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Strategies Mine Leaders Apply to Reduce Fuel Use and Associated Costs

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MSL, Walden University, 2019

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Doctoral Study Submitted in Partial Fulfillment

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Abstract

The inefficient use of diesel fuel can contribute to environmental degradation and global climate change. Mining leaders must ensure the effective use of diesel fuel to reduce costs and conform to global carbon taxation practices. Grounded in the social exchange and corporate social responsibility theories, the purpose of this qualitative multiple case study was to explore strategies successful mine leaders apply to ensure effective use of diesel fuel and reduce associated costs. The participants included four leaders of mining firms within Australia and South Africa who have successful experience with reducing diesel fuel consumption. Data were collected using semi-structured interviews and analyzed using thematic analysis. The four themes identified were emissions, asset management, haul truck driver style, and diesel cost. A key recommendation is for mining leaders to promote strategies that help reduce diesel fuel and minimize environmental issues surrounding mining operations. Implications for positive social change included the potential for mining leaders to invest in strategies to mitigate continuous environmental change further while improving the lives of people and communities residing near mining firms.

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Dedication

This doctoral study is dedicated to those seeking to take responsibility for finding the highest potential in others, and those who have the courage to develop that potential. I dedicate this research to those who seek to influence lasting positive change; those who are brave enough to invest in others and create ripples of humility through serving others. My hope is that this legacy can be continued, for it is within each of our hands, to make a better world for all of those who live within it.

Acknowledgments

The success and accomplishment of this study required a tremendous amount of guidance and assistance from many people in my life. I am incredibly fortunate and humbled to have received their guidance and support throughout my journey. All that I have achieved was only made possible by such individuals and the support, inspiration, and engagement they have provided me with. I respect and thank Dr. Betsy Macht and my doctoral committee members for providing me with the opportunity to complete this exploration and development, as well as their guidance and encouragement. Each were pillars of support and helped to ensure my success. Furthermore, I am extremely thankful to her for showing me such support. I would not forget to thank my mom and remember my dad for each of their encouragement, timely support, and guidance throughout my journey. Lastly, I would like to acknowledge and thank all my friends, family, and loved ones, who have supported me throughout the process, both by keeping me harmonious and aiding me with processes such as reflection and diligence.

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Section 1: Foundation of the Study

Introduction

Because of the cyclical nature of the mining industry and continual evolution in technology mining leaders have challenges related to how to create strategies to ensure effective use of diesel fuel and reduce costs. As a requirement of environmental cognizance increases, mine leaders must begin to develop new practices and strategies to ensure they are fulfilling their social and environmental obligations. Through corporate social responsibility (CSR) and social exchange, mine leaders maintain their license to operate within the boundaries of such requirements (Bahizire & FangLin, 2020). Because a mine's license to operate is partly based on factors such as environmental regulations (Swara & Simatupang, 2020), mining leaders must promote practices and police that allow for organizations to monitor efforts while promoting new strategies to promote effective use of diesel fuel and reduce costs.

In this study, I explored strategies mine leaders apply to ensure effective use of diesel fuel and reduce costs. Potential social change implications of the study are multifaceted. This study has the potential to shape a competitive ecology in the mining industry that encourages mining leaders to exceed their regulatory and legal obligations, while ensuring social governance is safeguarded. Results of the study will help to inform future mining leaders in terms of their efforts to reduce diesel fuel consumption and associated costs.

Information about the background of the problem is discussed first, leading to the problem statement. This is followed by the purpose of the study, research question, and

conceptual framework. The nature of the study, relevant definitions, and assumptions are then addressed, followed by the scope, delimitations, and limitations, as well as significance of research.

Background of the Problem

Diesel is the primary source of energy for the mining industry (Pyatakov et al., 2019). Diesel is used for activities such as transportation of materials, as well as hauling and dumping of overburden. Haul trucks are the central consumers of diesel. Multiple policy initiatives have been created in the mining industry involving diesel fuel consumption. One focus of mining policy proposals is to ensure all mining is handled in ways that promote social and environmental sustainability while ensuring organizations remain economically profitable (Githiria & Onifade, 2020). Mine leaders must create a balance between extraction of material and cognizance of human and environmental wellbeing.

Global carbon taxation practices are being introduced with the intention of reducing harmful emissions to mitigate climate change (CC). In this capacity, one way for mining firms to remain profitable is through investing resources into more efficient and environmentally friendly policies and practices such that operation costs are reduced. Given that diesel fuel consumption is a significant contributor to operational costs, minimization of carbon emissions and associated costs is advantageous.

Problem Statement

CC is influenced by increasing use of diesel for vehicles and equipment at mining sites driving an increase in the amount of greenhouse gases (GHG) (Odell et al., 2018, p.

208). Energy efficiency within the mining industry has become more important worldwide and is expected to continue increasing another 40% from 2007 to 2030 because of the rise of fuel use as well as CC and the environmental influences of rising emissions and GHG (Gupta et al., 2018, p. 2). The general business problem was that in the mining industry, there is an increase in diesel fuel consumption linked to ineffective mining practices. The specific business problem was that some mine leaders lack strategies to ensure effective use of diesel fuel and reduce costs.

Purpose Statement

The purpose of this qualitative multiple case study was to explore strategies successful mine leaders apply to ensure effective use of diesel fuel and reduce associated costs. The target population for my study included four leaders of mining organizations in Australia and South Africa with successful experience involving reducing their diesel fuel consumption. Implications for positive social change include the potential to enable leaders within the mining industry to create and develop effective fuel reduction strategies by emphasizing the importance of GHG reduction. Leaders concomitantly improving environmental regulations results in a new and environmentally conscious culture which can affect environmental improvements within surrounding areas of mining communities.

Nature of the Study

I used a qualitative multiple case study approach for my study. According to Hamilton and Finley (2019), the qualitative method is effective to provide the reader with information regarding evidence-supported practices, recommend outcomes that

emphasize how innovation is perceived, such as feasibility, acceptability, and appropriateness, and identify strategies that can be used to foster change, monitor how successful they are perceived to be, and classify how they make a difference (Matta, 2019). In addition to statistical analysis, quantitative research methods require formal, objective, and systematic processes that involve defining variables, reviewing relationships between them, and analyzing cause and effect (Bloomfield & Fisher, 2019). A mixed methods approach involves the amalgamation of qualitative and quantitative processes (Alavi & Habek, 2016; Hong et al., 2018). As I did not intend to analyze numerical data, quantitative and mixed method research methodologies were not appropriate for my study. The qualitative research method was appropriate for my study.

I contemplated four qualitative research designs: (a) phenomenology, (b) ethnography, (c) narrative, and (d) case study. Phenomenological designs involve individuals' perceptions and consciousness of lived experiences, behaviors, natural attitudes, emotional and nonverbal communications, and contextual backgrounds that can be used to help understand the phenomena (Emery & Anderman, 2020; Prusko et al., 2020). Further, phenomenological designs center on individual perspectives as ways to better understand a particular phenomenon (McConnell-Henry et al., 2009). Since I did not focus on personal meanings of participants' lived experiences, natural attitudes, or subjective or emotional interpretations of phenomena, the phenomenological design did not fit my study. Ethnography requires a researcher to conduct research relating to cultural issues involving individuals' perceptions regarding the way the world works (Hammersley, 2019), whereas the narrative approach requires analysis of individuals'

stories over a period (Robert & Shenhav, 2014). I chose the multiple case study design for my research study. The case study design was most appropriate. Multiple case studies are effective when seeking to explore intricate social and technical phenomena which result in organizational change or improvement (Lewis, 2015; Yin, 2018). A multiple case study is particularly appropriate when the purpose of research is to compare or replicate findings across multiple cases to draw assessments or predict contrasting or parallel results based on a theory (Yin, 2018).

Research Question

The research question for my qualitative multiple case study was: What strategies do successful mine leaders apply to ensure effective use of diesel fuel and reduce costs?

Interview Questions

1. Why is diesel fuel consumption a significant matter within your mine?
2. What strategies do you use to reduce diesel fuel consumption?
3. How is diesel fuel consumption tracked and investigated by mine leaders at your site?
4. What programs and procedures do you use to help to prevent excessive diesel fuel consumption?
5. How do you assess the effectiveness of your organization’s diesel fuel reduction strategies?
6. What metrics have you established to track cost savings and what documentation are you using to track and trend?

7. What metrics do you have on the total reductions of greenhouse gasses over the past 5 years based on the current fuel reduction strategies in your mine?
8. How does your organizational documentation identify trends in cost savings?
9. What additional information would you like to share about the strategies you use to ensure effective use of diesel fuel and reduce associated costs?

Conceptual Framework

The two conceptual frameworks for my study were the social exchange theory (SET) and CSR theory. The SET and CSR helped in terms of defining relevant themes for data analysis and mapping out how each theme was related to findings (Homans, 1958). CSR involves requirements of business to pursue policies which are advantageous in terms of their value to society and help organizations become more socially accountable to themselves, their stakeholders, and the public (Bhasa, 2017).

SET

The SET involves commutation of tangible or intangible activities between two organizations or individuals (Frederiksen, 2018). SET concepts include cost and reward, each element that drive human behavior (Zoller & Muldoon, 2019). One tenet of the SET is that the exchange of social behavior may result in social and economic outcomes; therefore, CSR is a theoretical underpinning of the SET (Frederiksen, 2018). Self-oriented social behaviors within an organization are explained through the SET as a series of interactions that one may choose to enter to maintain relationships to generate and maximize benefits (Zoller & Muldoon, 2019). Another tenet of the theory is that the exchange of social behavior may result in social and economic outcomes. The SET was

applicable to my study as leaders in mining organizations can perceive that contributing profits to social behaviors are an unequal exchange that might reduce their abilities to make profits and meet fiduciary responsibilities to their shareholders.

CSR Theory

CSR theory concepts include economic, legal, ethical, and discretionary social responsibility (Glonti et al., 2020). CSR variables such as economic, ethical, and social responsibility were addressed in interview questions and applied during data analysis. Awang et al. (2019) discussed that the growing concern for damages created by economic activities, such as mining initiatives, to the environment can be classified as being a CSR initiative. This CSR obligation can be met through adoption and implementation of corporate and social actions (Awang et al., 2019). CSR was also relevant because it involved addressing equitable ways to compensate communities for social and environmental costs associated with fuel consumption and associated emissions.

Operational Definitions

Corporate social responsibility (CSR): Organizational requirement to meeting economic, environmental, ethical, and social responsibilities toward individuals and their communities (Frederiksen, 2018).

Environmental sustainability: Rates of renewable resource harvest, pollution generation, and nonrenewable resource depletion that can be identified by maintenance of ecosystems and life-supporting structures at an appropriate level to ensure a continued supply of natural resources (Khan et al., 2020).

Rolling Resistance: Difference between gross and net traction, or the force resisting the motion when a wheel rolls on a surface (Farhadi et al., 2019).

Assumptions, Limitations, and Delimitations

Assumptions

In qualitative studies, assumptions are factors the researcher is not able to control (Ritchie et al., 2013). In qualitative research, participants' interpretations of a subject are discussed based on their personal perceptions and understandings of given subject matter (Ivankova & Wingo, 2018). Subjective descriptions may create uncertain data (Pulido, et al., 2003). In my study, I assumed all participants answered questions honestly and all information obtained from research participants and interviewees was presented in an honest manner. Another assumption was that all information found in public literature and documentation was based on valid, reliable, and factual data. I assumed leaders and employees in the target study population were willing to participate in this qualitative study. I assumed that relevant and pertinent documents for review were accessible for study.

Limitations

Limitations are possible weaknesses within a study that are not within the researcher's control, which can impact outcomes or generalizability of a study (Ritchie et al., 2013). Limitations can result in bias, which may have the potential to influence readers' interpretations of findings (Ross & Zaidi, 2019). Principal limitation of my study was its short period and lack of sufficient publicly held mines that were included in my

study population. This limitation was created based on the global dominance of privately held corporations in the mining sector.

Delimitations

Delimitations refer to limitations or boundaries set by the author within an investigation (Theofanidis & Fountouki, 2018; Yin, 2014). According to Yin (2013), delimitations are various decisions or choices a researcher makes to frame a workable research problem. One delimitation of this study was that that it included four participants from two geographical locations, and only a small number of mining firms. Because only four firms were studied in South Africa and Australia, the specific geographic area for this study was limited.

Significance of the Study

CC and the associated transition to a low carbon future brings various risks for the economy and mining industry and its fuel consumption requirements. Mining operations contribute to global warming, rising air pollution levels, land degeneration, contaminated water sources, and various human health problems that could create negative outcomes for future generations (Woźniak & Pactwa, 2018). Findings of my study benefit mining organizations, workers, and society considering that workplace safety, health, and environmental sustainability plays a significant role in organizational development, societal wellbeing, and employees' welfare. Findings will positively affect business practice in the mining industry and influence positive social change.

Contribution to Business Practice

Results of my research study provide additional value to mining businesses by providing strategies regarding how mine leaders can drive fuel and GHG reduction. Future compliance with environmental regulations and standards within Australia and South Africa is also a resulting consequence of my study. Leaders in the mining industry can apply recommendations of my study to inspire and create innovative and sustainable jobs and business practices.

Improved business sustainability and compliance works to benefit effective practices of business by minimizing costly penalties associated with environmental regulatory fines and charges. Strategies may help to create sustainability through profitable operations. Increased profit allows mines to become sustainable through managing their environmental footprint and further allowing them to create and sustain local jobs while becoming better partners in their surrounding communities.

Implications for Social Change

Increased costs associated with fuel use in the mining industry have reduced jobs and will continue to do so until strategies to reduce associated costs are developed (Nygren et al., 2009). Alternative fuel development should assist organizational leaders as they plan and envision sustainable possibilities for mining initiatives. The study includes strategies that, when applied, aid in the process of addressing global environmental problems, such as rising GHG emissions known to create contamination in water sources and agricultural fields and cause significant health concerns and various social implications. Communities residing around mines also benefit from application of

the research findings to counteract current water and air pollution sources and environmental degradation.

Mining businesses can create harm, including environmental pollution, disease, and industrial accidents; for this reason, it becomes essential for such organizations to develop policies that help mitigate damage caused by inefficient fuel use (Li et al., 2017). Any organization promoting CSR must seek to create profit through complying with regulations and rules within their present nation or community. Mining businesses have the capability to formulate such policies and promote CSR-based compliance to improve lives those living within surrounding areas and communities. Many mining organizations are profit-centered; they often disregard environmental impact. To ensure sustainable practice, mine leaders are responsible for creating policies and formulating sustainable strategies that incorporate the promotion of environmental cognizance and costs associated with such practices into their fuel efficiency policies (Khan et al., 2020; Li et al., 2017). Implementation of strategic CSR promotes alignment between mining business' interests, social value, and environmental stewardship, generating more impact and value to society and mining communities (Hąbek et al., 2019; Li et al., 2017).

A Review of the Professional and Academic Literature

The purpose of this qualitative multiple case study was to explore strategies successful mine leaders apply to ensure effective use of diesel fuel and reduce associated costs. The research question for my qualitative multiple case study was: What strategies do successful mine leaders apply to ensure effective use of diesel fuel and reduce costs? My aim was to use the qualitative research method and multiple case study design to

explore experiences, opinions, and perceptions of strategies mine leaders in South Africa and Australia apply to ensure effective use of fuel and associated costs. This critical analysis provided an opportunity to develop a synthesis of extant literature by identifying various gaps within the body of knowledge to uncover themes, information, and analyses to develop syntheses. Researchers can apply this information to create a consistent understanding of information.

My intent with this literature review was to critically analyze and synthesize numerous resources and data relating to the conceptual framework and research existing literature regarding the specific business problem. The conceptual frameworks of the study were the SET and CSR theory. In the literature review, themes were presented involving fuel reduction strategies and cost reduction. Sources used in the literature review included peer-reviewed studies obtained from the Walden University Library. A multiple case study design permits the researcher to present more than one case in the study. Conceptual frameworks that were used in my study were the CSR theory and SET. In this literature review, peer-reviewed scholarly studies were acquired from the following databases: Google Scholar, ProQuest, SAGE Journals, SAGE Research Methods, Science Direct, EBSCOHost, and Business Source Complete.

The literature review begins with evolution and general trends within SET and CSR research. Sources consulted for this literature review include articles from peer-reviewed scholarly journals, dissertations, and books. I used the following keywords to conduct this review: *CSR, SET, mining industry, diesel fuel consumption, rolling resistance, haul truck fuel consumption, mining operational procedures, mining*

emissions, and greenhouse gas. Of the 100 citations in this literature review, 90 were from works published between 2015 and 2020. Peer reviewed articles used for the literature review included 80 sources, accounting for 90% of articles. I reviewed 90 peer-review articles published during or after 2018. However, some sources in this review published prior to 2018 were pertinent because they provided background information regarding mining strategies developed over time to reduce diesel fuel consumption.

SET

One conceptual framework for this study was the SET. The SET was developed in 1961. It originally involved the ways in which individuals communicate and their willingness to divulge issues within small groups (Pattnaik, 2018; Sungu et al., 2019). Before individuals take part in social or group activities, they should first consider consequences of interactions because such experiences are founded on personal obligations, gratitude, and trust (Pattnaik, 2018). Individuals participating in group activities must first believe that they are rewarding (Sungu et al., 2019). Subsequently, individuals who engage in social activity do so expecting to receive some form of benefit.

The CSR theory can be a conjunctive theory as it can be applied to the SET to shape the culture of an organization and shift organizations into communities. The SET was used as part of the theoretical framework for this study because it helped in terms of combining concepts. Mining firms and leaders develop the perception that contributing resources to social exchange behaviors can create unequal exchanges because such behaviors work to reduce the firm’s ability to create profit and trust between communities, shareholders, and employees.

CSR Theory

Since its beginnings in the early 1960s, CSR has gone from a business practice to a legal obligation in some industries and regions (Tamvada, 2020; Velásquez, 2012). For example, CSR has been heavily embraced in the mining industry (Corrigan, 2018; Hilson et al., 2019). Mining firms have the ethical and legal obligation to consider interests of customers, employees, shareholders, and communities, as well as the ecological influence of their organization on all aspects of their operations (Contreras-Pacheco, 2020). Interests of customers, employees, shareholders, and communities are crucial components when examining a mining firm's responsibility. This perspective on responsibility should be viewed as both ethically and legally, to incorporate policies.

Advancement of CSR research has developed from a rudimentary emphasis on theory development to the impact and benefit of such practices. Preliminary CSR research was focused on development of theories, tenets, and principles. There are four theoretical components within the CSR theory: profits, political accomplishments, (social demands, and ethical standards (Garriga & Melé, 2004). Each of these four components can be applied to firms to help better develop understanding of CSR activities and how they impact social responsibility. Mining leaders apply CSR in ways that influence both organizational development as well as their relationship with society, allowing the integration of profits, political accomplishments, social demands, and ethical standards. CSR research also involves improving social effects of CSR activities of firms. Organizations have a broad influence on society as they are corporate citizens.

Organizations must create sustainable practices and be considerate of the environment and communities.

The CSR theory was part of the theoretical framework for this study because it involves awareness that industry actions can create harmful influences on communities and the environment. Destruction of the environment leads to loss of resources, productivity, sustainability, and quality of business and community life. Enlightened mining leaders must recognize the significance and benefit to CSR practices and their ability to safeguard the environment as well as endowing worthwhile philanthropies to surrounding communities where mining firms have a presence. Because practices in CSR often include processes or programs that give back to communities and promote environmental sustainability, they can be used to augment various social and ethical boundaries (Contreras-Pacheco, 2020). Similarities exist within the ways in which CSR is promoted in the mining segment. The fundamental practices used to employ such programs differ, requiring mining leaders to expand their understanding of sustainable practices and shift socially responsible business activities to create resilience and meet the different requirements of a specific industry or organizational context (Lamprinakis, 2019).

Mining firms commonly experience issues based in ethical principles within their basic operations. Such instances can work to either create innovative and process-based developments or add additional resistance to change (Chang, 2018; Contreras-Pacheco, 2020). One theory that works to generate positive momentum with regarding to ethical dilemmas within organization frameworks is CSR, which involves a high degree of self-

regulatory function whereby the organization begins to regulate both ethical and legal (Carminati, 2019). CSR can be applied as a founding theory in this study as it can be viewed as a social contract between organizations and the communities in which they operate. To ensure effective CSR within firms, mining leaders must demonstrate their commitment through strong examples of community importance and relevance. This responsibility and implementation encourage a social shift toward community engagement and environmentally conscious practices. Abuya and Odongo (2020) assessed the impact of 'inherited CSR' programs within the mining community in Kwale. Abuya and Odongo (2020) said leaders within the mining industry should promote CSR as a strategy to move forward and propel community alignment and organizational success. Within the context of mining firms and their surrounding communities, CSR can be employed as an empowering process to encourage social good as well as more efficient profitability.

In the context of mining firms, CSR is critical for leaders to reflect upon actions that are representative of either improvement of economic, social, and environmental living conditions of local communities or reduction of negative influences resulting from mining initiatives and operational processes. Mining firms could create significant disruption to environmental regularity as well as community sustainability (Corrigan, 2018; Hilson et al., 2019). CSR initiatives within mining settings must consist of investments to reduce effects on operational infrastructure; investments can be made involving environmental policies, new equipment, and investments in human capital such as employee training and development.

Alternative Theories

The General system theory (GST), protective action decision model (PADM), and stakeholder theory were alternative theories that I considered and could have applied as conceptual frameworks for this study. As my study focused on strategies mine leaders apply to ensure effective use of diesel fuel and associated costs, I did not use the GST. Although the PADM may have helped drive benefits in terms of improving understanding of strategies mine leaders apply to reduce diesel fuel use from the perspective of risk, it did not permit exploration of associated cost reductions. The PADM was not selected for this study. The stakeholder theory indicates that directors have a responsibility to shareholders, which does not align with this study. I did not use the stakeholder theory for the study and chose to focus on the SET and CSR theory as conceptual frameworks for the study.

GST

The GST was a possible alternative management theory. The GST is a framework used to investigate and describe objects that operate collectively to create a given result. Leaders who use the GST could provide their organizations with the ability to interact with systems to understand details of individual components as well as elements in which they are composed of. The GST is an interdisciplinary theory involving the nature of complex systems (Boulding, 1956). Systems can range from a single organism to any organization or society. The GST offers leaders a process for problem solving by viewing problems such as excessive diesel fuel consumption as a part of a process or system

rather than specific outcomes or events that may contribute to further unintended consequences such as associated costs and emissions.

Von Bertalanffy (1950) said a given system can be described as active collaboration of related business elements that influence one another. The GST has three business-related characteristics: (a) contiguity and interaction of systems within business environments, (b) effects of given decisions on systems to advance performance and influences on performance, and (c) inherent characteristics of systems on other business subsystems (Boulding, 1956; Šijan et al., 2019). The GST can be applied to collaboration of related business elements that influence fuel use and associated costs within the mining industry. The GST involves use of science for the purpose of investigating general laws of complex systems. As my study was specific to strategies mine leaders apply to ensure effective use of diesel fuel and associated costs, I did not use the GST and chose to focus on the SET and CSR theory as conceptual frameworks for the study.

PADM

The PADM is a behavioral theoretical framework that can be applied to research to help describe individuals' responses and preparedness in terms of long-term threats based on perceptions of risks (Liddell et al., 2020; Lindell & Perry, 2012). The PADM as an alternative conceptual framework was explored based on potential to enhance understanding of people's response to long-term threats and imminent disasters (Liddell et al., 2020). These conditions act collectively to influence perceptions of personal risks and processes individuals may take to create and implement protective action and associated decisions. Although this framework may have helped drive benefits in terms

of improving understanding of strategies mine leaders apply to reduce diesel fuel use from the perspective of risk, the PADM did not facilitate exploration of associated cost reduction.

Stakeholder Theory

In 1984, Freeman established the stakeholder theory as a foundation for emerging concepts of business and ethics while linking social performance with economic performance. The fundamental constructs within stakeholder theory includes: (a) descriptive / empirical, (b) instrumental, and (c) normative (Donaldson & Preston, 1995; Miles, 2015). Under stakeholder theory, organizations are characterized as being governed by relationships essential to maintain function among individuals and groups affect by organizational operations, (Freeman, 1994; Freeman et al., 2020; Freudenreich et al., 2020). With this understanding, the collective efforts of stakeholders and their networks are contributing factors to value creation within a firm while the removal of support from any stakeholder can threaten the viability of a business. This perspective acknowledges that relationships form the basis for a functioning value creation network make it difficult to operate an organizational model without robust relationships with stakeholders.

Using the conceptual framework, the stakeholder theory, the researcher can guide participants in ways that enable the exploration of perceptions and experiences regarding strategies used to engage stakeholders in organizational programs. This was a consideration as a secondary framework to CSR as it complemented the process of engagement in such responsibilities from a stakeholder's perspective. Freeman et al.,

(2020) noted that the central construct of the stakeholder theory was that firms hold various relationships with stakeholders, and that the purpose of such relationships is to create as much value as possible for the highest number of involved individuals and stakeholders. Alternatively, Tong et al. (2020) emphasized that stakeholder theory contributed to a deeper understanding for who stakeholders are and how best to target them based on engagement and interest. For leaders within industries, such as the mining industry, it critical to identify who the stakeholders are and understand their interest to ensure they are being satisfied in ways that promote value. Because organizations are founded on vision and purpose (Dumitrascu & Feleaga, 2019), stakeholders contribute to the basis of relationship building and foundational structure (Freudenreich et al., 2020).

With aspects such as environmental threats, unrest, and uncertainty in the mining industry, the issues of stakeholder salience and stakeholder relationship become relevant to the sustainability of the industry. The notion of environmental threats on a global scale justifies the need for this study to determine how best to engage stakeholders in conjunction with mining leaders to ensure improved outcomes in CSR programs. However, stakeholder theory maintains mining leaders' focus on the perspectives and interest of a firm's stakeholders rather than leaders. Shareholders are not the only contributors to the success of effective strategies. Although stakeholders have a direct impact on a company's operations, the stakeholder theory illuminates the notion that directors have a responsibility to shareholders and stakeholders alike, which does not align with this study as I was exploring the strategies mine leaders apply to ensure effective use of diesel fuel and associated costs. For this reason of strategy exploration, I

did not use stakeholder theory for the study and focused on SET and CSR as the conceptual frameworks for the study.

Environmental Responsibility

Global industries are continually being shaped in ways that help them to succeed during the transformations created by the requirements of sustainable development. Environmental responsibility is the notion of such industries being proactive and expanding beyond a legal obligation to create better corporate sustainability strategies (Curkovic & Sroufe, 2016). The foundation of environmental sustainability has been extensively analyzed in literature (Maas et al., 2016). Relatively little progress has been made in integrating applicable approaches for sustainability evaluations within industries. A significant number of studies, such as those by József (2020) and Danso et al. (2020), have attempted to broaden the knowledge base around environmental sustainability by providing universal and individual endorsements. The area of environmental responsibility may be particularly significant for mining leaders because their implemented processes are inherently disruptive to the natural environment (Tost et al., 2018). With knowledge of disruptive processes, mine leaders must attempt to ensure sustainable development and environmental responsibility remain driving forces within their development strategies.

Mining can create a range of benefits for our societies. However, it may also cause conflict in both social and environmental systems. Mining operations can influence environmental and social deficiencies such as global warming, air pollution levels, ground deterioration, polluted water sources, and can even affect several human health

problems that have the potential to generate negative influences for generations to come (Woźniak & Pactwa, 2018). The link between factors such as industrial mining and sustainable development is reflected by many global initiatives. For example, various programs and committees promote responsible mining practices within mining leaders to ensure that sustainability is at the forefront of operational activity:

- The Global Mining Initiative
- Towards Sustainable Mining commitment of the Mining Association of Canada
- The Sustainable Mining Initiative by Federation of Indian Mineral Industries (Vintró et al., 2014).

In parallel, mining industry leaders often demonstrate their commitment to environmental responsibility through the adoption of environmentally conscientious practices and processes such as sustainability reporting (Tost et al., 2018). Globally there has been a push to shift the leadership and its thinking around sustainable development within the mining industry through the adoption of new operational activities (Githiria & Onifade, 2020).

With long-term consequences of industrial growth, mining leaders must begin to develop awareness and create action toward the reversal of these effects and prevent additional destruction of both social and environmental systems. Under the umbrella of environmental responsibility, the notion of environmental sustainability has become an awareness for mining leaders as well as at the forefront of general human consciousness (Githiria & Onifade, 2020). Awareness driven by environmental regulations and global

programs was created during the 20th century, which forced industries to have awareness for their impact and influence on the world around them. However, in 1987, the UN's World Commission on Environment and Development published a definition of sustainable development: “Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs (World Commission on Environment and Development, 1987)”. The processes involved in mining minerals from the earth’s surface can be highly inefficient, there is often significant amounts of energy and pollution involved in the process. For this reason of added pollution and contamination, various incentives exist for mining leaders when seeking to increase efficiencies within their mining processes such as the reduction in diesel fuel. Leaders seeking to create goals around economic and social development could define them in alignment with sustainability.

Soil Stabilization

Soil stabilization is a general term used in the mining industry to describe the phenomenon of physically, chemically, or mechanically manipulating natural soils to better meet engineering purposes. When creating stabilization properties, soil improvements include increasing the weight bearing capabilities, tensile strength, and performance of in-situ subsoils, sands, and waste materials to strengthen haul roads. Studies have been conducted on the pavement property changes after stabilizers have been applied. Stabilization characteristics such as roughness and stiffness can lead to a significant change in rolling resistance (Coffey et al., 2018; Li & West, 2019). These surface conditions have the potential to reduce rolling resistance by 47% (Jackson et al.,

2011). However, there is a lack of understanding on the effects of the stabilized surface on rolling resistance. Rolling resistance is defined as the energy consumed per unit distance traveled by a rolling wheel (Coffey et al., 2018; Curtosi et al., 2019; Jackson et al., 2011). A portion of total energy is lost from a moving wheel because the pavement material's stress/strain response. Rolling resistance significantly affects fuel consumption: 10% of change in rolling resistance can lead to a 3% change in fuel consumption, equating to over three billion dollars (Barrand & Bokar, 2008; Jackson et al., 2011). A small variation in rolling resistance can create a significant change in a mine's total truck haulage and associated diesel fuel consumption.

Haul truck characteristics also play a role in calculating rolling resistance totals. Depending on characteristics such as truck weight, tire penetration into the pavement, and surface deformation rolling resistance can be significantly influenced (El-Sayegh et al., 2019). Many studies have been carried out on the influences of rolling resistance since haul truck tire response are associated with diesel fuel use. The effects of: (a) tire design, (b) tire condition (load, speed, tire pressure), (c) pavement surface, and (d) steering characteristics (tire slip) on the rolling resistance were found to significantly impact the effect of rolling resistance and associated diesel fuel consumption (El-Sayegh et al., 2019). Tire deformation is an additional source of rolling resistance which may account for a significant portion of the total rolling resistance (Li et al., 2019; Pelc, 2020). An increase of 60 microns to 98 microns pavement surface deflection can lead to 28% more fuel consumption (Bazi et al., 2018). Pavement-induced rolling resistance was significant for flexible pavements. Although several studies have been conducted to investigate the

combined rolling resistances, limited studies have been conducted to investigate the rolling resistance caused by pavement response (Wollny et al., 2015). With a clear understanding for influence because haul truck tire response and associated diesel fuel use, additional research must be conducted to understand effects on rolling resistance caused by pavement response.

Tire Properties

Within a mining system, a haul truck's tires can affect factors such as handling, braking, and acceleration, as well as their diesel fuel consumption. Analyses of haul truck tires involves the description of life cycle assessments regarding the development, design, operation as well as technology, and long-term cost effects (Kansake & Frimpong, 2018). Various tire properties associated with the tires of mining haul trucks, such as rolling resistance, tire pressure, tire condition, surface area, and other tread properties, can have a significant influence on diesel fuel consumption and associated costs.

Rolling Resistance

Rolling resistance is a significant factor in the productivity, cycle time, and diesel fuel consumption of haul truck operations. Rolling resistance is defined as the difference between gross traction and net traction or the force resisting the motion when a wheel rolls on a surface (Farhadi et al., 2019). The effects of haul truck tire properties on diesel fuel consumption can be related to the phenomenon of rolling resistance. As the tires on a haul truck roll under its weight, their pressure changes as the tire cycles through periods of deformation and reformation. During this process of shifting, mechanical energy is converted into heat and begins to dissipate from the tire. More diesel fuel is required to

replace any loss in energy. According to the Environmental Protection Agency (2013) under inflated tires can reduce a vehicle's fuel economy by as much as 2% for every pound per square inch (psi) below ideal tire pressure. The influence of tire penetration as an influential parameter on rolling resistance was found to have a direct correlation between tire penetration and rolling resistance (Soofastaei et al., 2015). Under inflated tires have added flexibility within their sidewalls which, in turn, created an increase in tire temperature and loss of diesel fuel efficiency in the form of energy (Environmental Protection Agency, 2013). These results indicate that an increase in tire pressure creates an increase in rolling resistance and diesel fuel consumption in vehicles. More specifically, as tire pressure increases, rolling resistance decreases with the same value of vehicle speed and weight (Szczucka-Lasota et al., 2019). A drop in pressure in truck tires by 0.02 MPa, creates an increase in fuel consumption by 1.5% (Szczucka-Lasota et al., 2019). Tire pressure can be a basic factor affecting the efficiency of the use of vehicles, rolling resistance, and the amount of fuel consumption.

Tire Pressure

As haul truck tires roll across a surface, there is a change in physical characteristics. One other factor that can influence haul truck tire performance such as the impact of external and environmental factors on tire pressure (Szczucka-Lasota et al., 2019). When a haul truck's tire is under-inflated, it generates a downward force that creates a larger point of contact with the road surface. This extra surface area and contact creates an increase in the roll resistance, which makes the haul truck consume more diesel fuel (Szczucka-Lasota et al., 2019). Increasing tire pressure creates a decreased

rolling resistance coefficient which corresponds to a decrease in the rolling resistance at higher tire pressures (Szczucka-Lasota et al., 2019). Haul trucks with tires inflated at 50% of the recommended pressure used 5–10% more fuel (Energy Efficiency & Renewable Energy, 2017). Tire pressure does not remain at a constant during haul truck operation and is affected by the temperature of the tire. Tire temperature changes during routine operation and affects the tire's pressure during the process of hauling material. Increasing atmospheric temperature as well as the temperature of the tire, causes an increase in tire pressure (Aldhufairi, & Olatunbosun, 2018; D'Ambrosio & Vitolo, 2019). The increase of atmospheric conditions such as temperature, can create an increase in a haul truck's tire pressure and diesel fuel use.

Tire Tread

Tires have the potential to impact haul truck diesel fuel efficiency primarily through rolling resistance. Tire condition is also an important factor when considering rolling resistance, mainly manifesting itself in tread wear (Aldhufairi & Olatunbosun, 2018; Szczucka-Lasota et al., 2019). Both tire structure and small-scale tread deformations are contributing factors to rolling losses and diesel fuel consumption (Lakkam & Tempiem, 2020). Tires that have high tread wear exhibit a decrease in rolling resistance, which can lead to increased fuel consumption (Lakkam & Tempiem, 2020). Irregularities within the tire, caused by tire tread, can result in time varying tire forces as well as tire vibrations. These tire vibrations are caused by the energy dissipation originated by tire tread and the tire structure (Boere et al., 2014). Haul truck tire treads can have a significant effect on diesel fuel consumption.

Tire Surface Area

The area of the haul truck tire that is in contact with the road can cause a variation in rolling resistance. Bachman (2018) discussed this variation in rolling resistance and used a test sample of nine tires (three for each axle position) and found that as tire diameter increased, rolling resistance decreased. The relationship between tire surface area and rolling resistance was found to be constant among different types of tires such as tires on the steer axle, drive axles, and trailer axles, as well as variations based on the load per tire. Tire surface area can be linked to tire diameter and has been identified in several studies as a contributor to rolling resistance and diesel fuel consumption (Aldhufairi & Olatunbosun, 2018). In a mining setting, larger tires reduce diesel fuel consumption because they are heavier and have a higher rolling resistance; they require more resistance and energy to get them rolling.

Tire Loading

Tire loading is also considered when assessing rolling resistance in haul trucks. The weight that can be carried by an individual tire can be influenced by the type of vehicle, payload, and the operational parameters of each truck. Chegenizadeh et al. (2020) found that increasing tire load resulted in increased rolling resistance. The results of Wollny et al.'s (2021) study indicated a significant increase in rolling resistance as the tire load on a vehicle increased. Tire and pavement temperature, as well as their relationship with rolling resistance, have been the subject of several studies. Tire and pavement temperature have a significant influence on factors such as fuel consumption. For example, increasing tire temperature resulted in decreased rolling resistance (Wollny

et al., 2021). Tire loading may cause an increase in rolling resistance as the tire load on a vehicle increases which can result in an increase in diesel fuel use.

Wheel Alignment

Wheel alignment serves a variety of functions in vehicle operation. Often, mining haul truck wheel alignment can impact the handling, steerability, stability, performance, and safety of the operation. When all wheels are in total alignment, the vehicle is balanced and in motion in one direction, this means no lateral forces counteract against the momentum and direction (National Research Council (U. S.) Transportation Research Board, 2006). In addition to various other factors, correct wheel alignment can also influence rolling resistance (Baldissera & Delprete, 2016; Rajapakse, 2017). When axles are improperly aligned, the wheels end up turning inward or outward as the vehicle moves forward, preventing the truck from traveling in a straight line (Baldissera & Delprete, 2016; Rajapakse, 2017). The angle created by the misaligned wheel in relation to the road beneath requires more force or energy, to keep the truck moving forward at a steady rate. Wheel alignment directly effects the rate of fuel consumption any misalignment of the wheels can cause a direct reduction on the efficiency of diesel fuel.

Wheel alignment can be applied to improve vehicle handling and keep the vehicle from pulling in one direction or vibrating strangely on the road. The inward and outward (positive and negative) angle of a wheel when viewed from the front of the vehicle is known as the camber angle (Young et al., 2017). The camber angel refers to the angle between the vertical axis of the wheels and the vertical axis of the vehicle (Matsumura & Ishigami, 2019; Young et al., 2017). If the top of the wheel is positioned pointing inwards

toward the axle, the wheel has a negative camber (Matsumura & Ishigami, 2019). Alternatively, if the top of the wheel points away from the center axle, the wheel has a positive camber angel (Matsumura & Ishigami, 2019). Davari et al., (2015) reflects this concept and noted that rolling resistance coefficient increases with increasing camber angle. In summary, wheel alignment can create an uneven distribution of vertical force which shifts the pressure distribution further creating an increase in torque, rolling resistance, and excess costs associated with fuel consumption.

In conjunction with camber angle, camber thrust is the force perpendicular to the direction of motion that is created when a leaning and rotating tire is forced to move in a straight line (Matsumura & Ishigami, 2019; Nakajima, 2011). A negative camber angle is commonly applied because it creates more favorable handling characteristics during material hauling and improves tire grip (Matsumura & Ishigami, 2019). Although negative camber is advantageous, it also has some disadvantages (Prayoga & Lie, 2020). For example, during straight-line acceleration, wheels with negative camber have a smaller contact area with the ground and can cause uneven tire wear (Matsumura & Ishigami, 2019). Mine leaders must be aware of the relationship between camber angle and rolling resistance because the more negative the camber angles, the larger the rolling resistance and the higher the fuel consumption of a haul truck.

Pavement Conditions

Diesel fuel consumption and final operational costs are not commonly used in the development of design plans within road design and construction. However, in the mining industry, operational costs such as material haulage are estimated to be 60% of

the total energy consumption (Norgate & Haque, 2010). Coffey et al., (2018) estimated that the load and haul process represent 50% of a mine's costs and 25% of their total costs. Pavement conditions of haul road surfaces had the potential to impact rolling resistance (Coffey et al., 2018). Higher textured road surfaces can lead to a higher rolling resistance and rolling resistance can be reduced by 8% on smooth newly constructed concrete surfaces (Loprencipe et al., 2019). Du Plessis et al. (1990) made 77 observations using 26 different sections of roads and reflected these findings by indicating that decreasing roughness and decreasing texture resulted in a rolling resistance decrease of 7%. For haul truck diesel fuel efficiency, haul road surfaces must have good surface characteristics (texture and roughness). Optimal maintenance of the roads is one means to limit excels diesel fuel consumption and associated costs.

Cycle Time/Payload Variance

The continual improvement of operational mining systems is one of the greatest challenges in mining. Haulage systems must be designed to be as efficient as possible to reduce haulage costs while increasing profitability. Haulage costs can be some of most significant costs within a mining system because about 50% of the operating costs are associated to this one area (Soofastaei, 2016). Cycle time and truck payload variance are important parameters in this field because they impact the production rate, but also contribute to a mine's diesel fuel consumption. The primary source of payload variance in haul truck and mining operation is the loading process. Variation of these parameters causes variation of bucket and consequently truck payloads, affecting productivity (Soofastaei, 2016). By reducing truck payload variance in surface mining operations

mining leaders can increase productivity by reducing bunching effects and machine wear from overloaded trucks.

Haul trucks are used to haul overburden and material. Their use must be scheduled in conjunction with other machinery, such as excavators, loaders, and diggers, according to the site layout and production capacity. The Department of Resources, Energy and Tourism (2010) investigated the energy costs associated with single stop cycle time, which equated to more than 361 kiloliters (kL) of diesel per annum. The Department of Resources, Energy and Tourism (2010) also found additional savings through a change to the engine control unit of the haul trucks. Modelling showed a 2.3% reduction in fuel consumption, with an increase in cycle time of 1.8%, resulting in a fleet-wide fuel savings of 232 kL of diesel per annum. In rail operations, The Department of Resources, Energy and Tourism (2010) found that the installation of an automatic start-stop system would reduce idle time, with savings estimated at 675 kL of diesel per annum. Numerical modelling also found that savings of between 300 kL and 500 kL of diesel could be achieved by reducing the speed of trains to reduce waiting times at crossing points. Another important observation around cycle times and locomotive throttle analysis' is that the most fuel-intensive part of the cycle is the empty run once a haul truck has extracted its load (The Department of Resources, Energy and Tourism, 2010). An empty run can account for 53.8% of the total cycle fuel use because the haul truck travels uphill and into the prevailing wind (Gurgenci & Aminossadati, 2009). Mining leaders must be sure to make close observations and make considerations when

understanding that the most fuel intensive component of haul truck haulage is during an empty run.

Shovel Truck Systems

In many mining operations, truck haulage is known to be a significant contributor to operational costs, constituting 50% to 60% of the total operational costs (Curry et al., 2014). If mine leaders are to become effective in reducing operational costs, haul trucks must be allocated and dispatched efficiently. One common barrier to implementing cost-effective energy use and emissions reduction is a lack of knowledge on strategies to plan and better use equipment Shovel-truck systems (STS) are the systems used to build operational processes for stripping and mining many mines (Koryagin & Voronov, 2017; Voronov et al., 2019). STSs include the processes implemented to manage fuel consumption in the form of haul truck allocation and dispatchment. During operational stages, each individual haul truck is loaded at dedicated loading machine cites or is sent to various loading cites (Koryagin & Voronov, 2017). The trucks depart from a starting point toward a specified dumping destination. The number of trucks required for an operation is determined according to the short-term plans established for the transfer of materials daily (Koryagin & Voronov, 2017). The number of required and allocated trucks must be determined in a manner that accounts for factors such as the truck's capacity, length of route, production objective and real-time truck dispatching, the number of trucks required for achieving mining objectives is as minimal as possible (Koryagin, & Voronov, 2017).

Because more than 50% of mining operational costs are associated with diesel fuel consumed during loading and transportation in mines (Curry et al., 2014), any small reduction of percentage to these costs creates savings for the operation. For example, if leaders can reduce the total idle times of trucks and shovels, both the queue of trucks waiting for loading, and the risk of shovel idle times can be reduced (Koryagin & Voronov, 2017; Voronov et al., 2019). A reduction in fuel by means of idle time decrease also results in an increase in CSR initiatives because there is a reduction in associated emissions and GHG production. Developing the appropriate models for optimized use of equipment and decreasing operational costs as well as environmental effects of mine are critical.

Operator's Driving Style

Many mining firms are interested in finding strategies and methods to reduce costs to remain profitable in a challenging economic environment. Martinez et al. (2018) noted that haul truck driving style had a significant role in energy management, and that identifying a driver's style and applying it to vehicle intelligent control has become a developing trend in mining leaders' strategies for fuel reduction. Driver training and fuel-saving driving strategies are critical to establish a high precision driving style identification model for mining haul truck drivers. According to Wang et al. (2019) driving style can be divided into three categories: normal, soft, and aggressive. Chen et al. (2018) demonstrated that the aggressive driving style has a larger throttle opening, throttle pedal change rate, and speed; the normal driving style has a moderate throttle

opening, throttle pedal change rate, and speed; while the soft driving style has a smaller throttle opening, throttle pedal change rate, and speed.

Aggressive driving styles create a higher demand for diesel fuel consumption in mining haul trucks. Liu et al. (2019) expanded upon this notion and suggested that the characteristic parameters related to throttle pedal angular velocity can characterize the driving style of mining trucks under heavy-load conditions; the characteristic parameters related to throttle pedal opening and angular velocity can characterize the driving style of mining trucks under no-load conditions; the driving styles of mining truck drivers in an open-pit mine are not unique, and consist of different driving styles (Wang et al., 2019). The fuel consumption of the aggressive driving style was the largest and 10% higher than the average fuel consumption, while the fuel consumption of the soft driving style was not very different compared to the normal driving style (Wang et al., 2015). Mining leaders must place a stronger focus on operational training for drivers to prevent excess fuel consumption from aggressive driving styles. The link between haul truck driver style and diesel fuel usage can be applied as a management tool and to achieve diesel fuel savings.

Weight of Haul Truck

The heavier an object is, the more energy it requires to get moving. Haul truck weight affects truck fuel use and emissions (Sandhu et al., 2015). Heavier vehicles have superior inertia and greater rolling resistance, which both contribute to increased fuel consumption (Collier et al., 2019). Loaded dump trucks are known to have approximately 30% higher fuel consumption than when empty (Sandhu et al., 2015). Fuel economy and

emissions are adversely affected by carrying higher weights (Sandhu et al., 2015). Mining leaders must develop strategies and processes that can strategically consider a haul truck's weight.

Idle Time

Mining equipment, such as haul trucks, can be left by drivers for significant time sitting with idling engines. Engine idle time can be quantified by the equipment's operational efficiency and is defined as being the ratio of non-idle time compared to the total time a piece of equipment is in use (Lewis et al., 2021). The Komatsu manufacturer, one of the world's leading manufacturers and suppliers of earth-moving equipment, suggested that, in the mining industry, a haul truck's average idle time can be over 40% (Komatsu America Corp, n.d.). An idling engine can use considerable fuel (Dindarloo & Siami-Irdemoosa, 2016). A diesel haul truck engine can consume up to four liters of fuel for each hour idling (Purewtogtoh et al., 2020). This hour of idle time equates to about 40 km of driving (Rutty et al., 2013). However, Lewis et al. (2021) noted that, while idle emission rates significantly reduced compared to non-idle emission rates, an increase in equipment idle time in mining activities can relate to a decrease in operational productivity, increased diesel fuel use and an increase in pollutant emissions. Leaders within the mining industry must understand the associated costs with policies and practices around idle time within their fleet because they have the potential to create an increase in cost of fuel and significantly higher emissions off-road trucks that have an average operational efficiency of 40%, can increase their efficiency by 10% through reducing their idle time by 6 min/h (Lewis et al., 2021). Lewis et al., (2021) suggested

that the hourly emissions would be reduced by approximately 25 to 30%. Although applying idling-time restrictions to haul trucks can have counterproductive consequences influencing productivity and fuel use, mining leaders must still consider the impacts and apply practices to ensure for maximum efficiency regarding diesel fuel use, emission production, productivity, and equipment maintenance. Haul truck idling can seem insignificant, but it can have a significant negative impact on diesel fuel consumption and increases unnecessary emissions into the environment. Mine leaders must ensure engine idling is minimized when haul truck drivers are operating equipment.

Engine Speed

Mining is an energy intensive industry using a significant amount of energy in each phase of its operations. These operations can be enhanced to offer mines with more cost-effective procedures, specifically through optimized engine speeds. By changing the speed of a haul truck, the diesel fuel efficiency is directly influenced (Siami-Irdemoosa & Dindarloo, 2015). Trucks are observed to stop or slow down most commonly when encountering other vehicles in the intersection. These occurrences are observed to both increase the cycle time, as well as increase the 61 amounts of fuel burned by the truck. To minimize the diesel fuel consumption of haul trucks and maximize the productivity, new speed management systems and tracking techniques should be used to solve this complex problem.

Fuel Quality

The understanding of fuel consumption within the mining industry should not be limited to the assessment of vehicle-specific factors such as tires and pavement. For many

users, the determinant for assessing fuel quality is the octane rating as users apply it to assess aviation gasoline capability against compression (Sulistyarini, 2019). However, other aspects of diesel fuel quality must also be considered such as additives. Leaders within the mining industry must also assess diesel fuel consumption through expanding their analysis to include the quality of diesel fuel being used.

Fuel Additives

Diesel engines are commonly used in the mining industry as their increased power generation creates better performance, dependability, and durability. With a global demand for diesel fuel and quality, there is an increase in the requirement for diesel fuel. Diesel fuel quality can be improved by processing or using additives (Sahoo & Jain, 2019). Additives have been shown to enhance the performance of diesel engines while reducing emissions. Fuel additives can be classified as organo-metallic or metal-free additives (Oudijk, 2010). Organo-metallic additives are frequently used as octane boosters and anti-knock agents (Oudijk, 2010). These additives are introduced into diesel engines for their ability to further oxidize soot (particulates) from combustion (Oudijk, 2010). Several metal additives are known to improve or catalyze combustion in diesel engines, including barium, cerium, copper, iron, and magnesium. However, metallic additives have the tendency to form deposits and can build up within the combustion chamber and lead to combustion inefficiencies and higher fuel consumption and maintenance, resulting in an increase in costs (Li et al., 2019; Ogunkunle & Ahmed, 2019; Oudijk, 2010). the use of metal-based additives in fuels is not recommended for mining leaders.

The mining industry is highly dependent on fuel prices; these costs have a significant impact on the total mining operating cost. The South African mining sector consumes more than 30% of the total energy supply in South Africa, and it supplies over 90% of all primary energy to generate power throughout South (Pollack & Bongaerts, 2020). Specifications for the type of diesel fuel used in mining vehicles in the South African mining industry were first introduced in the 2006 Integrated Resource Plan by the South African government (Ratshomo & Nembahe, 2017). Diesel fuel use plays a significant role in global environmental pollution. Diesel emissions contribute to the pollution of air, water, and soil (Tighe et al., 2012). Because compounds present in diesel fuel, such as sulphur, can still be present after refining and combustion, they are contributing factors to the air pollution and emission levels and can create harmful environmental influences globally (Tighe et al., 2012). The introduction of such practices around diesel fuel types are strategies used by the South African mining industry to reduce diesel fuel emissions and, as a result, diesel fuel sulphur was decreased from 0.3% (3000 parts per million (ppm) to 0.05% (500 ppm) maximum sulphur content (Ratshomo & Nembahe, 2017). In subsequent years, the consumption of the standard grade (500 ppm) declined on average at a rate of 2.6% per annum, and drastically falling by 30% year-on-year in 2016 (Ratshomo & Nembahe, 2017). The consumption of diesel fuel in the South African mining industry alone has grown by 36.2% per annum, from 298 million liters in 2007 to 5.7 billion liters in 2016 (Ratshomo & Nembahe, 2017). As an additional attempt to reduce harmful pollutants into earth’s atmosphere, the mining industry introduced 50 ppm grade diesel fuel. This was primarily implemented as the

main source of fuel as 50 ppm grade diesel was designed to operate on cleaner diesel fuel specifications.

Fuel Injection

Fuel injectors are essential parts within a haul truck's engine, delivering diesel fuel to the engine and ensuring efficient combustion. The central purposes of a fuel injector are the atomization of diesel fuel, conversion of liquid diesel into droplets, and autoignition combustion (Luo et al., 2019). The conversion of diesel fuel into droplets, creates a combustible homogenization of fuel and oxygen which is required for efficient engine operation and combustion (Luo et al., 2019). Improperly functioning injector systems can result in a reduced effectiveness in atomization and combustion and lead to an increase in diesel fuel use (Pham & Cao, 2019). For example, small deposits within the injector can create blockages and irregular spray patterns. Increased temperatures influence the build-up of deposits which continue to create a build-up of carbonaceous deposits around the injector nozzles is heightened. These build-ups and blockages can create an increase in pressure which can lead to sensor issues, misfires, and increased fuel consumption. Although these deposits do not often result in injector failure, they can impact the quality of the combustion process. Over time, deposits begin to form and build-up, which clog the injector and create added costs regarding diesel fuel use.

Truck Maintenance Programs

For mine leaders, maximizing efficiency while creating cost-effective practices is essential for operational success. Designing and executing an equipment maintenance program for equipment such as haul trucks is one way to create operational cost

reductions. Predictive and prescriptive maintenance programs are two ways mine leaders can create these cost reductions. Predictive maintenance can be described as the routine maintenance of an asset in the areas of equipment condition and performance metrics (Jimenez et al., 2020). With predictive maintenance, mine leaders can prevent future failures and minimize unexpected costs (Stodola & Stodola, 2019)., because this method only monitors the performance and condition of equipment during normal operation, predictive maintenance does not permit efficiencies outside the scope of the given piece of equipment being monitored (Reynolds, 2020). Alternatively, prescriptive maintenance helps to predict potential problems and offers mine leaders with insight into potential causes before an issue arises (Jimenez et al., 2020). Predictive and preventative maintenance programs can quickly and effectively identify critical issues while minimizing downtime and required resources. This preventative maintenance therefore allows mine managers a higher degree of understanding for life cycle trends as well as required resources to manage operational processes. With early detection of maintenance related issues, mine leaders are better equipped to mitigate a breakdown and the associated costs.

Dust Control

Mining road networks are the lifeline to productivity at a strip mine complex and must be kept in optimal condition to ensure operational effectiveness. In addition to meeting workplace regulations and social responsibility obligations, mining firms have a responsibility to their workers, community members, and their bottom line. The mining industry has been facing an era of increased regulation, increased opportunity, and

increased global competition. Routine maintenance of haul roads helps to ensure that the degradation of the compacted soil creating the haul road surface is controlled while maintaining a standard for operation and safety.

Rolling resistance is a primary driver of costs in mining operations with significant resources used to control dust generation (Katra, 2019). Many mines water their haul roads to help control the dust (Gonzalez et al., 2019; Gulia et al., 2018; Tasser et al., 2020). Although water is seen as a cost-effective solution to mitigating dust generation, its application for the purposes of routine maintenance adds operational costs such as fuel use, equipment maintenance, and added labor. Because the functional mechanism of water, for the purpose of dust control, is to create moisture and surface adhesion, its period of effectiveness is dependent on environmental conditions as well as frequency (Dust-A-Side, n.d.). The process of watering the haul roads can become increasingly costly and labor intensive. In some instances, a mine may need to water their roads up to eight times in one shift. In the case of some mines throughout South Africa, the cost of required equipment, operators, as well as water being a limited resource, their cost of operation significantly increases (Dust-A-Side, n.d.). The negative cycle of watering haul roads for dust control can result in increased expenditures that exceed mine leaders' budgets and expectations.

While mining firms benefit from using dust control practices, mine leaders must also understand how much dust control costs. This financial concern reflects a reasonable desire to save money while achieving social and regulatory obligations. However, mining leaders must also consider unexpected and hidden costs associated with dust control such

as, diesel fuel, salary, equipment use, as well as costs associated with water and product. well maintained haul roads are often less vulnerable to destruction and can help to maximize safety, reduce equipment maintenance, and increase the longevity of haul truck tires. Irregular road surfaces can result in depressions causing an increase in tire wear and rolling resistance (Dust-A-Side, n.d.). Mining leaders may associate a reduction in costs with using a naturally occurring and renewable resource such as water for these practices. Potable water is used for coal dust suppression across Australian mines (Prostański, 2021). Although dust control application strategies such as watering the haul roads can provide temporary relief from airborne dust, they do not offer the same level of dust control as more advanced chemical solutions and often require significantly more applications and maintenance (Gonzalez et al., 2019; Gulia et al., 2018). This increase in application frequency creates a demand for diesel fuel, equipment cost, and man hours. The watering of mining haul roads can wash out embedded surface fines that help create stability and hold the surface of the road together (Dangle et al., 2019). This loss of fines further contributes to potholes and rutting, which in turn creates a demand for repeated road maintenance and grading (Dangle et al., 2019). As this watering cycle continues, the durability of the haul road decreases leaving mine leaders with the requirement to spend more money on repairs, diesel fuel and damaged infrastructure.

Haul Road Stabilization

The construction of haul roads plays a critical role in a mine's productivity. During operation on haul roads mining firms are faced with several challenges caused by stabilization issues within the haul roads. For example, rutting of the haul road surface

may create an inability to operate as well as an increased consumption of because of increased rolling resistance (Coffey et al., 2018). Solutions to this problem may be the addition of haul road stabilizing products such as organic, environmentally friendly, polymer, or enzyme-based products. Chandler et al. (2017) found that after the construction of a haul road treated with an enzymatic based product, EarthZyme, the diesel fuel consumption of haul trucks decreased by over 17% (Chandler et al., 2017). Based on this, the annual savings of diesel fuel is about 3.9 million Liters and equates to hundreds of thousands of dollars in diesel fuel cost savings (Chandler et al., 2017). Associated costs such as haul road maintenance, tire depreciation, and equipment maintenance may also be reduced (Chandler et al., 2017; Coffey et al., 2018). An understanding for haul stabilization and associated characteristics such as road rolling resistance is critical for mining leaders to better identify and create solutions for reducing diesel fuel use and associated costs within their operations.

Dumping Speed

Mining haul trucks use large volumes of diesel fuel as they transport material. Mine leaders must be diligent in seeking new strategies to reduce operating costs such as diesel fuel. A dumping analysis was performed by Siami-Irdemoosa and Dindarloo (2015) to determine the effects of changing haul truck speed on fuel efficiency. Modifying dumping practices in the form of speed, can achieve an estimated cost savings of about $6,500 USD (Siami-Irdemoosa & Dindarloo, 2015). This savings equates to about 8,000 liters of diesel conserved and reduces CO2 emissions by about 22,000 kg of CO2 per truck per year (Siami-Irdemoosa & Dindarloo, 2015). Although an impactful

strategy for fuel consumption and associated cots, the additional time required for haul truck cycle is increased, resulting in added operational costs.

Associated Diesel Fuel Costs

Carbon pricing is a fee imposed on the burning of carbon-based fuels such as diesel to help reduce and eliminate the use of fossil fuels. A carbon pricing scheme was introduced in Australia in 2011 (Bakhtiari, 2018). With 0.3% of the globe's population, Australia produces about 1.8% of the world's total GHG (Pádraig Collins, 2019). The carbon pricing initiative was intended to control emissions created within Australia, as well as to support economic growth through clean technology developments (Bakhtiari, 2018; Gray & Metcalf, 2017). Emissions created by industries such as mining are some of the greatest contributing factors to the global carbon emissions. The carbon scheme launched in Australia was created to help control emissions by enforcing a tax directed at organizations and industries per ton of carbon released into the atmosphere. The amount of carbon released was given a standard calculation. The full carbon accounting model (FullCAM) is a calculation tool for modelling Australia's GHG emissions from the land sector and is used for mining and forestry sectors (Norris et al., 2010). The Clean Energy Futures Plan was implemented by government personnel who attempted to reduce GHG emissions by 5% below 2000 levels by 2020 and 80% below 2000 levels by 2050 (Hanna, 2012). More specifically, by 2020, the Australian taxation scheme prevented almost 160 million tons of carbon dioxide from entering the atmosphere and generated $24 billion in taxes over the past three years (Department of Industry, 2020). With ongoing development of governmental programs and policies such as The Clean Energy

Future Plans, mine leaders are better able to reduce, not only the costs of diesel fuel, but the associated emissions entering the environment.

Mine leaders must try to implement strategies to make their operations more profitable while creating new ways to promote CSR and environmental cognizance within their organizations. In a study of expectations about CC, Australia's emissions fell 1.4% or 7.7 million tons of carbon dioxide equivalent to 528.7, which is 14.3% below 2005 levels (Iannucci, 2020). The result of this new carbon tax was a reduction in Australia's GHG emissions as well as an advancement in economy-wide energy transformation. The implementation of industry wide taxation processes is one way to help promote CSR initiatives through creating a reduction of diesel fuel and in turn, helping mining leaders reduce associated diesel fuel and emissions costs.

After decades of unchanged policies, South Africa implemented a new carbon tax to help mitigate the impacts of CC due to impacts from rising emissions. The South African government has begun taxing organizations and industries for their GHG emissions (Campbell et al., 2020). This tax applies to anyone, including mining firms that exhibit emissions (Garidzirai, 2020). South African mines must begin to ensure that their entire organization is aware of and working toward meeting the requirements of the carbon tax requirements. In addition to reducing the environmental impacts of carbon emissions, this added tax may help mining leaders to become innovative and creative in their search from strategies to implement for the purpose of diesel fuel reduction.

Transition

The objective of this qualitative multiple case study is to explore strategies some mine leaders apply to ensure effective use of diesel fuel and reduce associated costs. Section 1 of this study is comprised of segments such as (a) the foundation of the study, (b) the problem statement, (c) the purpose statement, and (d) the nature of the study, which included the justification for using a qualitative method and multiple case study design. Other areas included within section 1 are the: (a) interview questions, (b) conceptual frameworks, (c) assumptions, (d) limitations, and (e) delimitations of the research. In Section 1 I discussed the significance of the study as well as presented a review of current professional and academic literature relevant to the business problem. This review of professional and academic literature also involved a critical analysis of several sources and information concerning environmental responsibility, tire properties, pavement conditions, cycle time/ payload variance, shovel truck systems, operator's driving style, weight of haul truck, idle time, engine speed, fuel quality, truck, maintenance programs, dust control, haul road stabilization, dumping speed, and associated diesel fuel costs.

In Section 2, I justified the use of a qualitative multiple case study to explore strategies some mine leaders apply to ensure effective use of diesel fuel and reduce associated costs. Some of the topics presented in section 2 are the: (a) purpose statement, (b) role of the researcher, (c) participants, (d) research methodology and design, (e) population and sampling, (f) ethical research, (g) data collection instruments, (h) data

collection technique, (i) data organization, (j) data analysis, as well as (k) reliability and validity.

In Section 3, I review knowledge presented in preceding sections and discuss application to professional mining leaders' practice and implications for change. Section 3 contains the purpose statement, research question, and findings. Other areas of Section 3 include: (a) applications to professional practice, (b) potential implications for social change and behaviors, (c) recommendations for future action, (d) recommendations for further research, and (d) reflections.

Section 2: The Project

The objective of this qualitative multiple case study is to explore strategies some mine leaders apply to ensure effective use of diesel fuel and reduce associated costs. Research data that are presented in Section 1 includes insights regarding requirements for mining leaders to support new strategies to help ensure effective use of diesel fuel and reduce associated costs. In Section 2, I address the research process, method, and design. Section 2 includes the purpose statement, role of the researcher, participants, research method, research design, population, sampling methods, data collection strategies, and data analysis, as well as validity and reliability of the study.

Purpose Statement

The purpose of this qualitative multiple case study was to explore strategies successful mine leaders apply to ensure effective use of diesel fuel and reduce associated costs. The target population for my study included four leaders of small and medium-sized mining organizations located in Australia and South Africa with successful experience in terms of reducing their diesel fuel consumption. Implications for positive social change include the potential to enable leaders within the mining industry to create and develop effective fuel reduction strategies by emphasizing the importance of GHG reduction. Moreover, companies concomitantly improving environmental regulations can result in a new and environmentally conscious culture which can lead to environmental improvements within surrounding areas of mining communities.

Role of the Researcher

Qualitative research requires the researcher to assume the roles of data collection, analysis, and objective summarization. Although data collection is critical to research, it is important that the researcher can conduct this in ways that do not influence the research process in terms of predispositions or biases (Thiem et al., 2020). Researchers must develop an awareness of bias, including their own personal biases, as they can impact integrity of research and associated findings (Wadams & Park, 2018). To reduce bias in my study, I reflected on my personal opinions and became aware of preconceived beliefs to ensure I was able to effectively suppress them during the interview process and assess participant responses. It is critical that the researcher has no prior existing relationships with participants. A researcher must create and apply rigorous ethical standards to protect participants during the research process (Yin, 2018). In the case of my research, I have a professional awareness of participants in a business context as well as understanding of the business problem. However, I have limited knowledge of their roles within their organizations or responsibilities.

I maintained three ethical standards for research with human subjects as established by the Belmont Report: respect for persons, beneficence, and justice. All persons involved as a subject of research should receive informed consent forms to freely decide whether to participate (Jenkins et al., 2020). To meet the requirement of the Belmont Report, I ensured that I showed respect to participants by using informed consent forms to provide information for comprehension. I also complied with the

guidelines of the Walden University Institutional Review Board (IRB) that demanded obtaining permission before collecting data from participants.

Researchers must mitigate bias and avoid viewing data through a personal lens. Yin (2014) said an interview protocol helps reduce bias while fostering reliability within case studies. Some of the ways in which I achieved this in my study was through the use of interview protocols and member checking, as well as attaining data saturation. I used the interview protocol as a tool to outline ethical procedures that were followed during semistructured interviews. Additionally, I adhered to the protocol by providing an informed consent form to participants, adhered to outlined participant eligibility criteria, and ensured confidentiality during the data collection process. Heesen et al. (2019) said member checking enables participants to revise and enhance the researcher's narrative until it is correct and complete, which supports the objective of data saturation and reduces bias. I used the process of member checking and provided participants with summaries of their interview responses to verify precision of data. Data triangulation can be applied to improve confidence in conclusions through verification of a proposition using independent measures (Farquhar et al., 2020). I used multiple data sources including participants' responses and publicly accessible organizational documents to triangulate my study. I also inquired at the end of the interviews if there was any additional information that could be provided during the interview process. I was sensitive to opposing information that emerged during the study to help mitigate personal bias and viewing the data through a personal lens.

In my qualitative study, I used semistructured interviews as the primary data collection method. Semistructured interviews are conducted using guided questions to navigate and direct interviews while allowing participants to expand on their thoughts and response (McGrath et al., 2018). Yin (2018) said data saturation is the point at which a researcher is not able to uncover any new information, codes, or themes during the data collection process. Through the application of a semistructured interview method, the researcher can apply probing questions to drive conversation and inquire further into participant responses (McGrath et al., 2018). By using semistructured interviews, I was better able to explore participant responses and ensure I reached data saturation.

I used an interview protocol (see Appendix A) to standardize the semistructured interview process for this study. Additionally, because I conducted semistructured interviews virtually, I recorded and transcribed interviews for the purpose of future data analysis and reference. Field notes can also be used by researchers to validate and interpret findings of research during the data collection process (Yin, 2018). In addition to field notes, I used a voice recording of virtual interviews to gather views and opinions of participants, as well as for member checking and transcription of interview data to mitigate biases.

In qualitative research, the researcher must foster and promote confidence within participants. Through honest and open dialogue with participants, the researcher can promote engagement and participation and further allow for a comfortable dialogue involving experiences (McGrath et al., 2018). I used the interview protocol (see Appendix C) to ensure that participants were able to answer the same semistructured

interview questions in the same order, further reducing interviewer bias and promoting continuity. Researchers have a responsibility to report the perspectives of participants objectively; therefore, I ensured I was striving to represent participants' thoughts and views accurately. The use of an interview protocol helped to strengthen my study through establishing consistency and continuity while creating a positive and trusting dialogue with participants.

Participants

Researchers must consider who to use as their population of participants. The process of participant selection is critical when seeking to apply a qualitative research method (Saunders & Townsend, 2018). When identifying a population, the researcher must be aware of participant eligibility, their ability to gain access to participants within a population, and ways that were used to develop working relationships between the researcher and participants. I applied the purposeful sampling technique as a strategy to help locate participants for my study. Researchers can use the purposeful sampling method to target members of a given population who meet established criteria (Campbell et al., 2020). I applied purposeful sampling based on lived experiences and success with strategies used to ensure effective use of diesel fuel and reduce associated costs.

Participant Eligibility

Participant selection is central to a researcher's study because selected individuals influence the findings and outcomes of the study. Yin (2018) discussed the importance of the researcher's engagement and suggested that participants should be selected from a population that has experienced the phenomenon under question to best provide valid

information around answering the research question. Researchers must select participants who align with the researcher's eligibility criteria (Campbell et al., 2020). To help ensure I had achieved data saturation, I included eligibility criteria: (a) that the participant was a leader (manager or higher) within the South African or Australian mining industry, (b) that the participant had successfully implemented diesel fuel reduction strategies and reduced associated costs, and (c) the participant could efficiently explain these applied strategies and results (Yin, 2018). To confirm that the population aligned with the research question, I ensured that selected participants met the criteria and were willing and eligible to contribute to my research.

Accessing Participants

To gain access to leaders within the mining industry, I used my professional awareness of the industry to contact South African and Australian mining firms using phone call introductions and using an emailed letter of invitation (see Appendix C). Once contacts respond favorably to my inquire on research participation, I requested to schedule a time to further discuss my research and address any questions regarding my business problem and research process. I also applied methods of communication such as virtual meetings through Zoom and Teams as well as through email and telephone calls to make contact and continue building relationships with South African and Australian mining leaders. Once participants had been identified and contacted, I asked participants their preference in interview methods to ensure they were able and comfortable to participate. If participants had any further concerns or questions regarding my study, I

provided them with the necessary explanation to ensure that I was able to maintain an open relationship and communication throughout the study with all participants.

Creating an open and objective duologue is critical to the success of the researcher. The topic of voluntary arrangement in research and suggested that such agreements were at the center of the relationship between the researcher and participants, because each party has the potential to create and offer useful knowledge that might not be attainable otherwise (Campbell et al., 2020). After the interview protocol and consent form were administered to the participants, I reviewed the informed consent form (see Appendix B) and ensured that all participants were aware of their rights and the research process. Consequently, I asked each of the participants to agree to and sign all required documentation before the interview and data collection process took place. If required, I also provided them with copies of this information for their personal records. I used the consent process to augment the researcher-participant relationship by communicating the significance of the study, as well as reassuring participants of their rights to ethical protection and confidentiality. This was done both before and during the interview process through the process of reminding each participant that their involvement is voluntary.

Establishing a Relationship

The development of relationships can help to foster an open and safe environment for objective conversation. Establishing a relationship that supports the notion that participants are not merely subjects within the research is critical to successful data collection (Datta, 2018). To properly establish respect and trust with the participants, I

regularly communicated through virtual methods such as e-mail and telephone calls. During this communication, I discussed elements such as: (a) the study's purpose, (b) data collection methods, (c) the interview protocol, and (d) the information confidentiality. I also took the time to highlight confidentiality and security protocols including data encryption and coded participant identifiers, to reduce any apprehension around identity and confidentiality. After receiving participant consent, it is critical to continue to establish a rapport and trust with the participants (Datta, 2018). Participants may be more willing to engage in open communication with the researcher if there is a feeling of trust amongst participants and the researcher (Guillemin et al., 2018). To certify I was successful in developing this relationship, I worked to establish a personal and professional rapport with participants through building connection based on respect and trust. When possible, I also arranged for a brief virtual introductory meeting with each individual using their chosen method of communication to create a sense of personal connection.

Participants should be able to have an opinion on interview location selection to ensure that they feel safe and comfortable to discuss the research. The interview location may work to create bias and may impact open conversation between participant and researcher (DeJonckheere & Vaughn, 2019). When researchers conducted interviews, they must select a location outside of the participant's place of work as it may help to offer an opportunity for participants to speak more freely on a subject and make discreet observations (DeJonckheere & Vaughn, 2019). Although I used virtual methods of communication such as Zoom, Teams and e-mail, I asked participants of their preference

on location and to designate a comfortable location to conduct interviews to ensure comfort and open communication.

Research Method and Design

The intent of this qualitative multiple case study is to explore strategies some mine leaders apply to ensure effective use of diesel fuel and reduce associated costs. Researchers may choose to apply various research methods and designs to collect data and perform their research. A researcher must select their research method based on the one that best aligns with their business problem and addresses their proposed research question (Yin, 2018). Creating alignment among the research method, design, and problem is essential when seeking to perform a qualitative research study (Gaudet & Robert, 2018). Below, I compare the different research methods and research designs to select the most suitable one for my exploration of strategies some mine leaders apply to ensure effective use of diesel fuel and reduce associated costs.

Research Method

Research methods that are available to researchers can differ depending on data collection techniques. The three research methods that are available to researchers include the quantitative, qualitative, and mixed methods methodologies. Quantifying the collection and analysis of data is one process a researcher may choose to apply to frame their research. In addition to statistical analysis, quantitative research methods may require objective and established procedures that define variables, review the relationships between them, as well as analyze the causation and effects (Bloomfield & Fisher, 2019; Yin, 2018). Researchers may elect quantitative research methods when

seeking to establish a data representation for a given phenomenon using variables, or when striving to perform deductive research during the testing of relationships between variables (Skews, 2020). Quantitative researchers have the opportunity to place a direct focus on devising and testing a hypothesis using variables, while drawing conclusions using close-ended questions (Bloomfield & Fisher, 2019). For my research study, I did not seek to develop a hypothesis to test. Additionally, I did not use closed-ended interview questions, conduct a statistical analysis, or evaluate variables. The quantitative research method was, therefore, not best suited for my research.

Researchers must be aware of various research designs. A mixed methods approach involves an amalgamation of qualitative and quantitative practices (Alavi & Habek, 2016; Hong et al., 2018). Researchers may choose a mixed method when interested in developing both a qualitative and quantitative perspective on a given subject matter, or when seeking to explore information unavailable through a single methodological outlook (Huyler & McGill, 2019). When using the mixed method approach, researchers can blur the lines between qualitative and quantitative methods to obtain desired outcomes. When a researcher seeks to explore individual experiences and perceptions, while simultaneously devising and testing hypotheses to obtain data, open-ended questions can be applied (Hong et al., 2018). Because I did not seek to explore any correlations with the use of numerical figures, the mixed method research methodology did not align with my study.

I applied the qualitative research method. Qualitative researchers are focused on exploring participants' behaviors and perceptions to better develop understanding around

a given phenomenon from a contextual standpoint (Matta, 2019). The qualitative method is efficient when seeking to gather information on evidence-supported practices and to recommend outcomes that emphasize how innovation is perceived (Gaudet & Robert, 2018). Qualitative research may also help a researcher identify strategies that can be used to encourage change (Matta, 2019). The qualitative method was most suitable when the researcher seeks a method that places a focus on exploration of differing experiences within subjective accounts (Busetto et al., 2020). I was interested in the individual analysis of the participants' experiences and am interested in performing an exploration into these experiences, the qualitative method is most applicable.

Qualitative research enables a researcher to explore and gain a deeper insight into others real-world experiences. The qualitative method generates an exploratory approach to achieve an awareness for a phenomenon, rather than assessing a hypothesis (Busetto et al., 2020). This qualitative focus helps to gain insight and understanding of participants' perceptions and lived experiences to better understand a phenomenon through the application of objective open-ended questioning (Busetto et al., 2020). I selected the qualitative method for the purpose of exploring the strategies some mine leaders apply to ensure effective use of diesel fuel and reduce associated costs because it is essential to collect in-depth. Because the objective of my study was to develop an understanding of the research question through the application of semistructured interviews, the qualitative research method was most suitable to the exploration of strategies some mine leaders apply to ensure effective use of diesel fuel and reduce associated costs.

Research Design

I used the multiple case study design in my research. The research design of a study refers to the framework and corresponding methods that are used to discuss the purpose and create questions to augment the collection and assessment of data, which in turn, influences the robustness of the analysis and subsequent conclusions (Abutabenjeh & Jaradat, 2018). I considered four qualitative research designs: (a) phenomenological, (b) ethnography, (c) narrative, and (d) case study. Researchers can use phenomenological designs when interested in individuals' perceptions and the associated understandings of their lived experiences, behaviors, outlooks, as well as emotional and nonverbal communications (Emery & Anderman, 2020). This knowledge can then be applied to the contextual experiences that are used to establish understanding around a given phenomenon (Emery & Anderman, 2020; Prusko et al., 2020). Further, phenomenological designs place a focus on singular perspectives and develop them into a strategy to improve understanding around a certain occurrence (McConnell-Henry et al., 2009). I did not seek to develop a deepened understanding for the cultural meanings of participants' lived experiences, their natural attitudes, or their subjective, emotional interpretation of the phenomena. The phonological design was, therefore, not relevant to my research.

Researchers perform ethnographies when seeking to complete a cultural analysis of one's belief systems through participant accounts to generate subjective and contextual perspectives over time (Kassan et al., 2020). Ethnography research requires the researcher to immerse themselves in the natural landscape of the participants to augment

the understanding of cultural norm and characteristic (Hammersley, 2019). Ethnographic researcher places a focus on the social context, culture, or community values within natural events; researchers may then use this type of data to determine significance within observed behaviors (Kassan et al., 2020). I chose not to apply an ethnographic design because I was not interested in the cultural analysis of beliefs.

When an individual is willing to tell their story, it follows a chronology in which the researcher writes about it. The narrative approach requires the analysis of individuals' stories over a period (Khwaja & Mahoney, 2019). Narrative research is used when the researcher seeks to collect information to tell a detailed story or describe individual experiences (Nasheeda et al., 2018). The narrative research design is focused on studying an individual person where the researcher becomes the interpreter of the individual's stories, as opposed to a community (Khwaja & Mahoney, 2019). Because I did not seek to study an individual person or tell their story in chronological order, I did not select the narrative design.

Case studies are a popular research method used by researchers. Case study researchers can explore research through techniques used to demonstrate the usefulness of applications or inferences (Lewis, 2015). Yin (2018) asserted this feature as one of the strengths of case study design as researchers may then explore topics or phenomena involving one or more individuals, which is an advantage over research designs requiring large numbers of research participants. The case study design enables researchers with flexibility because it can be founded on the exploration of either one case or a compilation of instances (Yin, 2018). My study's target population included four to six

leaders from within the South African and Australian mining industry who currently manage operational projects.

The case study design enables the researcher to obtain authentic accounts of participants' experiences using observations and interviews. Additionally, the case study method can also help the researcher to better understand each individuals' experience as well as their interpretation of phenomena experienced (Yin, 2018). Subsequently, researchers using the case study design can investigate a phenomenon from various perspectives, which allows for deeper descriptions of the phenomenon and a more robust awareness of the concept (Rashid et al., 2019). For my study, I collected data using semistructured interviews, observations, documentation, and the process of reflexive journaling to ensure that I was able to best investigate the phenomenon within the context of the four to six mining leaders that are currently successful in managing operational projects in terms of fuel reduction strategies and associated costs. A case study design is applicable when one has minimal influence over occurring events but seeks to explore the how or why behind a given research phenomenon (Yin, 2018). I selected the case study design over the alternative designs, phenomenological, narrative, and ethnographical, because it permitted me to influence the scope of research and focus on strategies mine leaders apply to ensure effective use of diesel fuel and reduce associated costs. Furthermore, I used a multiple case study design to explore mine leaders apply to ensure effective use of diesel fuel and reduce associated costs. I used a multiple case study design for my research as it helped create an opportunity for the application of data

collection techniques in a way that drives the generation of information relevant to the phenomena while employing replication and validation strategies.

Population and Sampling

For this study, I explored strategies some mine leaders apply to ensure effective use of diesel fuel and reduce associated costs. Yin (2018) suggested that to ensure that the data collected effectively addresses the research question, population and sampling techniques should be used. Researchers require Institutional review board (IRB) approval for all research involving human participants, whether participants are living individuals, data, or specimens (Lapid et al., 2019). I aligned various population and sampling methods with my research question to ensure I was able to achieve the research purpose while maintaining ethical criteria.

Population

My study's target population included four to six leaders from within the South African and Australian mining industry who currently manage operational projects. Because the boundaries between phenomenon and its context are not always clear, a multiple case study design relies on multiple data sources for evidence (Yin, 2018). In a multiple case study, having three to four cases for comparison is suggested by Yin (2018) as being sufficient as it is the most a researcher can handle at any given time. For this study, I defined a leader as anyone who is in a supervisory role or higher, who has the responsibility of preparing operational strategies for the mine, influence capital expenditure developments to improve operations, create operational budgets, and report on process performance as well as costs (Amissah et al., 2020). For my qualitative

multiple case research study, I conducted one interview with four to six mining leaders within the South African and Australian mining industry to develop themes for implementing successful diesel fuel reduction strategies.

Sampling

In my research, sampling involved the selection of participants. The process of sampling provided information and knowledge around my research topic (Gaudet & Robert, 2018). Purposeful sampling strategies can be applied to support the selection of sources with in-depth knowledge of a given problem with the application of criteria for selection of individuals (Etikan, et al., 2016; Gentles et al., 2015). Purposeful sampling enables the researcher to easily conduct sample selection and allows for the inclusion of participants with significant topic knowledge (Benoot, et al., 2016). I used purposeful sampling when participants were selected for the semistructured interviews. The population of my study included leaders from within the South African and Australian mining industry who currently manage operational projects.

Ensuring Data Saturation

Reaching data saturation was essential for my research as it helped establish the validity of the study and findings. Fofana et al., (2020) referred to data saturation as being data adequacy; the degree of saturation is achieved when the assembled data is adequate to cover the themes of importance and that when collecting additional data does not illuminate any new or important information. In a qualitative study, a large number of participants can be irrelevant to the study because more participants do not always lead to the occurrence of more data because after data saturation, additional data does not

contribute further insights or add to conceptual understanding (Saunders et al., 2018). However, researchers conducting a multiple case study must use four to ten participants to reach data saturation (Gentles et al., 2015). The sample population for this multiple case study consisted of 4 to 6 mining leaders from two mining firms from Australia and South Africa. To reach data saturation for the study, I interviewed participants until no added information was presented on the topic.

Researchers must seek to create validity and quality within their research. Triangulation is one method that one can take to augment the quality and validity of their research (Farquhar et al., 2020). Data triangulation is applied to enhance confidence in the findings through the confirmation of a proposition using two or more independent measures (Farquhar et al., 2020). Methodical triangulation can be described as the application of multiple methods for the purpose of collecting data (Heesen et al., 2019). For this study, I collected data from multiple sources, i.e., interviews and organizational documents. Joslin and Müller, (2016) discussed the unique focus on data by applying various approaches to collect data and facilitate significant insights from the data. Triangulation can be applied during different data collection approaches within the same research design (Heesen et al., 2019). Methodological triangulation uses multiple methods to collect and analyze data to support a complete understanding of the phenomenon (Heesen et al., 2019), while member checking enables the participant to revise and enhance the researcher's narrative until it is correct and complete, which supports the objective of data saturation. I formulated a summary of the interviews that enabled me to highlight my understanding of each participant's responses to validate

collected information as an application of member checking. Additionally, I applied methodological triangulation to create text-based data from the recordings of the interviews. Moreover, I used multiple assessment methods for the analysis of data which included coding and categorization of the data for the identification of themes. Interviews of mining leaders were the primary source for collecting the qualitative data for my multiple case study.

Ethical Research

Participation in research should be a voluntary action. After gaining approval from Walden University IRB, I e-mailed the consent form (Appendix B), including the interview questions and the letter of invitation (See Appendix B), to the selected participants who met the inclusion criteria. The consent form contained criteria such as: (a) inclusion criteria, (b) background information, (c) procedures, (d) the voluntary nature of the study, (e) the social benefit of participation, and (g) privacy and confidentiality. First, I gained approval for my research from the Walden IRB to certify that my research practices aligned with the required ethical procedures for research using human subjects and was not in violation of participant human rights. Once approved by the Walden IRB, my research commenced (IRB approval number #11-29-21-0737317).

Informed Consent

Effective ethical research must be demonstrated by the researcher's ability to conduct data collection and through the treatment of participants. The primary role of the IRB is to help protect the rights and wellbeing of all involved participants (Lapid et al., 2019). The Belmont Report established research principles that included: (a) respect for

persons, (b) beneficence, and (c) justice. Research involving human subjects or participants raises unique ethical, legal, and social issues and requires informed consent (Biros, 2018). I used the consent form to inform participants about the study's aim and about their right of choice to participate, withdraw, or discontinue their participation at any point by notifying me via e-mail.

Given the importance of protecting human participants in research, there is greater scrutiny of researchers to ensure that ethical principles have been achieved. The informed consent process should protect and respect participants' rights and dignity so that if they decide to withdraw from participating, the researcher must respect that decision (Wu et al., 2019). I respected the rights of the participants. Reports originating from this study did not include the personal information of individual participants. I respected the confidentiality and privacy of the participants throughout the data collection process.

When creating initial consent, I began by contacting participants through virtual communication such as Zoom, Teams, email, or phone calls to request a time and preferred location for the first meeting to discuss my research. Once I had connected with participants, I offered them a digital copy of the informed consent form for their review, signature, and personal files. The informed consent form included elements such as: (a) title of the study, (b) researcher identification and credentials, (c) study population, (d) the purpose, (e) study procedures, (f) data collection procedures, and (g) other procedures for obtaining study results (Kekewich, 2019). I included an outline each of these elements within the informed consent form for my study. The initial meetings with participants acted as a method for communicating aspects of research such as confidentiality and the

voluntary nature of participation since they were ethical requirements when the research involved human elements (Biros, 2018). Before conducting participant interviews, I also requested that participants review and sign the presented informed consent form, return it to me via an emailed pdf, and were provided with a copy before participation commences.

Participant Protection and Confidentiality

I ensured participant confidentiality and privacy by not including their names and other private information in electronic form without encrypting the electronic device. Ethics in research is essential for providing confidentiality and privacy, which are participants' fundamental human rights. I masked the identity of all volunteering participants (Kamanzi & Romania, 2019). Guillemin et al. (2018) recommended keeping participants' data and maintaining them in confidence, as this contributes to the ethical trustworthiness of research and improves participants' trust in a study. I completed the Collaborative Institutional Training Initiative (CITI) Web-based training course "Privacy and Confidentiality" (Record Identification No. 36290529; see Appendix D) to enhance my knowledge of ethics-based research. During the process of data collection, I ensured for participant confidentiality by designating identification pseudo names in replace of the participants' given names. This process consisted of using assigned participant letters and numbers such as P1, P2, and P3. During the process of data analysis, I designated each participant with an alias identifier in the form of codes to ensure confidentiality of participant identification throughout the process of my research. Finally, when addressing the conclusions of the study, I assigned each participant a well as their organization an

unrelated alias when referencing them in my research. I ensured that I maintained sole access to all data, transcripts, and material, which remains in a safe and locked place for a minimum of five years to guarantee the confidentiality of all participants. All electronic devices, storage media, and paper documents remain secure, with electronic data remaining stored on my password-protected computer and backed up on a password-protected hard drive. After the 5-year storage period, I will destroy all acquired information, data, and documentation collected from participants by shredding all paper documents and sanitizing the electronic media.

Withdrawing from Research

The research process is voluntary, it is appropriate to make an accommodation for participants who wish to withdraw from the process at any time. Participants must be aware of, and have the option to, withdraw from the research at any time without penalty or consequence (Wu et al., 2019). Researchers have the responsibility to certify that all participants are aware of their right and ability to withdraw from the study at any time without repercussion (Wu et al., 2019). During my research, if any of the participants wished to or needed to withdraw from the research process, I made it clear that I would remit all collected data, notes, and any other information relating to the participant for destruction. I confirmed that participants maintained the right and were aware of their right to withdraw from my study at any point in time and for any reason without repercussion through the process of notifying me of their choice to withdraw from my study. During the first point of contact as well as at the start of conducting the semistructured interviews, I reminded all participants of the voluntary nature of this

research as well as their right to withdraw from the research process at any time. I ensured that all participants were aware that there was no form of compensation, incentivization, or reward for participating in my research process. Finally, if any of the participants were interested in receiving or reviewing the completed research and findings, I offered to provide them with a digital copy or the methods to review the study electronically.

Data Collection Instruments

The research question in this study was: What strategies do successful mine leaders apply to ensure effective use of diesel fuel and reduce costs? A researcher must recognize that they are the primary data collection instrument (McGregor, 2018). Various data collection instruments exist for the purpose of data collection: (a) semistructured interviews, (b) phenomenological in-depth interviews, (c) review of organizational documentation, and (d) focus groups (Shteinberg, 2020). As the researcher, I was the primary data collection instrument and performed this role through the act of collecting data by means of semistructured interviews.

Reliability and validity are two significant components of research. Member checking is instrumental in the interview process to promote reliability and validity and entails the process of verification by the participant that the data the researcher interpreted are consistent with the responses that they provided (Caretta & Pérez, 2019; Iivari, 2018). Recording the interview process using Zoom or Teams, helps to augment the study's reliability by allowing for future transcription and member checking (Candela, 2019; Gani et al., 2020). Using Zoom, I recorded each interview and

interpreted participants' responses to the semistructured interviews, and presented the information for their review and confirmation. In addition to the use of member checking to confirm reliability and validity, I asked the same questions to each participant to maintain consistency in each of the semistructured interviews. Following member checking, researchers may choose to apply methodological triangulation to ensure they have a complete understanding of phenomena under investigation (Vidicki & Stojsin, 2021). As such, I used methodological triangulation by obtaining data from interviews as well as from document reviews to promote the reliability and validity of both instruments.

To help researchers improve the quality of research, data is collected to create inferences and make informed decisions on conclusions and relevant information. The application of semistructured interviews creates flexibility and allows the researcher to create conversations around a given phenomenon (DeJonckheere & Vaughn, 2019). Semistructured interviews can be applied to gain insight into participants' experiences around a given phenomenon. The process of conducting semistructured interviews is an amalgamation of a fully structured survey and an unstructured, casual conversation (Husband, 2020). The semistructured interview approach may be advantageous because it allows researchers to encourage two-way communication and allows for open ended questions to drive the process of data collection (DeJonckheere & Vaughn, 2019). However, the process can be disadvantageous because it is time consuming and often requires extensive resources and training; it can also be difficult to get some participants engaged (DeJonckheere & Vaughn, 2019). As the researcher and primary data collection

instrument, I applied semistructured interviews to drive conversation and collect data around the research question.

Interview protocols can be used to help supplement the data collection process. Wolcott and Lobczowski (2021) discussed interview protocols and noted that they comprised of pre-scripted probing questions to gather required information from participants. Interview protocols help explain the purpose of the study through the generation of targeted questions and engaging follow up (Bearman et al., 2019). For my main data collection instrument, I used an interview protocol (see Appendix B), which consists of the list of the interview questions that participants were asked during the semistructured interview process. I adhered to the data collection procedures as described in the interview protocol (see Appendix A) to ask nine interview questions (see Appendix B). I conformed to the interview protocol and provided an introduction along with a concise summary of the research process. Upon gaining approval from the participants to engage in the research, using Zoom or Teams, I created an audio recording of the virtual interviews. Yin (2018) discussed the importance of multiple data sources, such as company documentation to create depth and data from additional sources. For my secondary data collection instrument, I used company documentation, such as financial statements, annual reports, and fuel use policies.

Data Collection Technique

The purpose of this research study was to explore strategies successful mine leaders apply to ensure effective use of diesel fuel and reduce costs. Qualitative researchers may apply semistructured interviews in addition to the review of

organizational documentation to collect data (Nascimento & Steinbruch, 2019). The data collection practices included virtual semistructured interviews and the review of any available organizational documentation as well as publicly available documentation such as sustainability reports and compliance records. The process of conducting semistructured interviews ensures that a researcher can further explore concepts by using follow up questions to gain further information based on a participant's response (Husband, 2020). Semistructured interviews are useful in qualitative research because they allow the researcher to guide participants to explore participant experience (Husband, 2020). Participants were not offered incentivization to participate to help avoid bias. The interview process begun with the testing of technology and virtual platforms, an introduction and summary of the research process was also be provided to the participant. I considered using Livescribe Echo Pen and with the iTunes SpeakEasy Voice Recorder as backup to take audio recording of the interviews. Because I conducted the interviews using Zoom, I used this platform to create a recording which helped to confirm the accuracy of the information recorded through member checking. I used participant observation to observe any of the participant's expressions during the process of the interview. I also ensured that I followed my interview protocol and adhered to the Walden University regulations for conducting interviews.

The protection of participants must be at the forefront of researchers' priorities. Roberts (2020) suggested that researchers use interview protocols derive data collection from several participants and can create good interview and confidentiality etiquette during the process. My semistructured interview questions followed interview protocol to

derive information on the strategies mine leaders apply to reduce fuel use and associated costs (see Appendix B). Because the process of data collection is a significant portion of research, it is critical that researchers ensure efficiency throughout the process. The application of technology for recording a participant interview and transcription of that interview can drive efficiencies in the data collection process (Nascimento & Steinbruch, 2019).

When conducting my semistructured interviews, I used a recording method, such as Zoom or Microsoft Teams, to adequately capture all data and create opportunities for future transcriptions. Semistructured interviews present researchers with: (a) the ability to ask follow-up questions, (b) encourage two-way communication, and (c) probe for more information (DeJonckheere & Vaughn, 2019). There are disadvantages associated with semistructured interviews such as: (a) they are time-consuming, and (b) require significant resources, and (c) may create bias (DeJonckheere & Vaughn, 2019). Once receiving IRB approval, I contacted participants and developed a relationship of trust and familiarity to help ensure that the interviews were completed with sincerity and cooperation.

Researchers must confirm the information they have gathered from participants during the interviews. One tool that can be applied to confirm information is member checking (Vidicki & Stojsin, 2021). When researchers apply member checking, they can present their interpretations of participants' answers to interview questions to the participants and ask them to verify the accuracy of the researcher's interpretations (Candela, 2019). In addition, researchers should transcribe the recordings after each

interview to ensure they are able to capture all possible data effectively and improve the rigor of research (Nascimento & Steinbruch, 2019). Using Zoom or Microsoft Teams, I used virtual recordings of each interview as well as member checking to ensure that I was capturing and reporting valid and reliable information in my research. To transcribe the interviews, I used Descript. Once the transcriptions had been completed, I also e-mailed participants summaries of the interview transcripts one week after completing the interviews and asked them to review and respond within a week after receipt of the e-mail.

Data Organization Technique

The collection of data is significant for the process of research. Researchers may choose to use labelling systems, codes, and logs to organize data by types, names, and dates during their research process (O'Connor & Joffe, 2020). The use of tools such as Microsoft Word ™ and Microsoft Excel™ helped me in organizing data (Halpern et al., 2018). Data collection included a copy of the consent form, the interviews, the participant's responses as well as notes recorded during the interviews. I also retained an audio recording of the interview process, after which I backed up using an external USB drive.

During the process of data collection, I ensured participant confidentiality by designating identification labels to replace the participants' given names. This process consisted of pseudo names such as P1, P2, and P3. For example, the file for participant one is labeled as P1. I also assigned these same identification codes to individual participants during the process of data evaluation to ensure their identity remains

confidential throughout the study. Finally, when addressing the results of the interviews in my study, I referred to participants and their organizations with a designated alias. I ensured that I maintained sole access to all data, transcripts, and material by ensuring they are stored in a secure location, such as a locked drawer in my locked home office. I also stored the interview transcripts in Microsoft Word format in the various coded folders and further labeled the files with unique identifiers. Also, I used a pen and notebook to take notes and make observations during the interviews. I assigned participants identifying pseudo names to ensure their identities remain confidential and protect their privacy. In this case, I referred to the first participant as P1, the second participant as P2, the third participant as P3, and the fourth participant P4. Additionally, I password-protected all the folders and saved them on a thumb drive, which I store in a safe at my home office, along with any hard copies of documentation relevant to participants and the conducted semistructured interviews. Data will be stored for 5 years; once this period has expired, all documentation will be shredded and disposed of.

Data Analysis

Data analysis can be used to find meaning in data. There are various stages during the process of data collection and analysis including: (a) compilation, (b) disassembling data, (c) reassembling data, (d) interpretation, and (e) conclusion formulation (Yin, 2018). Various types of triangulation strategies that researchers may choose to apply in their research include: (a) data triangulation, (b) methodological triangulation, (c) theoretical triangulation, and (d) investigator triangulation (Nightingale, 2020). Researchers may choose to apply methodological triangulation to help verify

completeness in the data collection process (Vidicki & Stojsin, 2021). Methodological triangulation can involve the comparison of data from various sources to ensure for credibility (Candela, 2019). I collected data from various sources, such as mining leaders as well as organizational documentation. I used methodological triangulation to compare and validate data from member-checked interviews transcripts against data I derived from company documentation.

The analysis of data may help to provide insights into a given phenomenon. The conceptual frameworks, SET and CSR theory were also illuminated through the data collection process as themes and variables relating to one another. Yin (2018) stated that in data analysis, researchers must discover possible themes to substantiate findings. Elliott (2018) previously outlined the use of codes to classify themes and subthemes during the interview process and suggested that such codes may be used to help researchers identify and document trends within data. A common practice for researchers is to use Microsoft Excel™ as a reliable tool in the data analysis process (Halpern et al., 2018). I also used Microsoft Excel™ as well as ATLAS.ti as a tool during data collection. Once the process of member checking was completed, I used ATLAS.ti to analyze the data to identify common themes in the responses to each of the interview questions. Microsoft Excel™ and NVivo were also considered. However, when using ATLAS.ti, a quotation is the smallest unit which enables the researcher to work on the data level before moving it into a conceptual level. I then coded all the responses from the first interview into main and subthemes, looked for similar themes during subsequent interviews, and assigned the same codes if there were indeed similar themes in the

subsequent interviews. I then interpreted the qualitative data using Microsoft Word and coded the information using the color-coding technique. Through comparing the coded information with the conceptual framework and findings of the literature review and described the main themes that resulted from the interview transcripts. Researchers may apply methodological triangulation to create a complete understanding of phenomena under investigation by referencing collected data from each participant (Heesen et al., 2019; Vidicki & Stojsin, 2021). I also used methodological triangulation to verify or cross-check themes derived from interviews against themes I derived during the review of company documents and from direct observations. The grouping of similar codes then helped me to interpret the data effectively.

Alignment between collected data and themes discovered during the interview process may be used to help derive conclusions around strategies mine leaders apply for diesel fuel consumption reduction. Linking themes from data analysis to published research and a researcher's conceptual framework helps create alignment in qualitative studies (Boström, 2019). In my literature review, I highlighted numerous strategies mine leaders apply to reduce fuel use and associated costs identified in the extant literature. Although this information has been identified, when coding data from interviews, researchers may uncover new or contradictory themes (Elliott, 2018; Yin, 2018). During the data analysis phase, if themes arose that I had not previously identified during the literature review or within the conceptual framework, I assigned them a unique code for further review of the literature to determine whether I could discover any recently published journals to support the newly identified themes.

Reliability and Validity

Validity and reliability are key aspects of all research. Reliability in qualitative research refers to the consistency of responses to multiple codes within data sets created by the data collection process (Elliott, 2018). In qualitative research, Korstjens and Moser (2017) suggested that researchers must ensure that their study is reliable through creating dependability and validity through its credibility, transferability, and confirmability.

Reliability

Researchers must make it a priority to ensure that their study meets reliability criteria to certify that readers are able to have confidence in proposed findings. A study passes the test of reliability if it is free from biases, and they were able to achieve consistency over time (Korstjens & Moser, 2017). Additionally, triangulation is an appropriate method to apply when seeking to increase the validity, reliability, and legitimacy of one's research because it creates and confirms consistency within the data and findings, while improving auditability and understanding (Moon, 2019). I used Yin's (2018) case study interview protocol to design and align the study with the interview protocol recommended. Additionally, I used methodological triangulation because I collected data from more than one source.

Researchers should strive to ensure that their findings are consistent with the data they collected. Dependability refers to the consistency and reliability of the research findings and the degree to which research procedures are documented, allowing someone outside the research to follow, audit, and critique the research process (Korstjens & Moser, 2017). I applied member checking to ensure dependability within my study by

asking that participants review my interpretation of their answers to interview questions to verify the accuracy of my interpretations.

Validity

The use of validity and reliability are common practices in qualitative research. The process of instilling validity in one's study both supports good research and augments reflection and guidance (Hayashi et al., 2019). Researchers must also strive to implement credibility, transferability, confirmability, and data saturation to drive the validity of their study (Forero et al., 2018). To drive the validity in my research I used techniques such as member checking, interview transcripts, and triangulation.

Credibility

Readers should be confident in the validity of presented research findings. A study stands the test of validity if credible or logical in its application to business practice (Korstjens & Moser, 2017). A study has credibility if the data obtained by researchers clearly satisfy the purpose of the study and if the researcher could take actions to promote replicability and enhanced transparency (Closa, 2021). To establish credibility and reinforce the veracity of the study findings, investigators use triangulation to validate the completeness and integrity of data collection instruments (Vidicki & Stojsin, 2021). I ensured credibility throughout my study with the application of member checking and methodological triangulation, as these tools helped confirm that there were various sources used when creating conclusions.

Transferability

Transferability is an essential aspect of reliability in the qualitative multiple case studies. Transferability encompasses obtaining dependable results that are transferable to other settings (Korstjens & Moser, 2017). Transferability embodies the degree to which the results of the research are transferable to different contexts (Rose & Johnson, 2020). To ensure that other users can use my research with some level of certainty, I recorded my research observations, including documenting assumptions noted in the study, and verified my analysis of data and coding of themes. I also applied member checking, interview protocols, methodological triangulation, and data saturation to augment the process of creating transferability.

Confirmability

Confirmability in qualitative research relates to whether the researcher provides adequate information for other researchers to transfer research findings (Korstjens & Moser, 2017). Researchers should use peer debriefing as a source of feedback from participants to achieve confirmability (Rose & Johnson, 2020). According to Korstjens and Moser (2017), other researchers must be able to corroborate the interpretation of the current study results to ensure confirmability. To authenticate the quality and accuracy of research findings, I used methodical triangulation to compare research findings obtained from the analysis of face-to-face interviews and organizational document review.

Data Saturation

Data saturation is a critical aspect within qualitative research practices. Researchers achieve data saturation when they obtain no new information or

themes from interviews, observations, and document reviews arise (Saunders et al., 2018). However, in a fixed data set, Guest et al. (2020) suggested that data saturation inevitably occurs because there is a point at which the proportion of new themes becomes relative to the number of participants. Researchers employ member checking in the research process to ensure data saturation which can be established through the repetition of responses (Saunders et al., 2018). In my study, data saturation was based on the responses of participants, as well as my ability to ensure that my perception of the participants' responses was correct and thorough through member checking. Secondly, upon the review of participants' responses and documentation, I ensured that no new themes emerged and that there was no possibility for new coding.

Transition and Summary

The intent of this qualitative multiple case study is to explore strategies some mine leaders apply to ensure effective use of diesel fuel and reduce associated costs. Section 2 contained the purpose statement, the role of the researcher, and information on participants, including the justification of criteria for participants. Additional information provided in section 2 included: (a) research method, (b) research design, (c) population and sampling, and (d) ethical research. Section 2 also contained information on data collection such as: (a) instruments, (b) technique, (c) organization technique, and (d) analysis, which included a detailed explanation of data collection, organization, and analysis.

In Section 3, I develop the study by placing a focus on critical areas such as an overview of the research, findings, applications to professional systems, and implications

for social change. Additionally, I included my recommendations for action and suggestions for further study. Finally, I offer my reflections and study conclusions.

Section 3: Application to Professional Practice and Implications for Change

Introduction

The purpose of this qualitative multiple case study was to explore strategies successful mine leaders apply to ensure effective use of diesel fuel and reduce associated costs. Data were derived from semistructured interviews and company documentation at four mines located in Australia and South Africa. Despite various technological advancements that have made the mining industry more sustainable, mining still consumes significant amounts of diesel fuel. As the global mining industry and governments around the world seek new ways to reduce their carbon output and environmental impact of burning fuels such as diesel, the mining industry must begin to consider ways in which it can reduce its impact. Findings in this section of my study include strategies to help mine leaders reduce diesel fuel and associating costs. Strategies include the generation of new regulations involving associated emissions, creating policies for asset management, developing operator training programs, and capping the cost of diesel fuel. In this section, I provide findings, which include themes that were identified and derived from information collected during semistructured interviews: emissions, asset management, haul truck driver style, and diesel cost. Additionally, I also describe applications to professional practice as well as implications for social change. I also introduce recommendations for action and further research. Last, I reflect on my experience during the research and conclusions.

Presentation of the Findings

The overarching research question for the study was as follows: What strategies do successful mine leaders apply to ensure effective use of diesel fuel and reduce costs? The two conceptual frameworks I used to guide my research were the SET and CSR theory. Data were derived via virtual semistructured interviews with mining leaders who had successfully implemented strategies to ensure effective use of diesel fuel and reduce costs. Additionally, I used publicly available company documents obtained from mining firm web pages such as sustainability reports and equipment records to supplement information and triangulate data. During the process of analyzing data, I identified four main themes for ensuring effective use of diesel fuel and reduction of associated costs, which I present in this section. Member checking was conducted to ensure validity and accuracy of data as well as my interpretations of participants' responses to interview questions. Member checking and data triangulation also helped the process of ensuring credibility and reliability.

During research, validity is critical. Validity is improved when the study's conclusions are derived using multiple sources (Farquhar et al., 2020). For data triangulation and to help augment the study's reliability and validity, I applied and referenced multiple data sources, including semistructured interview data and company documents. During data analysis, I used ATLAS.ti software to identify subthemes and main themes from transcribed data. This information was then used to establish how themes related to the phenomenon and topic of my study. Once completed, I imported the four participant interview transcripts and relevant company documentation into

ATLAS.ti. This was then used to calculate word frequencies and later applied to code files. Through this process, several codes arose from my initial manual coding. I then evaluated data and determined relevant and common themes. For thematic analysis, I used ATLAS.ti to help categorize, justify, and identify frequencies of codes.

Researchers use data saturation to ensure and demonstrate validity of a qualitative research study (Yin, 2018). Data saturation is achieved when no new data, coding, or themes result, and replication occurs (Saunders et al., 2018; Yin, 2018). In my study, data saturation was achieved when no new themes or subthemes were identified during the coding process. For this reason, I stopped interviewing participants after the fourth interview. Once data saturation was completed, I applied member checking and data triangulation to validate that data saturation was achieved.

Table 1

Themes, Number of Responses, and Percentage of Respondents

Themes	Number of Respondents	Percentage of respondent's agreement
Emissions	4	100
Asset Management	4	100
Driver Style	4	100
Diesel Cost	4	100

Identification of themes is a fundamental task in qualitative research. The data analysis process in my study involved the identification of themes that were derived from data using Yin's coding procedures. Once interviews were completed, I coded participants' responses into main themes and subthemes. I also searched transcribed interview data for similar themes during subsequent interviews and assigned the same codes to them if similar themes were identified in subsequent interviews. Using this process, I identified eight subthemes from the first interview and nine subthemes from the second interview. The same nine subthemes continued to emerge with no new themes (see Table 1) arising after the fourth interview. The main themes identified during semistructured interviews were emissions, asset management, haul truck driver style, and diesel cost. I present an assessment of findings obtained from publicly available organizational documents along with observations during semistructured interviews to ensure methodological triangulation.

Theme 1: Emissions

The first theme identified in my study was overall importance of emissions generated by diesel fuel use in the mining industry. Emissions are significant within the mining landscape since they are often tied to CSR and environmental social governance (ESG) initiatives due to their harmful impacts on the environment and associated costs of operations in terms of fines and regulatory costs. All four participants discussed the notion of emission reductions as being a strategy to reduce costs associated with use of diesel fuel in a mining setting (see Table 2).

Table 2

Emergent Theme 1: Emissions

Subthemes	Number of sources	References
Regulations	4	17
Greenhouse Gas	4	14
Sustainability	4	9

Regulations

The global mining industry has only just started to set goals and initiatives for emission-reductions. Emissions include a myriad of toxic air and water pollutants as well carbon dioxide and other man-made climate altering GHG (Schwartz et al., 2019). Due to their harmful impacts, the reduction of emissions must be a priority and be closely monitored. P2 and P4 acknowledged that the emissions created by diesel fuel usage is a significant factor in a mining setting. More specifically, P2 reported that, “diesel fuel is closely monitored, every liter of diesel used creates about 2.7 kilograms of carbon dioxide.” P2 also said, “Many mines in Australia have the obligation of ensuring for a 40% emissions reduction by 2030.” P4 elaborated on the measurement of emissions and suggested that “there seems to be a missing is a consistency in approach and a standard that’s audited.” Carbon reduction initiatives must be put into place to control emissions

created within the mining industry and support economic growth through clean technology developments. P1 and P3 did not discuss regulations during their interviews. However, I referred to the publicly available sustainability reports from their mine to triangulate this. P1's mine published in their sustainability report that they continue to increase their "ability to obtain and maintain any necessary permits, consents or authorizations required for mining activities; environmental regulations or hazards and compliance with complex regulations associated with mining activities; CC and CC regulations." The sustainability report from P3's mine also noted that they are working to "increase in CC regulations to limit GHG emissions in countries where their mines operate." Explanation of the importance of reducing emissions associated with mines diesel fuel usage aligns with the Department of Industry (2020), by 2020, the Australian taxation scheme prevented almost 160 million tons of carbon dioxide from entering the atmosphere and generated $24 billion in taxes the past three years.

GHG

The mining industry has faced pressure from governments, investors, and society to reduce emissions. Mining is currently responsible for 4-7% of GHG emissions globally (Parizot, 2021). All participants acknowledged that emissions generated by diesel engines are tracked, reported, and then published in various sustainability reports. P1 stated that "over the past 5 years CC and reducing emissions, GHG and over all diesel fuel usage has been very big. Its arguable one of the largest mining initiatives right now." P3 said, "information on emission targets can be found in our mines sustainability report." I used the enterprise's publicly available sustainability initiative reports from each of the

participants mines as well as available and archival documents, such as carbon reduction policies, for data triangulation. With the review of this organizational documentation, the theme of emissions and their reductions is prevalent. P2 specifically acknowledged that their "mine take part in setting CC targets." The mine employing P2 published a publicly available sustainability report in 2020, that indicated the mine had "taken steps to reduce their GHG emissions." The action taken described in the sustainability report from P2's mine was to "implement a fully autonomous haulage fleet and a strategic alliance with other mining equipment suppliers which will promote a zero-emissions mining system." The published sustainability report from P4's mine stated that they "have set a goal to introduce emissions reductions targets by 2022." To triangulate this, I review the annual report found on the public web page of P4's mine which track and record compliance. The annual report from P4's mine noted that "in November 2020, we committed to industry leading climate targets of 30% reduction in GHG emissions by 2030, with an ultimate goal of achieving net zero carbon emissions by 2050." One of the strategic pillars in the overall reduction of GHG is the reduction of diesel fuel consumption on mine sites (Collier et al., 2019). The adherence to GHG reduction goals must form the basis of planning and establishes objectives by which mines measure performance.

Sustainability

From each of the participants mines, I was able to locate and utilize sustainability reports and various operational policies. The reviewed sustainability reports from all four participants mines revealed that sustainability is a strategic priority for mining firms in both Australia and South Africa. The sustainability report from P1's mine noted that "we

will actively work to build a culture of superior operational and project execution to drive shareholder returns and a sustainable future whilst staying true to our values of safety, integrity, sustainability, inclusion and responsibility". P1 also reflected this in the interview and noted that diesel fuel consumptions "directly impacts aspects such as CSR, sustainability, and our CC goals. The sustainability report from P2's mine indicated that they created a role specific to driving sustainability initiatives and noted that "in 2020, we created the role of Director of Sustainability to support Executive Management in ensuring that these values are carried out across operations." P3 discussed that their mine "puts out a sustainability report that is on our website and is released to the market." With review on this sustainability report, the mines goals were identified, "our sustainability vision is to create long-term value for all our stakeholders." Lastly, P4's sustainability report stated that "our strategy is building a growing, high-quality, low risk, sustainable business even in unpredictable times." Governmental regulations and member awareness has pushed firms into minimizing their emissions and carbon footprint (Choi et al., 2021). As per the information in the sustainability reports reviewed, mines apply a wide array of externally developed strategies through upholding international standards, aligning with environmental best practices, global sustainability objectives, and reporting requirements to allow stakeholders to track emissions reduction progress.

Resources are required to drive the success of strategic initiatives within the mining industry. There has been a global lack of political support and incentivization surrounding the implementation of green strategies (Pegels, et al., 2018). This is often mitigated by external pressures, such as government regulations on the environment

which should impact effective business practices as well as mining leader's implementation of emission reduction strategies (Choi et al., 2021). Political and governmental support for added CSR initiatives such as carbon reduction strategies or green entrepreneurship might correspond to entrepreneurs' stronger environmental orientation (Lyon, et al., 2018). Mine managers must utilize added requirements to derive new resources for implementing emissions reduction strategies and ensure for effective business practices. Such emission reduction strategies not only impact the total consumption of diesel fuel but may also help to reduce associated costs.

Theoretical Frameworks

In this study, CSR and SET were used as the theoretical foundations. One tenant of SET is that the exchange of social behavior may result in social and economic outcomes; therefore, CSR resides within the theoretical underpinnings of SET (Frederiksen, 2018). Variables linked with diesel fuel usage and associating emission reductions reside within economic, ethical, and social boundaries. Responses from participants align with that of Awang et al. (2019); there must be an augmented need for CSR and social practices that address damages created by economic activities, such as mining initiatives, to the environment. P4 noted that "environmental and economic factors are a priority for any operating mine." P1 also indicated that diesel fuel consumption directly impacts aspects such as CSR, sustainability, and CC goals." Under both theoretical frameworks, emissions associated with diesel fuel usage must be considered as primary obligations and strategies to maximize, protect, and improve welfare of the society and its association, in the present as well as in the future (Hąbek et

al., 2019). Emission reduction can be met through the adoption and implementation of various corporate and social actions by mining firms (Awang et al., 2019). For this to happen across the mining industry, stakeholders, suppliers, employees, and commodity customers must begin to work together to develop cost-positive emission reduction strategies.

Theme 2: Asset Management

For many mine leaders, increasing efficiency while developing cost effective practices is necessary for operational success. Participants discussed how the design and execution of maintenance programs for assets, such as haul trucks, is critical to reduce both diesel fuel consumption and associated costs. The result for Theme 2 is shown in Table 3, with 24 total references with the subthemes preventative maintenance and upgrading equipment.

Table 3

Emergent Theme 2: Asset Management

Subthemes	Number of sources	References
Preventative Maintenance	4	18
Upgrading Equipment	4	6

Preventative Maintenance

Preventative maintenance is critical when seeking to optimize assets and operational costs. P1 stated that “within our mine’s operations, we try to maximize asset efficiency by designing and executing an equipment maintenance program.” P1 also stated that “We also have preventative maintenance programs to make sure that all of our equipment is in great shape to keep the fuel costs low.” Another asset management strategy suggested by P2 was “making sure the utilization of equipment is being maximized.” P3 additionally indicated that “predictive maintenance done on assets has the potential to prevent future failures and minimizes unexpected costs.” P4 discussed preventative maintenance from the perspective of tracing automated trends and noted that “sensors are being used to collect data on fixed and mobile assets allowing us to understand when maintenance is required.” For mining leaders to meet new demands for environmental sustainability criteria in the globally competitive market, they must shift their attention to the proficiency of operations (Dubey et al., 2015). Strategies such as creating preventative maintenance programs or tracking asset failure through automated programming can be used to help reduce the overall cost associated with mining operations.

The ways in which assets, such as haul trucks, are managed and maintained is a critical component in a mine’s overall efficiency in terms of costs associated with diesel fuel consumption and productivity. P1 reflected this and noted that “we have preventative maintenance programs to make sure that all of our equipment is in great shape to keep the fuel costs low.” P2 further discussed this and stated that “managers must always try and

pick the lowest costing asset in terms of life cycle cost because over the total life of a truck asset for example, the diesel fuel consumptions are around about 75% of the life cycle cost". Mining leaders should aim to reduce both diesel fuel consumption and associated costs over the entire lifecycle of their assets through increasing maintenance programs, upgrading their systems when possible, and practicing preventative procedures (Stachulak & Allen, 2020). From maintenance planning, including predictive maintenance based on diesels fuel usage patterns and equipment lifecycle costing asset management applications can be used by mining leaders as a strategy to help optimize assets, lower overall costs, and improve their mines productivity.

Many mining firms may view their assets as the core variables required to sustain profitability. With maintenance requiring a significant proportion of the overall operating costs in the mining industry (Drygin, 2020). P1 elaborated on this and stated that "designing and executing maintenance programs is one way used to reduce overall costs". By maximizing the asset maintenance management, mining leaders can improve the uptime of asset and improve the life of them. P2 also discussed this and noted that "spending unnecessary money on equipment in the future can be limited though the maximization of asset life cycles." To triangulate this, I reviewed the governmental sites of each participant mine. P1's mine published an executive summary indicating that the mine was working on the "development of Preventive Maintenance Instructions (PMI)'s that added value to the business." P2 and P4's mine did not publish any information on their preventative maintenance programs. However, on the web page of P3's mine, they state that the mine "Promotes preventive maintenance by motivating personnel to plan

and prepare effective work plans and schedules in conjunction with the planning resources." Managers must begin to apply and develop asset management strategies to help reduce overall costs. Besides having an efficient asset management program, it is also important to have efficient asset maintenance management.

The mining industry uses significant amounts of diesel fuels as an energy source, The mining industry is responsible for a significant portion of the worlds GHG emissions due to its substantial use of diesel fuel (Barenblitt et al., 2021). P3 and P4 acknowledged the importance of asset management and suggested that an added strategy may be to convert current assets into equipment requiring new energy forms. P3 suggested that "Solar equipment and better generators may be more economic. Mining firms with the resources to install and run solar-powered equipment may find them to be a good investment (Lu et al., 2021; Victoria et al., 2021). P4 also elaborated on this and noted that, "then a replacement of equipment to offset the consumption of oil and diesel fuel is being addressed by the implementation and investment on solar panels." In addition, the cost reduction of solar power offers mines with an opportunity to integrate storage systems into solar power stations (Lu et al., 2021). Once purchased and installed, solar panel-based energy systems are virtually free as there is no added long-term cost to operation. The usage of solar storage for energy rather than diesel fuel results in more room for profit and creates momentum for added effective business practices. The development of new technologies and upgrading current equipment is a strategy that mining leaders may apply to reduce diesel fuel and associated costs.

Upgrading Equipment

With diesel fuel being a significant cost for mines, mining leaders must ensure they are careful to not spend more on fuel than they are making as a profit. Continually reducing costs and improving performance of assets, as well as innovations to support reliable operations have made these energy generation sources more attractive. However, to achieve medium to high renewable penetration, the use of the diesel gensets must be modified. A genset refers to the primary set of diesel generators that are used for the creation of electricity and heat (Baidya et al., 2021; Issa et al., 2019). P2 discussed the importance of gensets and suggested that mining leaders are currently reviewing the suability effectiveness of hybrid gensets. P3 also noted that, "every five years, the most efficient generators are looked into, and managers upgrade current sets". P1 and P2 did not discuss gensets as being significant to diesel fuel consumption at their mines. However, P1's mine published in their sustainability report that they have "cut power costs by adding a Caterpillar solar system similar to their gensets." During short periods energy collection or requirement, the solar cell energy collection method is effective enough to cover the mine's energy needs (Baidya et al., 2021; Issa et al., 2019). Successful management of assets and deployment of optimized gensets may assist the mining industry on its journey towards energy-efficient, and sustainable mining practices through creating nearly a 70% reduction in fossil fuel consumption (Baidya et al., 2021). The future of mining contains several more aggressive and higher emission reduction targets. Mining leaders must make a significant shift in their operational strategies and ensure that the management of their assets is maximized. Modern upgrades to equipment

can be used by mining leaders as a strategy to reduce diesel fuel and may allow for alternative energy sources or more efficient use of diesel. The continuous review of assets and their management is significant and should not be perceived by mining leaders as being a minimal approach for the reduction diesel fuel and associating costs.

Theoretical Frameworks

Under SET, mining leaders tend to reward suppliers and employees that are perceived to offer support and investment to them, which is shown as mutual benefit and cooperation. Since developmental purpose of such rewarded objectives provide individuals with a positive and supportive work environment, mine employee job satisfaction and optimization identification may be increased (Lu et al., 2018). Individuals may be more likely to safeguard the overall interests of the mine and strive to meet operational and CSR related goals such as meeting diesel fuel reduction targets. CSR strategies can be linked to various outcomes such as improvements in operational performance and overall credibility (Singal, 2021). Successful use of strategies such as assets selection and equipment upgrades may assist mining leaders in creating cost savings in terms of diesel fuel efficiency, as well as efficient operational practices by creating a significant reduction in fuel consumption and overall operational cost (Baidya et al., 2021).

Theme 3: Haul Truck Drivers Style

With the advantages of high mobility and a strong climbing ability mining haul trucks have been widely used in mines all over the world. However, there are some inefficiencies with the use of haul trucks such significant diesel fuel consumption.

Driving style of mining haul truck drivers has a direct impact on diesel fuel consumption and is an important indicator of productivity (Wang et al., 2019). Aggressive driving behaviors have been linked to vehicle performance (Armenta-Deu & Cattin, 2021). The result for Theme 3 is shown in Table 4, with 35 total references with the subthemes operator training and idling time.

Table 4

Emergent Theme 3: Haul Truck Driver Style

Subthemes	Number of sources	References
Operator Training	4	12
Idling Time	4	19

Operator Training

Based on the responses from P1 and P4, mining firms in Australia and South Africa have identified a driver's style as one strategy and method to reduce operational costs. P4 discussed the importance of a haul trucks driving style and stared that "behavior is a big piece of driver style and how you educate your workforce to do certain things." P1 elaborated on the notion of a driver's style and suggested that "we spend a lot of time developing our drivers and our operators' skills, giving them the ability to operate the equipment and applying the skills to reduce fuel". Although P2 and P3 did not directly discuss operating training as a strategy for diesel fuel reduction, I was able to find

evidence from their mines carbon reduction policies that triangulates this information. In the carbon reduction policy from P2's mine it noted that "we developed a driving behavior and mining truck condition monitoring system." P3's mines carbon reduction policy also suggested that they track haul truck driver's behavior and noted that "data of driving behavior and the status of different drivers is collected." This information is consistent with research discussed by Martinez et al. (2018), haul truck driving style has a significant role in energy management and identifying a driver's style as well as applying it to vehicle intelligent control is a developing trend in mining strategies for fuel reduction. According to Liu et al. (2019) mine managers must place a stronger focus operational training for drivers to prevent excess fuel consumption from aggressive driving styles. The link between haul truck driver style and diesel fuel usage can be applied as a strategy to reduce diesel fuel consumption as well as associated costs. However, this strategy can also be applied by mining leaders as a management tool and to achieve overall operational cost savings.

Idling Time

Patterns in a haul trick drivers' style can be quantified and analyzed through real driving parameters obtained from vehicle software or monitoring systems. The availability of such data offers new opportunities for diesel fuel reductions and costs savings due to the interpretation of raw data collected from haul trucks. Driving style can be related to factors sch as change of speed and idling time (Armenta-Déu & Cattin, 2021). P1 acknowledged the relationship between diesel fuel consumption and haul truck driver style. P1 elaborated on the relationship between diesel fuel consumption and haul

truck driver style and suggested that “the majority of equipment have tracking systems within them that allow the mine to see real time stats on the operations from the RPM’s to how much fuel is being burned when they are idling. We keep track of these programs to really get an understanding for the truck’s performance. This data is them applied to intelligent algorithms to identify changes in driver behavior and optimize driving patterns over a haul trucks life cycle.” Additionally, P4 discussed idling time and suggested that “we do not permit unnecessary idling.” Reducing idling time on mining sites can be a strategy used by mining leaders to reduce diesel fuel and associating costs. However, it can also be applied in ways that relate to the overall effectiveness of business practices such as reductions of emissions and harmful airborne toxins that impact environmental parameters and the mines license to operate.

Theoretical Frameworks

The social responsibility of a mine as it relates to communities and a mines license to operate is a critical component of business practice. Under the of SET and CSR frameworks, mining leaders may develop practices that work to, not only reduce diesel fuel and associated costs, but also increase the firm’s ability to create profit as well as trust between shareholders, and employees. Growing concerns surrounding the credibility of CSR initiatives within the mining industry necessitate the measurement of the effectiveness of CSR practices as mandated by government policy and driven primarily by society (Singal, 2021). The recent global push towards the requirement for mining firms to develop and publish sustainability reports and CSR practices augments the movement toward reduced diesel fuel consumption throughout the landscape of mining

(Ma, & Chang, 2019). Policies that cover and control drivers' efficiency and skill as well as time spent idling and burning unnecessary fuel are critical to a mines license to operate as well as the social exchange and outward facing image of the mining industry. Triangulation was completed by reviewing the participants mines publicly available sustainability reports and published anti-idling policies. In a publicly available sustainability report published by P3's mine it was noted that, "mitigation to minimize GHG includes training drivers to minimize idling, limiting truck speed, and reclaiming mine stockpiles and disturbed areas as they become available." Additionally, the sustainability report published by the mine P2 is employed by suggested that they "have implemented no idling policies that have resulted in over $360 million dollars in annual cost savings." P1 and P4's mines did not discuss their CSR initiatives within their sustainability reports but did discuss the monitoring of haul truck driver style and data collection. Mine managers must be cognizant of the relationship between an operator's driving style and fuel consumption as each relate directly to diesel fuel consumption and associated costs. It is for this reason that new policies and strategies, such as no idling policies, may be initialized to help ensure for the adoption of effective business practices, the reduction of diesel fuels, and associated costs.

Theme 4: Diesel Cost

The variable cost of diesel fuel in a mining setting is a critical component when assessing strategies to reduce cost. In some instances, mines have had to reduce operating and maintenance budgets, creating a situation of insufficient maintenance planning and asset investment. Insufficient maintenance and reduced resources for assets can create

conditions in which assets begin to underperform or cause increased risks, service disturbances, and even asset failure (Allin et al., 2019). The net result is an overall strain on a mines operation in the form of increased lifecycle cost or deprecation of technology and assets. The result for Theme 4 is shown in Table 5, with 18 total references with the subthemes asset selection and operational cost.

Table 5

Emergent Theme 3: Diesel Cost

Subthemes	Number of sources	References
Asset selection	4	10
Operational Cost	4	8

Asset Selection

When seeking to reduce diesel fuel consumption and associated costs, it is important for mine managers to work with finance departments to ensure for proper cost reduction tracking. P2 and P3 stipulated that mine managers must work with financial decision makers to set targets and track costs to be successful in effectively reduce the negative environmental impacts of business operations, reduce cost, and improve the enterprise's competitive advantage. P2 suggested that "commercial aspects of diesel supply are very accurate based on the invoicing process. When the diesel supply company sends and invoice the mine has strong financial systems to measure and cite deliveries." In addition, P3 noted that "monitoring our consumption is tracked as part of financial systems." Although P1 and P4 did not discuss asset selection during their interview, for triangulation purposes, I collected data using sustainability reports to

triangulate asset selection as a strategy used my mine managers for P1 and P4's mines. The notion of mining manager setting targets to track and reduce emissions and costs is confirmed by various mines' social governance and environmental protection policies. In P1's mine's social governance policy report, the mine suggested that, to meet emissions and cost reduction targets, the mine "completed a project which created a costs and carbon emissions by approximately 20%." The environmental protection policy from P4's mine also discussed their asset selection process and noted that they are making changes to their selection processes to "better understand how specific investments can protect and enhance ecosystems while supplying critical public goods and services." By using new, alternative tracking techniques, such as optimized asset selection, mining companies can reduce their environmental impact while ensuring effective business practices.

Financial performance of diesel using mining equipment includes the cost to acquire, maintain and dispose the equipment. Diesel haul trucks financial performance has become a focal point for the industry at the end of the commodities boom in early 2000's and remains a focal point for mining leaders. As suggested by participants, the primary driver of mining equipment's financial performance is on-going costs such as diesel fuel. This is because of the extensive utilization of mining equipment and machinery. For mining leaders, P2 noted that, "Diesel fuel can be a large portion of a haul trucks life cycle costs." Triangulation was done using published sustainability reports which conformed this. In P3's mines annual report, it was estimated that the overall direct and indirect energy consumed by source was as high as 7,830,278.6

gigalitres (GL) of non-renewable energy. Given the importance of equipment's financial performance, leveraging diesel fuel savings through asset selection to improve financial performance is a significant strategy to improve financial performance and reduce costs associated with diesel fuel consumption in a mining setting. P2 explained that one strategy used to achieve this is, "we try to get the best, most efficient, and most up to date engines into the assets from the original equipment manufacturers". When selecting an asset, managers are often provided with a budget, which often requires them to choose assets that do not always incur the greatest increase for the mine's productivity when applied. Selecting assets such as efficient engines that relay long-term values in terms of diesel fuel efficacy and maintenance, is a critical strategy for mining leaders seeking to create effective business practices while reducing diesel fuel consumption and associated costs.

Operational Costs

Participants indicated that the constant monitoring of the price of diesel is one critical aspect in cost reduction strategies. P1 noted that "diesel fuel and its consumption in the mine is very important since it impacts our overall profitability and directly impacts aspects such as CSR, sustainability, and our CC goals." P3 discussed this and suggested that the cost of diesel fuel is a highly variable cost. P3 also noted that, **"**our total operating cost is power generation and is probably 95% diesel". However, there are various aspects to the costs associated with diesel fuel. For example, this includes the cost of diesel fuel, the cost associated with burning diesel fuel in terms of environmental and decarbonization fines, as well as the investment of new capital to achieve reduced cost.

One strategy that was discussed by P2 and P4 was the notion of price caping. P2 elaborated on this and noted that “the diesel fuel prices are flexible and a function of the price of crude oil. The price that we pay for diesel is capped.” P4 noted that “Diesel fuel is a capped cost.” P1 and P3 did not discuss the notion of price caping on their diesel fuel sources. The fluctuating prices of diesel fuel in the mining industry has the potential to underwrite the global supply of consumerism, caping fuel costs can help to mitigate this instability (Rai& Nunn, 2020). By applying effective business practices and techniques that reduce the consumption of diesel fuel, the mining industry can become more economical and sustainable. Therefore, evaluation of the variables that control diesel consumption levels and its overall cost become necessary to certify the competitiveness of the mining industry.

In the mining setting, capital investments are required to accomplish goals associated with decarbonization potential since the adoption of renewables, electrification, and operational efficiency, are required. P1 emphasized the need for greater strategies to track operational costs and suggested that “manual systems are used where we can measure the fuel dispensing systems at the asset level. But the data is not really looked at in a lot of detail and tends to get lost in the noise of the operations.” P4 also highlighted this need for added diesel fuel consumption tracking metrics and indicated that the process of tracking diesel consumption tracking is “done very poorly.” P3 went into detail regarding the strategies their financial departments use to regulate and monitor the average cost of diesel. P3 suggested that financial departments within mines used “cost codes and are responsible for monitoring the annual or monthly price of diesel

as well as the overall productivity associated with that cost." P3 elaborated on this and noted that, "every individual reagent for diesel is tracked against a cost code and a cost location". With the collection of these cyclical costing data points, the mine is better able to determine if the cost of diesel is associated with fluctuating market prices or of it is associated with an increase in diesel fuel usage. If the cost is linked to an increase in usage, they are then able to track that increase to productivity to isolate the reason. Environmental awareness has become a vital issue affecting operational and consumption choices.

An increasing number of industries, including the mining industry, have adjusted their practices and policies because of the influence of environmental awareness. In many instances, this is done by preference being given to environmentally friendly products, equipment, and preferring eco-conscious organizations (Herrington, 2021). In response to this increase in environmental cognizance, mine managers have had to adjust their policies and processes. P2 and P4 indicated that cost saving is done at the asset level and that the relationship between diesel fuel consumption and a mines productivity in terms of cost must remain linear and consistent. P2 stated that "we do have manual systems where we can measure the fuel dispensing systems at the asset level." However, P4 elaborated on the sophistication of tracking systems and noted that "it is becoming a lot more sophisticated in terms of how the mine is utilizing the tracking of equipment; this is done at the asset level." If diesel fuel consumption goes up and productivity remains the same, the negative costs associated with those emissions results in a profit loss for the mine (Purvis et al., 2019). An understanding of the breakdown of mine overall

operational costs is an important strategy for mining leaders who seek to create cost reductions and reduce diesel fuel consumption.

Theoretical Framework

Directly related to this is CSR and sustainability initiatives. Researchers have linked the preference for eco-friendly practices to the ability to remain efficient in operations. Purvis et al. (2018) argued that stakeholder's interest is reflected in their actual purchase decisions and that the environmental aspect affects profitability. Ongoing evaluation must be tailored to the needs of both the mine and the needs of social responsibilities. On a global scale, mining leaders can apply the strategies of asset selection to ensure they are acquiring technologies and assets that help to meeting their CSR requirements and remain effective in their business practice. The mining industry as a whole can make this change to better understand how their specific investments can be used to help protect the environment while meeting their CSR Environmental Social Governance (ESG) initiatives and maintaining their license to operate.

Applications to Professional Practice

The findings of my study could prove valuable to the current and future mining leaders for implementing strategies to ensure effective use of diesel fuel and reduce costs. Other industry leaders may also find diesel fuel reduction strategies helpful when seeking to adapt to continuous environmental change and regulation changes. This information may be helpful to them for the purpose of creating sustainable business operations and developing a deepened understanding for the scope of impact that surrounds operational investment and cost. The results of my research study may provide additional value to

mining leaders and businesses through providing additional knowledge and strategies on how mine leaders can derive a reduction in diesel fuel and associated emissions. Future compliance with environmental regulations and arising emission standards within Australia and South Africa may also be a resulting consequence of my study. Leaders in the mining industry seeking to apply such recommendations may also help to inspire and create innovative and sustainable jobs and business practices.

Not all diesel fuel reduction strategies currently used by mining industry leaders can be considered functional and effective. The mining industry has begun to shift to a more sustainable direction through the adoption of various governmental regulations as well as internal mining policies and strategies surrounding carbon reduction. Improved business sustainability and compliance work to benefit the effective practice of business by minimizing costly penalties associated with environmental regulatory fines and charges. The implementation of strategies recommended may create sustainability through profitable operations. This increased profit may allow mines to become sustainable through managing their environmental footprint and further allowing them to create and sustain local jobs while becoming a better partner in their surrounding communities.

Implications for Social Change

The application of the findings derived from this study may lead to positive social change by enabling mining leaders to invest in social and environmental change initiatives. Such investment may further enable a shift in awareness and wiliness to adapt to continuous environmental change and regulation. With added cognizance, the leaders

within the mining industry may be better able to improve the working standards of individuals employed by mining firms as well as creating added environmental awareness in surrounding communities. The implication for positive social change includes aspects such as the potential to empower mining leaders to create and develop effective fuel reduction strategies by emphasizing the importance of emissions and GHG reduction. Leaders concomitantly improving environmental regulations may result in a new, environmentally conscious culture which may then have overarching impacts such as environmental improvements within the surrounding areas of mining communities.

The social implications of this study may also include effecting positive social change in the lives of individuals and the local communities surrounding mining areas. Increased costs associated with fuel use in the mining industry has reduced jobs and may continue to do so until strategies to reduce associated costs are developed (Nygren et al., 2009). The alternative fuel development should assist organizational leaders as they plan and envision sustainable possibilities. Alternatives fuel developments may assist mining leaders as they plan and envision future sustainable possibilities. Positive social change is probable since the study included strategies that, when applied, may aid in the process of addressing global environmental problems, such as rising GHG emissions, known to generate contamination in water sources, agricultural areas, and cause substantial health apprehensions and various social implications (Emmanuel et al., 2018; Li et al., 2017). Communities residing within the surrounding areas of mines may also benefit from the application of the research findings to counteract current water and air pollution sources,

environmental degradation, and many other aspects that cause serious human health and social problems.

One of the main goals of fuel reduction strategies is the overall reduction of emissions and GHG. All organizations are impacted by changes within their business environment prompting the need for strategies to adapt to continuous change to enhance sustainability (Venkatesan, 2021). The mining industry as a whole can create harm including environmental pollution, disease, and industrial accidents, for this reason, it becomes essential for such industries to further apply strategies and develop policies that help mitigate damage caused by inefficient diesel fuel use (Li et al., 2017). Industries and organizations promoting CSR may also seek to create profit through complying with regulations and rules within their present nation or community. Mining firms have the capability to formulate such policies and promote CSR based compliance to improve the lives those living within surrounding areas and communities. Many mining organizations are profit centered; they often disregard environmental impact. To ensure for sustainable practice mine leaders are responsible for creating policies and formulate sustainable strategies that incorporate environmental promotion and costs associated with such practices into their fuel efficiency policies (Khan et al., 2020; Li et al., 2017). The implementation of strategic CSR promotes alignment between mining business' interests, social value, and environmental stewardship, generating more impact and value to society and mining communities (Hąbek et al., 2019; Li et al., 2017). Using findings from this study, leaders within the mining industry might provide sustainable services to their work

force as well as the public, which could improve the social well-being of people in surrounding communities.

Recommendations for Action

The purpose of this qualitative multiple case study was to explore strategies successful mine leaders apply to ensure effective use of diesel fuel and reduce associated costs. Based on the results of this study, I propose several actions that the current as well as future mining leaders can adopt to adapt to create continuous change the ways that work to sustain their business operations while maintaining environmental cognizance.

The implementation of the strategies identified by mining leaders are beneficial to various mining firms including mine owners, mine leaders, and shareholders within the mining industry. Mine leaders are mandated to address ongoing environmental pollution and emission issues associated with diesel fuel usage and mining activities to improve mining operations and protect the environment. The results of this study can be disseminated using platforms such as new implantation of policy, member training programs, and conferences on the strategies that can be implemented to provoke change in the area of diesel fuel consumption and associated costs. Such implementations may work to encourage mining stakeholders to implement best practices to improve compliance with environmental regulations surrounding emissions reductions. Based on the findings of the four critical themes, I recommend that mining operations, mining leaders, and national stakeholders come together to promote collaborative efforts in resolving the environmental issues facing the mining industry and its diesel fuel consumption. Each of these members have an invested interest in the outcomes of mining

operations and the ways in which they address the current changes in the mining industry. Some stakeholders are more concerned about the profitability of mining operations, while others have a greater interest in protecting the environment and surrounding communities.

Another recommendation based on this research is to create added communication between mining leaders and local communities to help further address concerns and achieve mutually desirable outcomes concerning the mining industry and its operations in South Africa and Australia. The final recommendation is that mining firms in South Africa and Australia continue to embrace new policies and changes on behalf of local communities to improve mining operations and further protect the natural resources and environment. Mining leaders should intensify policy initiatives to create added training and awareness of the growing need for transparency in enforcing a reduction in diesel fuel consumption associated with mining operations and to ensure local communities safe remain safe from emissions and pollution.

Recommendations for Further Research

I conducted a qualitative multiple case study on the strategies successful mine leaders apply to ensure effective use of diesel fuel and reduce costs. Through virtual semistructured interviews with mining leaders who had successfully implemented strategies to ensure effective use of diesel fuel and reduce costs. The population of the study consisted of four mining leaders located in Australia and South Africa who had successfully implemented strategies to ensure effective use of diesel fuel and reduce costs. The small sample size is a limitation of the study. Also, the study is limited to two

geographic locations. Thus, to generalize the findings, future researchers should decide on a different location, such as a different region or country.

Although qualitative studies provide insight into a given phenomenon, they have limited generalizability with regards to the depth of the data collected. The principal limitation of my study may be the short period of the study and lack of sufficient publicly held mines to include in my study population because of the global dominance of privately held corporations in the mining sector, various leaders and employees with valuable knowledge and experience in study my decline to participate. The lack of testable variables also worked to limit the degree to which data could be generalized and assessed. A limitation of this study was the use of a sample size that only included four participants. A future study with a larger sample size may help to augment the data collection and generate more useful information. Future researchers interested in this subject matter may also seek added knowledge through the identification of concepts expressed in this qualitative study and operationalize the results as testable variables. These testable variables may then be applied in a quantitative survey gauging the relationship between diesel fuel and associated costs. In such a larger and more representative sample could be generated. Additionally, quantitative studies may also be completed that seek to conducted examine the associated profits of reducing diesel fuel.

Reflections

Through this work, I came to understand the depth of reflective practice, and was able to expand my own personal awareness and understanding of what it means to be a reflective scholar. In this study, I explored the strategies that some mining leaders applied

to ensure effective use of diesel fuel and reduce associated costs. Throughout the study, I was able to develop and acquire invaluable skills and experience from my interaction with mining leaders. At the beginning of this study, I thought that the use of diesel fuel within South Africa and Australia mines was one factor driving increased emissions and ecological impact. However, through this process, I learned that the overall usage of diesel fuel in a mining setting is a complex problem with multiple factors contributing to the problem. One factor that may have contributed to the problem was the lack of commitment and support offered by global governments. Understanding the potential to provide mining leaders, stakeholders, employees, and even community members with a better set strategy for making informed decisions around asset selection and management could lead to a shift in policy and regulation around carbon emissions and diesel fuel consumption.

Further, I learned that leadership in the mining industry is continually evolving and changing as accountability initiatives increases within geographical governing regulation. I was inspired by the participants' responses to questions, as I did not have the knowledge of the strategies that successful mining leaders applied to ensure effective use of diesel fuel and reduce associated costs. I have gained invaluable experience from the entire research process, which has enhanced my resolve to be a successful business leader. I intend to share the knowledge gained with other leaders, both in the mining industry and in business, who may be interested in creating continuous environmental cognizance.

I was inspired by the various conversations with study participants. Although having an understanding for the mining landscape, I did not have the depth of, knowledge into the various strategies that successful mining leaders use to reduce diesel fuel and associated costs. Through this experience, I have had the opportunity to gain invaluable experiences that has further enhanced my ability to become a more environmentally cognizant successful business leader. In the future, I intend to share my newfound knowledge other business and mining leaders who may be experiencing continuous challenges within the landscape of diesel fuel consumption and associating issues. Pressures that must be considered by mining leaders include the awareness of strategies and associated knowledge of the equipment operators, the ability to influence personal buy in and employee behavior, as well as the ability to nurture the need for sustainable technologies that promote more environmentally friendly perspectives within decision making policies within the mining landscape. This work is critically important because working together as a system to address the global need for emission reductions while assuring that the strategies placed in each mine are properly formulated to create a suitable future for not only the mine but also the communities that surround them.

Conclusion

The purpose of this study is to explore strategies successful mine leaders apply to ensure effective use of diesel fuel and reduce associated costs. Four main themes emerged from coding and data analysis of interview data, interview notes, and company documentation. The three emergent themes from the data analysis were: (a) emissions, (b) asset management, (c) haul truck driver style, and (e) diesel cost. The research adds to

the limited literature on strategies used to ensure for the successful reduction in diesel fuse consumption and associated costs. The government, regulators, and other stakeholders may use the research findings as supplementary information to help engage with the mining industry for the purposes of improved mutual benefits. The increase in diesel fuel reduction strategy utilization by mining leaders contributes to the global need for a reduction in carbon footprint. This approach accounts for global increase in air pollution, increasing GHG, as well as the increases in susceptibility of the global population to the health effects. Previous studies have examined the short-term and regional benefits of reducing GHG. However, CC is a long-term, global problem. Since diesel fuel reduction is a mandate that must occur on a global scale, nations have the potential to drive longevity though investing in strategies that may impact factors such as air quality and human health. Diesel fuel reduction strategies both in the mining industry as well as across other industrial boarders could motivate countries to pursue a more sustainable and low-carbon future.

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Appendix A: Interview Protocol

Interview Protocol	
What you will do	**What you will say-script**
Introduce the interview and begin to set the stage.	Hello, I want to first take the time to thank you for agreeing to participate in my research study. For the last several years, I have been working to achieve a Doctorate in Business Administration emphasizing on the strategies mine leaders apply to reduce fuel use and associated costs. In this study, I will explore the various strategies mine leaders have applied to be successful in reducing fuel use and associated costs. To share a bit about myself, I have a Bachelor of Science from the University of Manitoba and an, MSL from Walden University. My doctorate focuses on one of the most critical organizational factors

	used to reduce fuel and associated costs in the mining industry. In preparation for this interview, you had reviewed and responded to an informed consent form. I will ask you nine questions and will be recording your answers. Please note that this interview will remain confidential; your identity and your company's identity, will remain anonymous using a code created for this research. Moreover, your name, location, position, and other personal information that may identify you will not be shared in the study report. During the process, should you feel as though you are unable to or cannot answer a question, please let me know and I will move on to the next question or end the interview process. Before we begin, do you have any questions?

• Listen and watch for non-verbal queues • Paraphrase or summarize as required • Ask any follow-up or probing questions to promote more in-depth responses from participants	1. Why is diesel fuel consumption a significant matter within your mine?
	2. What strategies do you use to reduce diesel fuel consumption?
	3. How is diesel fuel consumption tracked and investigated by mine leaders at your site?
	4. What programs and procedures do mine leaders use to help to prevent excessive diesel fuel consumption? 5. How do you assess the effectiveness of your organization's diesel fuel reduction strategies?
	6. What metrics have you established to track cost savings and what documentation are you using to track and trend?

	7. What metrics do you have on the total reductions of greenhouse gasses over the past 5 years based on the current fuel reduction strategies in your mine?
	8. How does your organizational documentation identify trends in cost savings?
	9. What additional information would you like to share about the strategies used to ensure effective use of diesel fuel and reduce associated costs?
Wrap up the interview and thank participant.	Thank you for your participation in my research study; I appreciate your time. Before we close, are there any supporting pieces of organizational data you can share with me that support the information you provided today? Last, I would like to follow up with you, with an email, in one week with my interpretation of the three most prominent concepts from your interview.

Organize the process of member checking through scheduling a virtual follow-up using either phone, email, MS Teams, or Zoom.	As a follow up to your interview, you will find my interpretations of the three most prominent concepts from your interview. To ensure that my interpretations of your responses are accurate, I would like to request your feedback through a phone conversation or email correspondence.
By email, I will distribute a copy of my interpretations for the three prominent concepts from the interview. I will also invite participants to participate in a follow up conversation using the phone, MS Teams, Zoom, or in email format. I will also bring any probing questions related to other information that you may have found. Please note that the information must be related so that adherence to the IRB approval is	I wanted to share a concise synthesis of your answers to each question asked during your interview. I would also appreciate feedback on these results and the accuracy of my interpretation/synthesis. Concept 1: Question and succinct synthesis of my interpretation—one paragraph or as required. Concept 2: Question and succinct synthesis of my interpretation—one paragraph or as required. Concept 3: Question and succinct synthesis of my interpretation—one paragraph or as required.

always maintained. I will then re-visit and review each question by reading the interpretation, and asking: “Did I miss anything?” Or “what would you like to add?”	

Appendix B: Informed Consent Form

You are invited to participate in a research study exploring the strategies mine leaders apply to reduce fuel use and associated costs. The purpose of this study is to explore strategies successful mine leaders apply to ensure effective use of diesel fuel and reduce associated costs. I am seeking four to six South African and Australian mining leaders who successful experience reducing fuel use and associated costs to participate in this study. The interview will be recorded for audio using Zoom or Microsoft Teams. Additionally, all participants will be asked to share any publicly available documentation at the end of the interview. This informed consent form is a part of the process that helps you to understand the research prior to deciding on participation.

The name of the researcher is Teaghan Wellman, a doctoral student at Walden University. Should you agree to take part in this study, you will be asked the following:

- To participate in a 1-hour semistructured interview through a phone call or video conferencing regarding the strategies mine leaders apply to reduce fuel use and associated costs.
- Ms. Wellman will record or transcribe the interviews to ensure the data collected is accurate.
- You will be invited to participate in a 20-minute follow-up interview via a phone call, Zoom, or Teams to discuss the results of the first interview.

Some sample interview questions that will be asked during the semistructured interview:

1. Why is diesel fuel consumption a significant matter within your mine?

2. What strategies do you use to reduce diesel fuel consumption?
3. How is diesel fuel consumption tracked and investigated by mine leaders at your site?

Voluntary Nature of the Study:

Participation in this research study is voluntary. The researcher will respect your decision to participate in this research or not. Additionally, participation is voluntary, and you have the right to decline or stop participation at any time without consequence. Lastly, should you choose to withdraw from the process, you may do at any time.

Risks and Benefits of Participating in this Study:

Participation in this study will involve minimal risk. However, some minor discomfort may be encountered, such as fatigue and stress. However, involvement in this study will not cause risk to your safety or wellbeing. Your participation may create social benefit through formulating strategies to successfully implement strategies to reduce fuel use and associated costs. There are no benefits for the participants of this research study.

Payment:

No payment or any other incentives will be offered for participating in this research.

Privacy:

All information provided during participation in this study is confidential. The researcher will not use your personal information for any purposes outside of this research project. Also, the researcher will not include your name or anything else that could identify you in the study reports. If the researcher were to share this dataset with another researcher in the future, the researcher is required to remove all names and identifying details before

sharing; this would not involve another round of obtaining informed consent. Lastly, all data and information will be stored in a secure location for a minimum of 5 years.

Contacts and Questions:

You may ask any questions by contacting the researcher via email at teaghan.wellman@waldenu.edu If you wish to privately discuss your rights as a participant, you may contact the university's Research Participant Advocate at 1-800-925-3368 ext. 312-1210 from within the USA, or 001-612-312-1210 from outside the USA, or email address irb@mail.waldenu.edu.

Statement of Consent:

If you feel you wish to participate in this research, please indicate your consent to the researcher by replying to this email with the words "I consent" within one week of receipt. If you choose to participate, you may wish to retain a copy of this form for your personal records.

Appendix C: Letter of Invitation

Dear,

My name is Teaghan Wellman, and I am a candidate for the Doctor of Business Administration (DBA), at Walden University. I am contacting you to invite your participation in my dissertation research study exploring strategies mine leaders apply to reduce fuel use and associated costs. Study participants will include four to six mining leaders from operations, resource, environment and various engineering departments; you have been selected to participate based on your role.

The study allows me to fulfill the requirements of the DBA program adding value through identification of strategies mine leaders apply to reduce fuel use and associated costs. The findings of this study may contribute to positive social change and enhanced industrial practice by providing strategies needed by mining leaders to ensure reduce fuel use and associated costs. I am performing this study under the direction of Dr. Betsy Macht, chair of my dissertation committee.

Should you choose to participate, I will contact you with a study summary and coordinate a time, to conduct the virtual interview. The interview includes nine questions and is anticipated to take 60 minutes. Participation is voluntary and the research process ensures full confidentiality of your responses and identification. Should you have any questions or concerns, please feel free to contact me directly at

teaghan.wellman@waldenu.edu

Thank you for your time and consideration,

Teaghan Wellman, DBA candidate

Appendix D: CITI

Completion Date 20-Apr-2020
Expiration Date N/A
Record ID 36290529

This is to certify that:

Teaghan Wellman

Has completed the following CITI Program course:

Not valid for renewal of certification through CME.

Student's
(Curriculum Group)
Doctoral Student Researchers
(Course Learner Group)
1 - Basic Course
(Stage)

Under requirements set by:

Walden University

CITI
Collaborative Institutional Training Initiative

Verify at www.citiprogram.org/verify/?w33305758-be66-42a0-a073-28de0dfdbae5-36290529