standard Deviation	P-value
Project Financial Performance	No	3,0910	3,1183	2,5654	0,6591	0,057
	Yes	3,5046	3,6650	2,5332	0,6757	

Table 37: Comparison of project financial performance on whether any risk mitigation strategy was applied or not

	Risk mitigation strategies	Mean	Median	Range	Standard Deviation	P-value
Project Financial Performance	No	3,37210	3,45333	2,53319	0,79277	0,813
	Yes	3,18669	3,38872	1,98042	0,59342	

D4: Regression analysis 1

The number of COVID-19 cases has very little effect on the three dependent variables in all three models, as the coefficients of regression are in millionths or less, except for schedule performance in model 2 (-0,004). The only significant coefficients of the number of cases are for financial performance, at a 10% significance level, in all three models. It can also be noticed that the number of COVID-19 cases has a positive effect on the dependent variables, except for asset performance in model 3 (-0,000000924) and schedule performance in model 2 (-0,004).

The moderating variable, the risk mitigation strategy, changes, on asset performance, the level of significance of COVID-19 presence (from 10% to 5%) and of incidents (from 5% to 10%). It also changes the direction of impact of COVID-19 cases (from positive to negative) and the number of people on site (from negative to positive). On financial performance, the risk mitigation strategy did not change the direction of impact of both the independent variables and control variables. But on schedule performance, it changed the signs of the coefficients of COVID-19 cases (from negative to positive) and of lockdown level (from positive to negative).

All the coefficients of the contractor claims are not statistically significant for all three dependent variables. Also, it can be noticed that asset, finance, and schedule performance decrease when the contractor's claims are controlled in the models.

All the models in Regression Analysis 1 - normal data with variables combined

Table 24 are statistically significant at either a 10% significance level (models 1 and 2 of asset performance, Prob> χ^2 < 0,10), or at a 5% significance level (model 3 of asset performance, models 1 to 3 of financial performance, and model 1 of schedule performance, Prob> χ^2 < 0,05), or at 1% significance level (models 2 and 3 of schedule performance, Prob> χ^2 < 0,01).

The goodness of fit statistic, Akaike's Information Criterion (AIC), indicates that the models of asset performance improved from model 1 to model 3 as the AIC values decrease. This demonstrates the importance of including both control and moderating variables for better explanatory power. But for financial and schedule performance, basic models are better explanatory power as the AIC increases from basic models to models 3. Note that the negative sign in AIC is not considered as the absolute value only is considered.

D5: Regression analysis 2

Models 1 of asset and financial performance are not statistically significant at any of the three considered levels of significance (1%, 5%, and 10%). All the other models in Regression Analysis 2 - lagged data with variables combined

Table 25 are statistically significant at either a 10% significance level (model 2 of asset performance and model 1 of schedule performance, Prob > χ^2 < 0,10), or at a 5% significance level (model 3 of asset performance, models 2 to 3 of financial performance, and model 3 of schedule performance, Prob > χ^2 < 0,05), or at 1% significance level (model 2 of schedule performance, Prob > χ^2 < 0,01).

The goodness of fit statistic, Akaike's Information Criterion (AIC), indicates that the models of asset performance improved from model 1 to model 3 as the AIC values decrease. This demonstrates the importance of including both control and moderating variables for better explanatory power. But for financial performance, model 2 is better with lower AIC, and for schedule performance, model 3 is the best. Note that the negative sign in AIC is not considered, as the absolute value only is considered.

D6: Regression analysis 3

Models 1 and 2 of asset performance, as well as model 1 of schedule performance, are not statistically significant at any of the three considered levels of significance (1%, 5%, and 10%). All the other models in Regression Analysis 3 - normal data with variables split

Table 26 are statistically significant at either a 10% significance level (models 1 and 3 of financial performance, Prob > χ^2 < 0,10), or at a 5% significance level (model 2 of financial performance, Prob > χ^2 < 0,05), or at 1% significance level (model 3 of asset performance, and models 2 and 3 of schedule performance, Prob > χ^2 < 0,01).

The goodness of fit statistic, Akaike's Information Criterion (AIC), indicates that model 3 of asset performance is better (AIC is the least) than the first two models. This demonstrates the importance of including both control and moderating variables for better explanatory power. But for financial performance and schedule performance, their respective model 1 is better with a lower AIC

D7: Regression analysis 4

All model 1 of performance outcomes are not statistically significant at any of the three considered levels of significance (1%, 5%, and 10%). All the other models in Regression Analysis 2 - lagged data with variables combined

Table 25 are statistically significant at either a 10% significance level (models 2 and 3 of financial performance, Prob> χ^2 < 0,10), or at a 5% significance level (model 2 and 3 of asset performance, Prob> χ^2 < 0,05), or at 1% significance level (models 2 and 3 of schedule performance, Prob> χ^2 < 0,01).

The goodness of fit statistic, Akaike's Information Criterion (AIC), indicates that model 3 of asset performance is better (AIC is the least) than the first two models. This demonstrates the importance of including both control and moderating variables for better explanatory power. But for financial performance, model 2 is better, and for schedule performance, model 1 is better with a lower AIC.

Appendix E – Proposed schedule and timelines

Table 38: Consistency table: research questions, propositions, data collection and data analysis (authors' construction)

RQ #	Research Objective	Hyp #	Hypothesis (Hyp)	Data collection detail	Data analysis method
1	Analyse the delivery timelines (Schedule Performance) of Eskom mega-project: Kusile Power Station during a black swan event (COVID-19).	1	**Null Hypothesis (H0):** The black swan event (COVID-19) has no effect on delivery timelines (schedule performance) at Kusile Power Station Project. **Alternative Hypothesis (H1):** The black swan event (COVID-19) significantly delayed delivery timelines at Kusile Power Station Project.	Sourced from Kusile monthly reports and Key Performance Indicators (KPIs) – which are internally and externally audited. COVID-19 Presence sourced from published paper ((Hasan et al., 2022), COVID-19 Cases in South Africa sourced from (Worldometer, 2024), Lockdown Level sourced from Government official communications (Government, 2021) *moderating and control variables will form part of the assessment	IBM SPSS statistical quantitative analysis: Comparative, correlation and regression analysis
2	Assess the financial performance of Eskom mega-project: Kusile Power Station in light of a black swan event (COVID-19).	2	**Null Hypothesis (H0):** The black swan event (COVID-19) has no effect on financial performance at Kusile Power Station. **Alternative Hypothesis (H1):** The black swan event (COVID-19) led to a substantial impact on financial performance at Kusile Power Station.		
3	Evaluate the overall asset creation performance of Eskom mega-project: Kusile Power Station in the context of a black swan event (COVID-19).	3	**Null Hypothesis (H0):** The black swan event (COVID-19) had no impact on the overall performance at Kusile Power Station. **Alternative Hypothesis (H1):** The black swan event (COVID-19) significantly hindered overall performance at Kusile Power Station.		

Appendix F – Ethical considerations and permissions

Graduate School of Business Administration
University of the Witwatersrand, Johannesburg

Wits Business School Ethics Committee

24/10/2024

Ethics clearance number: **WWBS/BA0603548J/447**

This letter is only valid with a legitimate ethics clearance number and signed by the Researcher (below).

RE: Miss Shamita Jagjiwan

To whom it may concern

Miss Shamita Jagjiwan (0603548J) is currently registered as a MBA (Research Article) student at the Wits Business School, University of the Witwatersrand, Johannesburg.

This letter is to confirm that, at the time of writing, Shamita Jagjiwan does not need ethical clearance for the study entitled:

Impact of a black swan event on the performance of coal power station mega-projects in South Africa

This decision has been reached based upon a description of the project supplied by Shamita Jagjiwan to the Wits Business School Ethics Committee, constituted as a subcommittee of the University Human Research Ethics Committee (Non-Medical), which has been evaluated by the subcommittee chair. This decision has then been ratified by the University Human Research Ethics Committee (Non-Medical).

If, however, Shamita Jagjiwan changes the methods of data collection and analysis for this project, this decision may no longer be valid. If such changes take place, this should be communicated to the Wits Business School Ethics Committee.

Please feel free to contact me or the supervisor should you require any further information.

Yours sincerely,

Chairperson
Dr Ayanda Magida
☎ +27 11 717 3953
✉ ayanda.magida@wits.ac.za

Supervisor:
Dr. Appiah
✉ erasmus.appiah@wits.ac.za

Declaration by Researcher

One copy must be signed by the Researcher and returned to the Chairperson of the Wits Business School Ethics Committee.

I fully understand the conditions under which I am authorized to carry out the abovementioned research and I guarantee to ensure compliance with these conditions. Should any departure to be contemplated from the research procedure as approved I undertake to resubmit the protocol to the Committee.

Signature

01/11/2024
Date:

Eskom

MEMORANDUM

To:	Zandi Shange, General Manager: Kusile Power Station Project	Reference	
From:	Ms Shamita Jagjiwan, Chief Engineer - New Projects Technical Lead, Kusile Power Station Project	Version:	00
Date:	28 August 2024		

SUBJECT: REQUEST FOR ETHICAL CLEARANCE TO CONDUCT ACADEMIC RESEARCH STUDY

PURPOSE

1. This memorandum serves as ethical clearance, confirmation of Eskom's rights and security clearance for the **Master of Business Administration** study undertaken by **Shamita Jagjiwan** under the proposed research topic: **"Impact of black swan events on the performance of coal power station mega-projects in South Africa."**

BACKGROUND

2. It must be noted that this general clearance is for a limited period only, which will be for the period **September 2024** to **June 2025**.

3. This permission in no way waives Eskom's rights in terms of Intellectual Property, Publication and Copyright as reflected in the agreement reached between Eskom and the **University of Witwatersrand (WITs)** of which said agreement is recorded and incorporated into the *Ethical Clearance: Permission And Security Clearance Letter To Conduct The Study For* **"Impact of black swan events on the performance of coal power station mega-projects in South Africa"** as attached to this memo for approval by the Group Executive Human Resources.

REQUEST FOR ETHICAL CLEARANCE TO CONDUCT ACADEMIC RESEARCH STUDY

DECISION MAKING PROCESS

4. **Shamita Jagjiwan** has followed due internal processes in terms of obtaining permission for this research.

DISCUSSION

5. ***Indicate the research methodology and the nature/type of nature of information or data required from Eskom/or participants***,
   This is a quantitative study which uses secondary data as a form of data collection. The study will evaluate the relationship between black swan events (Covid-19) on the overall performance of Kusile Power station construction progress. Data will be collected from key performance indicators, planning/schedule progress, finance, risk mitigation strategies, and safety at Kusile Power Station.

FINANCIAL IMPLICATIONS

6. **Indicate any financial implications for Eskom.**
   None

BUDGET IMPLICATIONS

7. **Indicate any budget implications for Eskom.**
   None

RECOMMENDATION

8. Consideration and approval is requested for Shamita Jagjiwan to conduct this study. This research will benefit Eskom, as it can inform strategic decision making in the organisation and improved preparedness for black swan events in future mega-structure projects.

REQUEST FOR ETHICAL CLEARANCE TO CONDUCT ACADEMIC RESEARCH STUDY

Compiled by:



Shamita Jagjiwan
CHIEF ENGINEER: NEW PROJECTS TECHNIAL LEAD - KUSILE POWER STATION PROJECT
28 August 2024

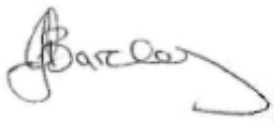
Recommended/~~Not recommended~~



Tumiso Railo
PROJECT ENGINEERING MANAGER – KUSILE POWER STATION PROJECT

Date: 04 September 2024

Recommended/~~Not recommended~~



Chris Barclay
SENIOR DELIVERY MANAGER – KUSILE POWER STATION PROJECT

Date: 2024-09-04

Recommended/~~Not recommended~~



Binesh Singh
SENIOR MANAGER CONTRACTS – KUSILE POWER STATION PROJECT

Date: 2024-09-04

Supported/~~Not supported~~



Zandi Shange
GENERAL MANAGER: KUSILE POWER STATION PROJECT

Date: 2024/09/09

Eskom

The Registrar

Date: 17 September 2024

Enquiries: Kagiso Mgimeti
Email: Mgimetke@eskom.co.za

To whom it may concern

ETHICAL CLEARANCE: PERMISSION AND SECURITY CLEARANCE TO CONDUCT THE STUDY FOR MASTER OF BUSINESS ADMINISTRATION RESEARCH PURPOSES AT THE UNIVERSITY OF WITWATERSRAND

Research topic: "Impact of black swan events on the performance of coal power station mega-projects in South Africa "

1. Intellectual Property Rights

All rights, title and interest in and to the Intellectual property of the experimental-based research data shared by Eskom, shall remain vested with Eskom. Research results and questionnaires developed by **Shamita Jagjiwan** shall remain vested with the student.

2. Publication Protocol

Eskom recognises that under the academic policies of **University of the Witwatersrand** the results of research work must be publishable and agrees that the Researchers engaged in the research shall be permitted to present a symposia, at national or regional professional meetings and to publish in journals, theses or dissertations, or other methods of reporting of their own choice, results of the Research.

The **University of the Witwatersrand** may publish or allow the publication of the proprietary data of Eskom, on whatever medium, concerning the research provided that this does not affect the protection of Intellectual Property Rights. Eskom shall be given 30 (thirty) days prior written notice of any planned publication of the research to take steps necessary to protect its rights.

ETHICS CLEARANCE: PERMISSION TO CONDUCT STUDY AND SECURITY CLEARANCE TO CONDUCT THE STUDY FOR MASTER OF BUSINESS ADMINISTRATION RESEARCH PURPOSES AT THE UNIVERSITY OF WITWATERSRAND

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It must be noted that this general clearance for the use of the requested data is for a limited period only, which will be for the period **September 2024** to **December 2027.**

Yours sincerely



Prudence Madiba

GENERAL MANAGER: RESEARCH TESTING AND DEVELOPMENT

Date: 2024-09-27

UNIVERSITY OF THE WITWATERSRAND, JOHANNESBURG

WITS FACULTY OF COMMERCE, LAW & MANAGEMENT

THESIS/DISSERTATION/RESEARCH REPORT – FIRST SUBMISSION CHECKLIST *(for Examination)*

**** This checklist must be completed and included as part of the submission. ****

Name of Candidate:	Shamita Jagjiwan	
Person/Student Number:	0603548J	
Qualification:	Master of Business Administration	
Title:	Impact of a black swan event on the performance of coal power station mega-projects in South Africa	
Supervisor(s):	Dr. Erasmus Appiah	
Contact Details:	**Cell number(s): 083 263 1885**	**Email: 0603548J@students.wits.ac.za**

FIRST SUBMISSION CHECKLIST *(for Examination)*

Has this research been submitted with the consent of the supervisor? (Y/N)		Y
Student to submit:	Electronic copy of research in PDF *(Hard copy may be required upon request from the examiner)*	Y
	Full Turn-it-in Report *(signed by Supervisor)* *** For WBS – this report does not require the Supervisor's approval ***	Y
	Confirmation of Ethics (*Clearance/Waiver certificate*)	Y
	Overall Supervisor Evaluation form *(MBA candidates ONLY)*	Y
Supervisor to submit:	University Clearance Certificate *(Supervisor to complete and send directly to Faculty)*	
	Supervisor's Report *(Supervisor to complete and send directly to Faculty)*	
Faculty to check on:	Approved title and supervisor(s)	
	Approved examiners	
	Registration status *(students must be registered during the examination period)*	

Please send your research submission to the correct email:

- #Fac-MBAsubmissions@wits.ac.za – for MBA (ARP) research submissions
- Veli.Mongwe@wits.ac.za – for PhD and Full Research Masters students belonging to WBS
- #Fac-MMsubmissions@wits.ac.za – for MM research submissions belonging to WBS and WSG
- Nasreen.Abdulla@wits.ac.za – for PhD and Full Research Masters students belonging to WSG
- Tshepo.Mohlakoane@wits.ac.za – for all research types belonging to Commerce and Law (SEF, SBS, SOA and SOL)

Please Note:

- *Incomplete submissions will NOT be prioritised.*
- *Outstanding fees must be cleared to enable Awaiting Examiner's registration (upon submission).*
- *WBS submissions may undergo internal academic quality checks before the exam process may begin.*
- *There may be a delay in the examination process – for more information, click:* Exam Process
- *For more information on the graduation, click:* Graduation info. and Graduations Office

Overall Supervisor Evaluation

Name of Supervisor: Dr. Erasmus Appiah

Name of Student: Shamita Jagjiwan

Student Number: 0603548J

Topic of Research / Project Report: Impact of a black swan event on the performance of coal power station mega-projects in South Africa

The aim of this questionnaire is to evaluate the overall supervision you received. It would be appreciated if your comments could reflect your honest opinion as improvements can only be undertaken as a result of the questionnaire. **Please note that this form will be treated confidentially and no details will be given to the Supervisor.**

1. Was your Supervisor readily available to help you at any time?

   Yes

2. Approximately how many times during the course of the year did you meet with your Supervisor? 8-10 times (virtual and in-person)

3. Approximately how many times did you contact your Supervisor during the year?

   More than 15 times

4. Approximately how many times did your Supervisor contact you during the year?

   4-6 times

5. Did your Supervisor keep you informed of how to contact him/her at all times?

   Yes

6. Did you keep your Supervisor up to date with your contact details?

   Yes

7. Do you feel that the supervision you received was adequate for your needs?

   Yes

8. Would you recommend your Supervisor to other students in next year's class of students?

   Yes

This form is to be handed in to the Faculty Office on completion of your Research / Project Report.

Signed:  Dated: 2025-06-06

Handed to: #Fac-MBAsubmissions@wits.ac.za

2025 REGISTRATION DECLARATION

(PLEASE READ BEFORE SIGNING)

1. I must
   a. Perform such work as may be assigned to me by members of the staff.
   b. Conform to the University's rules, regulations, policies, procedures and standing orders ("the Rules") as approved and amended from time to time by the Council of the University.
   c. In accordance with the Rules notify the Faculty Registrar, in writing through the Faculty Office and before the specified deadlines, of my intention to cancel my registration or any part of my registration with the University, failing which I admit liability for all fees or any part thereof which have or may become due in terms of the Rules.

2. I hereby acknowledge that:
   a. I understand the provisions of the limitation of liability in the application form and that I am bound by all provisions in the application form.
   b. the information furnished by me on this form is accurate and complete;
   c. no change in my curriculum may be made without the consent of the Senate;
   d. in accordance with the Rules I must immediately notify the Faculty Registrar through the Faculty Office of any change whatsoever of my contact details including my address/es. My term residential address/es serve as my *domicillium citandi et executandi*;
   e. I have received or been referred to the University's website as well as the office of the Faculty Registrar where the Rules including the General Rules for Student Conduct are available and acknowledge further that I must acquaint myself with them and am bound by the contents thereof.
      The Rules are also available at the following link:
      https://www.wits.ac.za/students/academic-matters/rules-and-syllabuses/

3. I further acknowledge that:
   a. I am aware that the University follows a particular procedure for determining whether a student is qualified to present himself/herself for an examination/assessment.
   b. I undertake to acquaint myself with the procedure and acknowledge that I am bound thereby.

	COURSE CODE	BLOCK	SLOT
COURSE CODE/S REGISTERING FOR	BUSA7417A Research Project	1	Gen
	BUSA7420A African Leadership	1	Gen
	BUSA7422A Business in Africa	1	Gen
	BUSA7429A Indust Fores & Bus Fut Strateg	1	Gen
SCHOOL APPROVAL: NAME & SIGNATURE			
STUDENT'S NAME	**Shamita Jagjiwan**		
STUDENT'S NUMBER	060548J		
STUDENT'S SIGNATURE			
DATE:	June 2025		
FACULTY OFFICER: NAME &SIGNATURE			
DATE:			

Registration is approved subject to compliance with the Rules and Regulations of the University.