BOARD SIZE, BOARD INDEPENDENCE, OCCUPATIONAL HEALTH AND SAFETY RISK MANAGEMENT PERFORMANCE. A STUDY OF CORPORATE GOVERNANCE

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Abstract

The purpose of this paper is to empirically examine the influence of internal corporate governance (CG) mechanisms (board size — BS and board independence — BI) on the occupational health and safety (OHS) risk management performance of 30 Johannesburg Stock Exchange (JSE) listed mining firms. We exploit data chosen from published integrated annual reports of JSE-listed mining firms for the period from 2002 to 2018. Following an empirical approach based on descriptive statistics and multivariate regression analysis, the study found a negative relationship between CG mechanisms and occupational safety risks. However, the results of the study confirmed a significant and negative relationship between CG mechanisms and occupational health risks. The study endeavour outlines the decisive importance of optimal BS and independence as essentials of effective OHS risk management approaches, resulting in improved overall performance for the firms under study. Moreover, the study results contribute to the existing body of knowledge as well as assist policymakers and regulators in supporting mining firms in their quest to attain the "zero harm" milestone by December 2024 (Mineral Council South Africa [MCSA], 2022).

Keywords: Occupational Health and Safety Risks, Corporate Governance, Board Size, Board Independence, Zero Harm

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1. INTRODUCTION

The influence of the board of directors' key features on occupational health and safety (OHS) risk management and the overall performance of firms epitomise an interesting research focus area fundamentally approached in the existing literature. The corporate board of directors is the principal and overriding internal corporate governance (CG) mechanism and plays a crucial role in monitoring top management and bringing into line the interests of key stakeholders with management (Ludwig & Sassen, 2022; Guluma, 2021). Corporate boards are charged with the responsibility of ensuring that both financial and non-financial controls are in place and effective with due diligence and care (Noja et al., 2021; Institute of Directors Southern Africa [IoDSA], 2016). Also, boards are responsible for providing management with strategic direction and may veto management decisions in the interests of stakeholders at heart (Awad et al., 2023; Grove et al., 2022; Ulfah et al., 2022). These underlying responsibilities are also at the centre of this study, being brought into the open discussion as well as an argument on the significance of board features like board independence (BI) and board size (BS) — linked with the CG and OHS risk management performance, in impacting the overall risk management performance of companies, particularly mining firms.

The justification behind the examination of the influence of CG variables on OHS risk management performance is premised on the fundamentals of operational risk management disclosure in the hazardous industry, such as the mining sector, as a new approach in assisting firms in identifying, assessing and mitigating risks at enterprise-wide level (Anton & Nucu, 2020; Frederiksen & Banks, 2023). OHS risk management and CG is a research area of importance, especially for mining firms, risk practitioners, corporate boards, policymakers, and academics in the field grounded on the growing significance of internal CG mechanisms in giving insights for improved OHS risk management performance (Mabe & Bwalya, 2022).

The association between internal CG mechanisms and OHS risk management is captured by the importance of eliminating the excessive exposure of mining firms to OHS risks (Signé & Johnson, 2021). Additionally, the impact of the BS and BI on OHS risk management is greatly argued in the plethora of literature, being confirmed by the indispensable function fulfilled by the board of directors in overseeing the undertakings of the firm, in addition to the decision-making process, therefore, influencing the proficiency to effectively employ in attaining the objectives that cascade into enhancing overall and OHS risk management performance (Frederiksen & Banks, 2023; Noja et al., 2021).

Premised on the plethora of existing relevant literature, this paper aims to explore the impact of BS and independence on the OHS risk management performance of companies operating in the mining sector of South Africa. Consequently, the paper is bound to offer novel evidence to confirm that BS and independence are crucial to effective OHS risk management and overall performance.

The paper involves vital contributions to the existing literature body by proposing a valuable standpoint of view on the correlations between internal CG mechanisms and OHS risk management performance in the mining sector of South Africa using quantitative empirical analysis. As such, the paper offers somewhat reliable evidence on how BS and independence impact OHS risk management performance in the mining sector of a developing country.

The rest of the paper is structured as follows. Section 2 presents the literature review; Section 3 describes the methodology; Section 4 analyses the results of the study; Section 5 overviews a discussion of the results, and Section 6 provides recommendations and conclusions.

2. LITERATURE REVIEW AND HYPOTHESES DEVELOPMENT

This section of the paper offers a discourse of the existing applicable theories that try to offer the cradle of the association between internal CG mechanisms with specific reference to BS, BI, as well as OHS risk management performance and hypotheses development. The extant theories underpinning CG were drawn from different fields of study, including finance, economics, and law, among others. The theoretical perspectives on CG adopted in this paper are based on the financial view by means of a quantitative research methodology. As in previous studies (Guluma, 2021; Tshipa et al., 2018), for the current study, multiple theoretical perspectives entailing the agency, stewardship, legitimacy, and stakeholder theories provided the foundation of CG literature. The augmentative relationship between adopted theories in this study also justifies the adoption of multiple theoretical perspectives. According to Tshipa et al. (2018), agency theory on CG is augmented by other perspectives, such as shareholder theory, stewardship, stakeholder, legitimacy, and human capital theories.

2.1. Theoretical perspectives

Tshipa et al. (2018) assert that agency theory-grounded research emphasises mainly the association amid board structure, control over management behaviour as well as decision-making. Also, the primary perspective believed by proponents of the agency theory of CG points out that managers may tend to pursue their interests at the expense of shareholder value (Jensen & Meckling, 1976). However, supporters of the agency theory allude to the fact that shareholders' interests can be protected by managers only if apt internal governance mechanisms are in place to minimise agency costs (Jensen & Meckling 1976). As such, in the absence of strong CG in the mining sector, management can abuse their power to maximise their interests and goals at the expense of the health and safety of employees (Kim, 2022; Frederiksen & Banks, 2023).

As propounded by Jensen and Meckling (1976), agency theory asserts that there is a conflict of interest between shareholders and the board of directors due to separation of ownership and control, different risk tolerances and appetite, moral hazards, and information asymmetry. Liu and Sickles (2021) further assert that agency problems exist in firms since principals (shareholders) appoint agents (managers) to manage their economic interests, whilst managers are risk averse and are concerned about their benefits. In the context of this study, the board of directors may concentrate on maximizing their economic interests in the form of

remuneration by attaining high-profit levels, disregarding the health and safety of employees. Consequently, the agency theory provides the basis for the investigation of the impact of CG on OHS risks among Johannesburg Stock Exchange (JSE)-listed firms. In this light, directors as agents of the companies are appointed by shareholders to formulate, implement, and evaluate OHS risk management strategies to attain the "zero harm" milestone by December 2024.

Stewardship theory is premised on the assumption that managers are good stewards who will execute their duties with the main aim of pursuing and promoting the interests of shareholders (Donaldson & Davis, 1991). King IV's report on good CG (IoDSA, 2016) recommends that CG of business entities must lead ethically and exercise risk management oversight. As such, the stewardship theory is appropriate in settling the CG/OHS risk management performance debate. The CG structures as stewards are expected to act in a manner that balances firm performance and governance by satisfying and effectively managing OHS risks in a manner that makes the attainment of "zero harm" by December 2024 (Wang, 2021). Under the banner of stewardship theory, directors of mining firms are agents whose interests are in line with all key stakeholders, including the health and safety of employees (Tshipa et al., 2018; Ke & Chen, 2022). Tshipa et al. (2018) also assert that managers as curators are inspired to make decisions that equal those of owners that would boost firm performance and OHS risk management is not exceptional.

In addition, stewardship theory is based on the premise that managers execute their duties with due diligence to enhance shareholder returns by virtue of being noble overseers of company resources, including safeguarding the health and safety of employees. This cascades to the fact that CG under stewardship theory is linked to structure and hierarchy (Khan et al., 2021). As such, CG ought to deliver enabling and empowering systems and processes to managers, which should permit managers to provide effective OHS risk management strategies (Tshipa et al., 2018). Thus, managers as stewards should meet the interests and expectations of key stakeholder groups in an entity, which will consequently increase OHS risk management performance. Advocates of the stewardship theory put up that improved OHS risk management performance is linked with internal CG mechanisms that allow managers superior independence and control (Wang, 2021; Kowala & Šebestová, 2021). The CG influence must be bestowed on managers as they have an intimate and in-depth acquaintance of the OHS risk management performance. To that end, stewardship theory is applicable to the study area as managers need to be granted power and autonomy over the OHS risk management performance. Legitimacy theory is rooted in the generalized discernment that operations of the business are appropriate, suitable, or inapt with some socially developed systems of norms, beliefs, and values (Silva, 2021; Dzingai & Fakoya, 2017). Also, the legitimacy theory has been used as a basis for previous studies by various researchers on corporate social responsibility reporting in the mining industry (Sturdy & Cronje, 2017; Duho, 2023). Olateju et al. (2021) posit that the theory is premised on the notion that profit is not a complete benchmark of the organization's legitimacy.

Most importantly, the organization's legitimacy is grounded in its compliance with societal expectations, including OHS risk management performance and failure to comply will result in exclusions being put in place in the form of restrictions on the business activities, compensation to employees who get injured, killed, or sick and access to mineral resources (Silva, 2021; Khan et al., 2021). The mining firms' legitimacy is also impacted by, but not limited to, environmental disasters and health and safety incidences (O'Donovan, 2000; Duho, 2023). As such, one of the avenues a CG structure may act to maintain the legitimacy of mining corporations is to voluntarily report on OHS risk management performance in the integrated annual reports (Ozlati et al., 2021; Silva, 2021). Furthermore, legitimation may take one or more of the following forms: educating stakeholders about the business' intentions, seeking to change stakeholder perceptions of issues and seeking to change external expectations about the company's OHS risk management performance (Olateju et al., 2021; Ozlati et al., 2021). In the context of this study, legitimacy theory provides the basis for the investigation of the relationship between CG and OHS risk management performance in the South African mining sector since reporting and management of OHS risks are an overarching legitimate issue that guarantees social license to operate.

Stakeholder theory was founded by Freeman (1984) as a management tool and advanced into a firm theory with a great explanatory perspective. According to stakeholder theory, the balance of stakeholder interest is the major determinant of a business entity's policy. O'Donovan (2000) indicates that company stakeholders are classified into consubstantial, contractual, and contextual. O'Donovan (2000) further asserts that the most important class of stakeholders are consubstantial since they are critical to the firm's sustainable growth and include employees and the board of directors, among others. Moreover, Freeman (1984) alludes that the most significant contribution to risk management is the addition of implicit contracts, such as employment contracts, that, in turn, expose firms to OHS risks. As such, the CG of mining firms is expected to formulate and implement OHS risk management practices to increase firm value and reduce financial costs and chances of bankruptcy. Thus, stakeholder theory provides new insight into the link between CG and OHS risk management performance in the mining sector since the mining sector is labour-intensive. One of the elements of corporate risk management is operational risk management, which embeds OHS risks. To that end, the literature of this study is based on the premise of stakeholder theory because employees are the key stakeholders who are interested in the firm's performance (Mabe & Bwalya, 2022; Khan et al., 2021). As such, if the governing structures of mining firms inadequately balance OHS risk management and firm performance, the risk steers the firm into a loss-making entity.

Hence, in this context, the relationship between CG and employees of mining firms in South Africa needs to be well-matched to mitigate the impact of health and safety risks in the mining sector. Consequently, CG practices should be tuned to OHS risk mitigation strategies.

2.2. Hypotheses development

The main purpose of this paper is to examine the impact of internal CG mechanisms on OHS risk management performance among JSE-listed firms for the period 2002 to 2018. In view of that, the hypotheses for this paper are premised on the relationship between BS and independence and OHS risk management performance proxies (total injury frequency rate — TIFR, and new cases of occupational diseases — NCOD). The variables are some of the key internal CG mechanisms that determine the efficacy of the board of directors in protecting the interests of shareholders. The selection of the internal CG mechanisms was premised on previous studies (Guluma, 2021; Mabe & Bwalya, 2022; Tshipa et al., 2018) in addition to the JSE listing requirements as commended by King IV (IoDSA, 2016).

The impact of BS on OHS risk management performance was explored in a handful of literature with mixed results. The study by Lornudd et al. (2021) in Swedish manufacturing, trade, health, and construction firms using the survey approach found that the board of directors are equally responsible for OHS risk management. To that end, the BS must be large enough to include members with OHS competence to enhance the firm reputation, legitimacy, financial and non-financial risk management and production hours (Lornudd et al., 2021). Also, Gan and Simerly (2019) conducted a study on the impact of BS on non-financial performance encompassing employee health and safety of selected New York Stock Exchange-listed firms and found a positive and strong relationship. On the contrary, Al-Saidi (2021) investigated the impact of CG on operational, financial and market performance in Kuwait-listed firms. The study found a negative and insignificant relationship between BS and financial performance, BS and operational performance, and BS and market performance using pooled data. On that end, limited research was undertaken on the impact of BS on OHS risks in the mining sector of South Africa. In this study, BS was used as one of the CG variables to examine its impact on OHS risks.

Risk management is one of the key performance areas of the board of directors in every entity (IoDSA, 2016; Awad et al., 2023), and as such, health and safety risk management is embedded in the daily duties of the board of directors. Lornudd et al. (2021) further assert that board members who fail to show leadership in health and safety risk management are failing to execute their daily duties and responsibilities as directors as well as their moral duties and are damaging the image of the entity.

The extant literature, therefore, presents proof that BS as a CG proxy impacts the firm performance in terms of occupational risk management performance of organisations, which is expressed in TIFR and NCOD. Therefore, this study proposes a hypothesis to prove if CG variables measured through BS might have significant impacts on OHS risks, and the hypotheses are stated as follows:

H1: There is a significant relationship between board size and total injury frequency rate.

H2: There is a significant relationship between board size and new cases of occupational diseases.

Wu and Dong (2021) defined BI as the proportion of the aggregate number of independent directors to the aggregate number of directors on the board. IoDSA (2016) indicated that members of the corporate governing body may be classified as non-executive independent only if it determines that there is no interest, position, or relationship, which, when adjudicated from the viewpoint of a rational and knowledgeable third party, is probably to sway improperly or lead to bias in decision-making in the finest interests of the entity.

Various research studies have been done to examine the impact of BI on the performance of firms, with different findings (Wu & Dong, 2021; Abdulsamad et al., 2018). On the one hand, Wu and Dong (2021) examined the impact of independent directors on Chinese listed firms' performance, including OHS risk management and found a negative relationship. The study found that independent directors worsen the agency problem as they are incapacitated to fulfil monitoring and advisory roles in Chinese-listed firms. On the other hand, Abdulsamad et al. (2018) carried out a study on the impact of independent directors on firm performance embroiling OHS risk management among Malaysian publicly listed companies and found a weak but positive relationship.

The extant literature suggests that BI has significant impacts on firm performance, including OHS risks. However, the current study builds on the previous studies by striving to establish if BI impacts health and safety risks in the South African mining sector. Therefore, the proposed hypotheses are stated as follows:

H3: There is a significant relationship between board independence and total injury frequency rate.

H4: There is a significant relationship between board independence and new cases of occupational diseases.

3. METHODOLOGY

A correlational research design was used to determine the impact of CG mechanisms on OHS risk management performance among the JSE-listed firms. Quantitative secondary data on internal CG mechanisms (*BS* and *BI*) and OHS risk management performance (*TIFR* and *NCOD*) were accessed from online published integrated annual reports of 30 JSE-listed mining companies for the period 2002 to 2018. Consequently, the number of JSE-listed mining firms and the timeframe translated to 510 firm-year observations. The choice of this period was made to assure data availability while also accounting for changes in these factors. Furthermore, with the JSE's implementation of the CG guidelines, data from 2002 onwards were included because subsequent JSE laws prompted listed firms to disclose their CG procedures. The choice of time resonates with previous CG studies (Herbert & Agwor, 2021; Khatib & Nour, 2021). Moreover, the period under study of 2002 to 2018 is justified since during that period, King II (IoDSA, 2002), King III (IoDSA, 2009), King IV (IoDSA, 2016), and the Companies Act No. 71 of 2008 were put into place with the aim of improving CG practices and risk management is not an exempt.

Furthermore, the global financial meltdown prompted corporations to enhance their CG processes because of improvements in CG frameworks (Gan & Simerly, 2019). King III (IoDSA, 2009) was introduced based on an "apply or explain" approach. This allows businesses to function for their original goals without being limited by rigid norms. Accordingly, purposively, 30 JSE-listed sampled mining firms

have been subjected to all the local and international regulatory and CG guidelines reforms besides the global financial collapse of 2008–2009.

To this end, comparable to the studies of Mukwarami (2021) and Guluma (2021), a multivariate regression model was utilised as the principal tool for data analysis. Additionally, two estimation methods, the ordinary least squares (OLS) and the feasible generalized least squares (FGLS), were taken into consideration to enhance the robustness of the results. Owing to its desirable properties such as consistency, asymptotic normality, and asymptotic efficiency, OLS was adopted as in other studies (Al-Saidi, 2021; Mukwarami, 2021). Similarly, FGLS was chosen as the primary approach due to its statistical power, and its ability to offer more robust parameter estimations by taking into account the structure of the error components (Mukwarami, 2021). Furthermore, FGLS was used as an extension of OLS to reduce probable heteroscedasticity and serial correlation.

As alluded to in previous studies (Al-Saidi, 2021; Frederiksen & Banks, 2023), one of the critical issues in CG data is addressing the violation of regression assumptions owing to the existence of normality, autocorrelation, and heteroscedasticity of CG independent variables. Relevant tests such as normality, multicollinearity, serial correlation and heteroscedasticity were conducted, and it was found that the data was free from any form of regression violations that may result in biased and unreliable coefficients of the regression model. To test dynamic endogeneity, the Hausman specification test was conducted as in previous studies (Frederiksen & Banks, 2023; Mukwarami, 2021). The results (p-value = 0.06) of the Hausman specification test confirmed the absence of endogeneity justifying the use of OLS.

Considering the preceding, the model specifications for this study are as follows:

Model 1

$$Y_1 = \beta_0 + \beta_1 BS + \beta_2 BI + \beta_3 TA + \beta_4 TE + \epsilon \qquad (1)$$

Model 2

$$Y_2 = \beta_0 + \beta_1 BS + \beta_2 BI + \beta_3 TA + \beta_4 TE + \epsilon \qquad (2)$$

The description of the variables of the econometric models is given in Table 1.

Table 1. Description of variables

Variables	*Description of variables*
Dependent variables	
Occupational safety risks (Y_1)	Total injury frequency rate (TIFR)
Occupational health risks (Y_2)	New cases of occupational diseases (NCOD)
Independent variables	
Board size (*BS*)	Natural log of the total number of members on the board of directors
Board independence (*BI*)	Percentage of independent directors to total number of directors on the board
Control variables	
Total assets (*TA*)	The natural log of the total value of assets
Total employees (*TE*)	The natural log of the total number of employees, both permanent and contract employees

Source: Authors' elaboration.

As mentioned earlier, for internal CG mechanisms proxies, the study considers *BS* and *BI*, whereas the moderating variables are *TA* value and the total number of employees. OHS risk management performance proxies, *TIFR* and *NCOD*, were accessed from the online published integrated annual reports of JSE-listed mining firms for the period 2002–2018. Table 1 presents the summary of the variables, including their definitions as adopted from an existing plethora of literature to allow comparison with previous studies

4. RESULTS

4.1. Descriptive statistics

This section presents the descriptive statistical outcomes (measures of central tendency and dispersion) in tabular format.

Measures of central tendency and dispersion. The outcomes of descriptive statistics were generated from panel data collected from annual reports of 30 JSE-listed firms for the period ranging from 2002 to 2018. The descriptive statistics of the nine variables employed in this study are presented in Table 2, with 510 observations.

The occupational safety risks quantitative secondary data, as measured by *TIFR*, showed a mean of 7.249663 per million hours worked, while the standard deviation was 6.033076. However, the standard deviation is less than the mean, indicating that most data variables are bundled around the mean. This indicates a slight variability in *TIFR* in the JSE-listed mining firms for the period ranging from 2002 to 2018. The *TIFR* data showed a maximum of 33.91 and a minimum of 0 per million hours worked.

The data pertaining to occupational health risks as measured by *NCOD* showed a mean of 259.5624 and a standard deviation of 501.0986, as shown in Table 2. The standard deviation is more than the mean, inferring that there is great variability in *NCOD* among JSE-listed mining firms. The maximum *NCOD* was 3942 and a minimum of 0, implying that *NCOD*'s data range was equal to the maximum value.

BI data showed a mean of 51.4385 and a standard deviation of 16.32077, meaning that the data is clustered around the mean. The *BI* showed less variability in the percentage of independent directors sitting on the boards of JSE-listed mining firms from 2002 to 2018. Thus, the lower degree of *BI* variability confirms that listed mining firms have a common trend of accommodating many independent directors on their boards.

The maximum *TA* value was ZAR 1.99 trillion, and a minimum of ZAR 876. The mean for *TA* value was ZAR 7.90 billion, whilst the standard deviation was 2.5, confirming little variability among 30 JSE-listed firms for the period 2002 to 2018 in asset investment. The slight variability among JSE-listed firms in total asset value reflects a narrow gap in terms of asset investment.

TE are one of the variables that measure the size of firms, with a maximum value of 287043 and a minimum of 176 employees. The data for *TE*

showed a mean of 22636,98 employees, which is less than the standard deviation of 28029,11 employees. This shows little variability among the 30 JSE-listed firms in terms of *TE*.

Table 2. Descriptive statistics

Measures of central tendency	*BI*	*BS*	*NCOD*	*TA*	*TE*	*TIFR*
Mean	51.4385	10.48515	259.5624	7.90E + 10	22636,98	7.249663
Median	50	10	67	1.48E + 10	11659	5.4
Maximum	93	21	3942	1.99E + 12	287043	33.91
Minimum	0.44	4	0	876000	176	0
Std. dev.	16.32077	3.34763	501.0986	2.50E + 11	28029,11	6.033076
Skewness	0.02281	0.590221	3.456014	5.400063	2,973041	1.352283
Kurtosis	2.671683	3.314727	17.34667	34.14243	19,96402	4.874768
Jarque-Bera	2.311915	31.40464	5336.233	22861.64	6799,273	227.8694
Probability	0.314756	0	0	0	0	0
Sum	25976.44	5295	131079	3.99E + 13	11431673	3661.08
Sum sq. dev.	134249.2	5648.139	1.27E+08	3.14E + 25	3,96E + 11	18344.59
Observations	510	510	510	510	510	510

Source: Authors' elaboration.

4.2. Inferential statistics

A correlation matrix and multivariate regression analysis were employed to examine the relationship between CG and OHS risk management performance among JSE-listed mining firms.

4.2.1. Correlation matrix

Table 3 presents the correlation coefficients for each variable between -1 and 1, and p-values of less than 5% ($p < 0.05$), implying that all the variables were significant and related.

Table 3. Correlation matrix: Corporate governance and occupational health and safety risk factors

Variable	*TIFR*	*NCOD*	*BS*	*BI*	*TA*	*TE*
TIFR	1	0.14267	-0.10781	-0.07572	-0.09349	-0.07912
NCOD	0.14267	1	0.295963	0.124494	0.025852	0.437309
BS	-0.10781	0.295963	1	0.058795	0.154226	0.405041
BI	-0.07572	0.124494	0.058795	1	0.234633	0.205907
TA	-0.09349	0.025852	0.154226	0.234633	1	0.38577
TE	-0.07912	0.437309	0.405041	0.205907	0.38577	1

Source: Authors' elaboration.

As illustrated in Table 3, *TIFR* is positively correlated with *NCOD* (0.14267), confirming a weak linear relationship between the two variables. Thus, an increase or decrease in *TIFR* will result in a slight increase or decrease in *NCOD*. However, *TIFR* is negatively correlated to *BS, BI, TA*, and *TE*, with a value close to zero. As depicted in Table 3, there is a weak negative linear relationship between *TIFR* and independent (*BS* and *BI*) and moderating variables (*TA* and *TE*).

NCOD showed a weak positive linear relationship with *TIFR, BS, BI, TA*, and *TE*. This confirms that an increase in *BS, BI, TA*, and *TE* will result in a slight increase in *NCOD*. Moreover, an increase in *TA* and *TE* translates into an increase in *NCOD* as more employees are employed, more assets are utilised chances of occupational diseases increase. The positive association between *TE, TA*, and *NCOD* calls for CG bodies in the mining sector to apply strict and comprehensive health and safety measures that match the growth of firms in terms of *TE* and *TA* to mitigate OHS risks.

4.2.2. Ordinary least squares and feasible generalized least squares results

The study employed OLS and FGLS models to determine the association between CG mechanisms (*BI* and *BS*) and OHS risk management performance in JSE-listed mining firms. We utilised two regression econometric models. The first econometric model employed *TIFR* as the dependent variable, two independent variables (*BS* and *BI*), and two control variables (*TA* and *TE*) to establish how CG impacts OHS risk management performance. The second regression econometric model employed *NCOD* as the dependent variable, whilst the independent and control variables were the same as in the first model. From Table 4, the analysis of the results deliberates the regression coefficients and asterisks (*) to define the direction (+/-) and power of the association between CG and OHS risk management variables.

Table 4. Corporate governance and occupational health and safety risks

Variable	*OLS*		*FGLS*	
	TIFR	*NCOD*	*TIFR*	*NCOD*
BS	-0.165* (-1.71)	23.92** (3.31)	-0.165* (-1.73)	23.92*** (3.33)
BI	-0.0231* (-1.36)	1.546 (1.21)	-0.0231* (-1.37)	1.546 (1.22)
TA	-0.304 (-1.58)	-23.35 (-1.61)	-0.304 (-1.59)	-23.35 (-1.63)
TE	0.433 (1.70)	150.3*** (7.88)	0.433 (1.72)	150.3*** (7.94)
Const	14.49** (2.98)	-905.5* (2.98)	14.49** (3.00)	-905.5* (-2.50)
N	510	510	510	510

*Note: T-statistics in parentheses. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.*
Source: Authors' elaboration.

5. DISCUSSION OF THE RESULTS

The study intended to explore the impact of *BS* and *BI* on OHS risk management performance. The study employed quantitative secondary data for 16 years (2002–2018) to analyse the relationship between CG and OHS risks in the South African mining sector. Diagnostic tests were conducted to guarantee the adequacy of the regression models used, and these include normality, multicollinearity, serial correlation, and heteroscedasticity tests, among others.

As such, panel data was confirmed to be free from assumption violations, and, therefore, the study utilised OLS to analyse the association between CG and OHS risk proxies. Also, an FGLS was employed to consolidate the estimated OLS outcomes to confirm the strength of the testing techniques performed.

5.1. Multivariate analysis: The relationship between CG and OHS variables

The multivariate analysis was employed to offer a description of the linear relationship between CG (*BI* and *BS*) and OHS (*TIFR* and *NCOD*) risk variables. Table 4 shows the results estimating the impact of CG on OHS risks. CG proxies are the board of directors' size (*BS*) and *BI* and OHS risk proxies are the *TIFR* and *NCOD*.

On one hand, the results confirm a negative relationship between *TIFR* and CG proxies. On the other hand, *NCOD* showed a positive relationship with *BS, BI*, and *TE*. Moreover, the results confirm a negative association between *TIFR* and CG proxies except for one control variable (*TE*). However, *NCOD* confirmed a positive relationship with *BS, BI*, and *TE*.

5.2. Examining the relationship between BS and OHS risk variables

According to Table 4, the results show a negative and significant relationship between *BS* and *TIFR* (-0.165) at a 5% significant level, inferring that *BS* has a meaningful regressive effect on *TIFR*. Thus, an increase in *BS* translates into a decrease in *TIFR* in the South African mining sector. Therefore, the results support the hypothesis *H1*.

The findings are consistent with Mustapha et al. (2020) research, which argues that larger boards lead to poor communication and decision-making, negatively influencing business performance, particularly OHS risk management in this environment. However, the study's findings do not align with those of Rena and Msoni (2017), who discovered a positive and substantial association between business performance, including OHS risk management. Though there is no recommended ideal *BS*, Mahmood et al. (2018) argue that the recommended *BS* for listed corporations ranges from five to 16 members, depending on the firm's size, sector, and character, for improved overall performance.

As depicted in Table 4, the OLS and FGLS outcomes confirmed a positive (23.92) relationship between *BS* and *NCOD* at a 1% significant level, implying that an increase in *BS* results in a considerable increase in *NCOD*. Thus, the results suggest that an increase in *BS* results in adverse OHS risk management performance resonating with findings from previous studies (Al-Saidi, 2021; Gan & Simerly, 2019). As such, the result of the study supports the hypothesis (*H2*).

5.3. Examining the relationship between BI and OHS risk variables

Moreover, OLS and FGLS confirmed a negative (-0.0231) and significant relationship between *BI* and *TIFR* at a 5% significant level, confirming that a change in an increase in *BI* percentage reduces *TIFR*. Consequently, the results, as shown in Table 4, support the hypothesis (*H3*). Thus, the results are in line with the extant literature that posits that independent directors act as a monitoring mechanism for management activities, encompassing OHS risk management (Mahmood et al., 2018). Moreover, the existing literature confirms that the presence of independent directors in the CG structures enhances the likelihood of complying with applicable policies, laws, and standards. As such, the degree of *BI* improves the execution of directors' duties and responsibilities, including OHS risk management.

As depicted in Table 4, OLS and FGLS results confirmed a positive and insignificant (1.546) relationship between *BI* and *NCOD*. Therefore, the results justified the rejection of the hypothesis (*H4*).

5.4. Examining the relationship between moderating and OHS risk variables

OLS and FGLS estimators confirmed an insignificant and negative relationship between moderating variables (*TA* and *TIFR*) (-0.304) and *NCOD* (-23.35). Therefore, JSE-listed mining firms need not increase or decrease their asset values to reduce OHS risks. However, *TE* and *TIFR* showed a positive (0.433) and insignificant relationship. On the other hand, *TE* and *NCOD* showed a positive (150.3) at a significant level of 5%. In this case, an increase in employees has the potential to increase *NCOD*. Thus, the results suggest that an increase in the number of employees is likely to increase the new cases of occupational disease prevalence rate in the mining sector. In this regard, CG structures are obliged to formulate, implement, monitor, and evaluate comprehensive and robust OHS risk management practices that match the size of the workforce. Failure to match the increase in employees with appropriate and effective OHS risk management practices will fail to achieve pre-defined health and safety milestones.

6. CONCLUSION

This paper empirically investigated the impact of *BS* and *BI* as primary proxies of internal CG mechanisms' effectiveness on OHS risk management performance with *TA* and *TE* as moderating variables for JSE-listed firms over the 2002–2018 period with 510 firm observations. The study employed a multivariate regression model using OLS and FGLS to achieve research objectives. The basis for conducting the study emanated from, firstly, no prior studies on the topic of the impact of CG on OHS risk management performance focused on JSE-listed mining firms. Secondly, in contrast to this study, which utilised multivariate regression equation analysis, a plethora of studies employed mixed-method approaches. Consequently, this study aimed to close the prevailing knowledge gap in OHS risk management performance. Moreover, the study meaningfully contributed to CG/OHS risk management, particularly in the developing world context.

The recommendations premised on this study are three-fold: theoretical, methodological, and practical. CG in mining sector research is intricate; in addition, per se, mono theory exploration is inadequate in elucidating all portents within this fraternity. Consequently, the demand for the application of a multi-theory approach is deemed necessary, as it may augment the enlightening of the underlying forces of this fraternity. In line with the focus on CG–OHS risk management incorporation exploration, there is a prerogative for pervading theories to explore this novel paradigm for further research. Customary conventional CG theories, for instance, the shareholder, stakeholder, stewardship, and agency theory, are constricted and idiosyncratic in enlightening this integration and embedding of the inadequately-explored CG theories, such as the resource-dependency, human capital, proactive stakeholder engagement, behavioural agency, and enlightened shareholder theories is a step towards governance — OHS risk management integration.

The study provides clear indications for a linear negative association between *BI* and *NCOD* and a positive relationship between *BS* and *TIFR*. However, the generalizability of the study is limited due to its focus on a JSE-listed mining firm's sample for the period 2002 to 2018. As such, future studies may utilize CG and OHS risk management data for more than 20 years to enhance the reliability and robustness of results. Future studies could include firms listed on both developed and developing countries' bourses, allowing for a comparative analysis. Furthermore, the use of quantitative secondary data does not allow for a qualitative analysis of the firm's internal CG mechanisms linked with OHS risk management proxies. Thus, future studies could focus on how internal CG mechanisms (BS, board meetings, board gender diversity, chief executive officer duality, and BI, among others) impact OHS risk management performance using qualitative data by means of meta-analysis. However, the current study employed BS and BI to determine the influence of CG on OHS risk management performance due to data availability constraints. Most importantly, owing to the focus on publicly listed firms, it remains indistinct if the perceived association also stands for non-listed companies and non-mining companies.

Academia and regulators have proposed an extension of sustainability reporting that includes health and safety risk management performance, and future research could focus on non-listed firms, considering their invaluable contribution towards sustainable economic growth and development of South Africa and the world at large. The study offers a handful of recommendations from policymakers and management of the corporate world.

Firstly, the CG-OHS risk management performance integration research results in the mining sector call for the need to improve governance structures and mechanisms of mining firms to warrant that corporate boards meritoriously and competently perform their duties autonomously of external stakeholders' interference. Governance structures such as the board composition, board committees, performance, remuneration, performance, and meetings need to be realigned with the present-day paradigm towards the attainment of "zero harm" principles in the South African mining sector.

Secondly, there is a necessity to fortify governance oversight and align the fragmented legislative charter governing mining firms, a challenge that was noted by the MCSA (2022). The report notes that mining in developing countries such as South Africa made strides in their reforms of mining firms by illuminating the role of the government as a policymaker, legislator, and shareholder. Also, an aligned and harmonised approach will guarantee that OHS risk management performance inadequacies and obstacles are acknowledged and addressed straightaway.

The third recommendation of the study suggests that training in the form of education and skills development programmes must be implemented to ensure that mining firms comply with codes of good CG and uphold OHS risk management standards.

The fourth recommendation is that top management of mining firms need to adopt modern technologies in their daily operations. Recent technologies should focus on increasing productivity and concurrently enhancing the health and safety of mining workers. For instance, mining firms may adopt high-efficiency and low-emission technologies that minimise the deterioration of the working environment in the mining sector by reducing all forms of pollution.

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