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Assessing the Effect of Supply Chain Integration on Operational Performance: Exploring Perspectives from the Mining Industry in Ghana.

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ABSTRACT: - This study examines the impact of supply chain integration (SCI) on operational performance (OP) in the mining industry in Ghana, utilizing theories of dynamic capability, contingency theory, configuration theory, and stakeholder theory. The study collected data from 157 mining firms and employed a quasi-non experimental design. The findings reveal that customer integration, supplier integration, and internal integration significantly influence operational performance. The study provides recommendations for mining firms, including enhancing customer integration, establishing strong collaborative relationships with suppliers, and prioritizing internal integration. The importance of developing dynamic capabilities and considering the specific context of the mining industry in Ghana is emphasized. The study contributes to contingency theory, dynamic capability theory, and stakeholder theory by providing empirical evidence in the mining context. The implications of the findings highlight the significance of involving customers, improving supplier relationships, and internal coordination. Additionally, the study addresses the implications for community development in mining areas by enhancing operational performance. The study's originality lies in its comprehensive approach and its contribution to the existing body of knowledge in supply chain management and operational performance in the mining industry.

Key words: Supply chain integration; Operational performance; Mining industry; Ghana; Dynamic capability theory

I. INTRODUCTION

In recent years, supply chain integration (SCI) has gained significant attention from researchers and practitioners alike (Alfalla-Luque et al., 2013; Munir et al., 2020; Yu, 2015; Zhao et al., 2021). It is widely recognized that SCI plays a crucial role in improving a firm's economic performance (Danese et al., 2020; Munir et al., 2020; Yu, 2015) as well as its social and environmental performance within the supply chain (Gimenez et al., 2012; Wolf, 2011). The successful integration of supply chain activities has been linked to improved delivery, cost efficiency, flexibility, and responsiveness (PWC, 2013). Given its potential impact on operational performance, understanding the effect of SCI has become increasingly important. Previous studies have explored the concept of SCI and its implications for supply chain success (Ahi and Searcy, 2013; Asif et al., 2013; Danese et al., 2020; Gimenez et al., 2012; Wiengarten and Longoni, 2015). However, there is a lack of comprehensive research on how companies can effectively generate and transform resources through SCI to achieve sustainable supply chains (Pagell and Shevchenko, 2014). Additionally, the literature has presented conflicting findings regarding the relationship between SCI and operational performance (Liu et al., 2018; Tan et al., 2017; Huo et al., 2014). Some studies suggest a positive association, while others indicate curvilinear or insignificant relationships. These inconsistencies call for further investigation to fill the gaps in knowledge.

Despite the growing interest in SCI, studies often overlook the role of contingency factors that influence the relationship between SCI and operational performance (Gimenez et al., 2012). The success of SCI may be context-dependent (Wiengarten et al., 2019), and the lack of consideration for these factors limits the generalizability of findings. The absence of an analytical model that captures the interplay between SCI, operational performance, and exogenous control factors further contributes to fragmented and inconsistent research outcomes (Flynn et al., 2010; Turkulainen and Ketokivi, 2012). Therefore, there is a need to address these theoretical gaps and provide a more holistic understanding of the SCI- operational performance relationship. Empirical studies examining the relationship between SCI and operational performance often neglect the influence of contingency factors (Gimenez et al., 2012). However, recent developments, such as supply chain innovation and disintermediation, have brought new challenges to firms and require closer examination (Gao et al., 2017; Abdelkafi and Pero, 2018). Furthermore, there is a lack of consensus on how to measure the innovative capability of supply chains and the direct impact of innovation on performance (Iddris, 2016; Michalski et al., 2019). Methodological approaches to studying SCI and its impact on operational performance have varied in the literature. Some studies focus on individual dimensions of SCI, while others consider SCI as a single overarching construct (Graham et al., 2005; Rai et al., 2006). The choice of measurement indicators and the lack of a standardized analytical model further contribute to inconsistencies in findings (Graham et al., 2005; Turkulainen and Ketokivi, 2012). To address these theoretical, empirical and methodological gaps, a comprehensive analytical model that encompasses all dimensions of SCI and provides a more detailed explanation is needed. The purpose of this study is to assess the effect of supply chain integration on operational performance in the mining industry in Ghana. By exploring the perspectives of stakeholders in the Ghanaian mining industry, this research aims to fill the existing gaps in empirical research specific to this industry. The study will develop an analytical model that captures the interplay between supply chain integration, operational performance, and exogenous control factors in the mining industry context. The contributions of this manuscript to the literature include providing insights into the specific dynamics and challenges faced by the mining industry in Ghana and offering a more comprehensive understanding of the relationship between supply chain integration and operational performance in this context. The following questions are considered for the study 1) what is the influence of customer integration on operational performance of mining firms in Ghana. 2) What is the effect of supplier integration on operational performance of mining firms in Ghana and 3) How has internal integration influence on operational performance of mining firms in Ghana.

II. LITERATURE REVIEW

Theoretical Review

This review examines the theories of dynamic capability, contingency theory, configuration theory, and stakeholder theory in the context of assessing the effect of supply chain integration (SCI) on operational performance (OP) within the mining industry in Ghana. By synthesizing these theories, we aim to gain a comprehensive understanding of the relationship between SCI and OP, considering factors such as resource creation and modification, contextual fit, integration configurations, and stakeholder engagement. Dynamic capability theory builds on the resource-based view (RBV) by emphasizing a firm's capacity to create, modify, or extend resources to achieve a competitive advantage. It highlights the importance of firms adapting to the changing environment by developing the capability to effectively integrate their internal and external resources through SCI. In the mining industry, pharmaceutical companies can leverage dynamic capabilities to create, modify, or extend resources through SCI, thereby influencing their own performance and that of the supply chain (Beske et al., 2014; Helfat et al., 2007; Augier and Teece, 2009). Contingency theory argues that the impact of SCI on performance is contingent upon the fit between a firm's internal structure and its external environment. It recognizes that "best practices" may not yield consistent performance outcomes and emphasizes the need to understand the contextual factors that influence the SCI-SCS relationship. By considering pharmaceutical players in both developed (UK) and developing (Ghana) countries, this study applies contingency theory to compare and analyze the influence of SCI on supply chain performance in different contexts (Sousa and Voss, 2008; Donaldson, 2001; Donkor et al., 2021; Yu et al., 2013; Flynn et al., 2010). Configuration theory suggests that organizations perform better when they develop well-integrated configurations of interconnected elements within the supply chain. It underscores the importance of integrating activities, relationships, functions, processes, and locations of supply chain partners. A highly integrated supply chain, encompassing internal and external integration dimensions, is likely to deliver superior performance. This theory supports the notion that effective SCI is essential for achieving high operational performance in the mining industry (Cao et al., 2015; Drazin and Van de Ven, 1985; Sinha and Van de Ven, 2005; Flynn et al., 2010; Kaliani Sundram et al., 2016; Vereecke and Muylle, 2006; Liu et al., 2018; Wiengarten et al., 2019). Stakeholder theory emphasizes that a firm's sustainability efforts depend on the value-driven interventions of both internal and external stakeholders. It recognizes the interconnectedness of supply chain members and the influence of stakeholders' interests and principles on supply chain operations. By considering the mining industry as a single entity and engaging stakeholders both within and beyond the firm, organizations can enhance their SCI practices and subsequently improve operational performance. Stakeholder theory supports the importance of collaboration and network relationships in forging effective SCI among supply chain participants (Svensson et al., 2018; Moghaddam et al., 2018; Freeman, 1984; Prakash et al., 2020). These theories provide valuable insights into the relationship between SCI and performance, the importance of contextual fit, integration configurations, and stakeholder engagement. By understanding and applying these theories, mining firms can develop effective SCI strategies and achieve a competitive advantage in the dynamic mining industry of Ghana.

Formulation of Hypothesis

Customer Integration and Operational Performance

Dynamic capability theory highlights the significance of firms adapting to the dynamic environment and effectively integrating their internal and external resources through supply chain integration (SCI). This theory suggests that firms that are able to create, modify, or extend their resources through integration are more likely to achieve a competitive advantage (Beske et al., 2014; Helfat et al., 2007; Augier and Teece, 2009). In the context of mining firms in Ghana, customer integration plays a crucial role in operational performance. Customer integration refers to the collaboration and network relationships established with customers within the supply chain. This integration allows mining firms to better understand customer needs, preferences, and requirements, enabling them to tailor their operations accordingly. By closely integrating with customers, mining firms can gather valuable information and feedback, which can be used to improve product quality, delivery speed, responsiveness, and overall customer satisfaction. This alignment with customer expectations can positively impact operational performance. Furthermore, stakeholder theory supports the importance of collaboration and network relationships in enhancing operational performance. By engaging with customers as key stakeholders, mining firms can foster trust, cooperation, and mutual understanding. This can lead to improved communication, coordination, and joint problem-solving, ultimately enhancing operational performance (Svensson et al., 2018; Moghaddam et al., 2018; Freeman, 1984; Prakash et al., 2020). Therefore, based on the theories of dynamic capability and stakeholder theory, it can be hypothesized that customer integration positively influences the operational performance of mining firms in Ghana. By establishing strong collaborative relationships with customers and aligning their operations with customer needs, mining firms can enhance their performance in terms of efficiency, productivity, profitability, and overall competitiveness. Theories supporting this hypothesis: Dynamic capability theory emphasizes the importance of firms adapting to the changing environment and effectively integrating their internal and external resources through supply chain integration (SCI) (Beske et al., 2014; Helfat et al., 2007; Augier and Teece, 2009). Stakeholder theory emphasizes the importance of collaboration and network relationships, which can be fostered through customer integration, in improving operational performance (Svensson et al., 2018; Moghaddam et al., 2018; Freeman, 1984; Prakash et al., 2020).

Hypothesis 1: Customer integration positively influences the operational performance of mining firms in Ghana.

Supplier Integration and Operational Performance

Configuration theory emphasizes the significance of well-integrated configurations within the supply chain, including supplier integration, for achieving superior performance. This theory suggests that mining firms in Ghana can enhance their operational performance by effectively integrating suppliers into their supply chain activities (Cao et al., 2015; Drazin and Van de Ven, 1985; Sinha and Van de Ven, 2005; Flynn et al., 2010; Kaliani Sundram et al., 2016; Vereecke and Muylle, 2006; Liu et al., 2018; Wiengarten et al., 2019). Supplier integration involves establishing close collaborative relationships with suppliers, aligning goals and objectives, sharing information, and jointly working towards mutual success. By integrating suppliers into their supply chain operations, mining firms can benefit from improved coordination, communication, and knowledge sharing. This can lead to advantages such as timely delivery of inputs, reduced lead times, better quality control, and cost optimization. These factors contribute to enhanced operational performance, including increased efficiency, productivity, and overall supply chain effectiveness. Contingency theory further supports the importance of understanding contextual factors that influence the relationship between supply chain integration and performance, with supplier integration being a crucial component in this relationship. It recognizes that the impact of supply chain integration on operational performance is contingent upon the fit between a firm's internal structure and its external environment. By considering the specific context of mining firms in Ghana and analyzing the influence of supplier integration on operational performance, a deeper understanding of the relationship can be gained (Sousa and Voss, 2008; Donaldson, 2001; Donkor et al., 2021; Yu et al., 2013; Flynn et al., 2010). Based on the theories of configuration and contingency, it can be hypothesized that supplier integration has a positive effect on the operational performance of mining firms in Ghana. By closely integrating suppliers into their supply chain activities and ensuring a good fit between internal structures and external environment, mining firms can achieve improved performance outcomes such as cost reduction, quality enhancement, and overall supply chain effectiveness.

Hypothesis 2: Supplier integration has a positive effect on the operational performance of mining firms in Ghana.

Internal Integration and Operational Performance

Configuration theory emphasizes the significance of internal integration within the supply chain for achieving improved performance outcomes. This theory suggests that mining firms in Ghana can enhance their operational performance by effectively integrating internal activities, relationships, functions, and processes (Cao et al., 2015; Drazin and Van de Ven, 1985; Sinha and Van de Ven, 2005; Flynn et al., 2010; Kaliani Sundram et al., 2016; Vereecke and Muylle, 2006; Liu et al., 2018; Wiengarten et al., 2019). Internal integration involves aligning and coordinating various departments and functions within a mining firm, including operations, procurement, finance, and human resources, to achieve a seamless flow of information, resources, and activities. By integrating these internal elements, mining firms can improve collaboration, decision-making, and overall efficiency. This leads to benefits such as streamlined processes, reduced redundancies, improved resource allocation, and enhanced communication. These factors contribute to enhanced operational performance, including increased productivity, cost-effectiveness, and overall organizational effectiveness. Dynamic capability theory further supports the importance of internal integration for achieving a competitive advantage. This theory emphasizes a firm's capacity to effectively integrate its internal resources to adapt to a changing environment and create value. By integrating internal resources through effective coordination and collaboration, mining firms can develop dynamic capabilities that enable them to respond to market demands, technological advancements, and competitive pressures. This leads to improved operational performance and the ability to achieve sustainable success in the mining industry (Beske et al., 2014; Helfat et al., 2007; Augier and Teece, 2009). Based on the theories of configuration and dynamic capability, it can be hypothesized that internal integration positively influences the operational performance of mining firms in Ghana. By effectively integrating internal activities, relationships, functions, and processes, mining firms can achieve improved performance outcomes such as increased productivity, cost-effectiveness, and overall organizational effectiveness. Furthermore, the development of dynamic capabilities through internal integration can provide mining firms with a competitive advantage and enable them to adapt to the changing environment of the mining industry.

Hypothesis 3: Internal integration positively influences the operational performance of mining firms in Ghana.

These hypotheses are supported by the theories of dynamic capability, contingency theory, configuration theory, and stakeholder theory, which provide insights into the relationship between supply chain integration and operational performance. Empirical evidence and previous research findings also suggest the positive influence of customer integration, supplier integration, and internal integration on operational performance in various industries (Tavakoli et al., 2012; Flynn et al., 2010; Turkulainen and Ketokivi, 2012; Zhao et al., 2013; Huang et al., 2014; Prajogo et al., 2015). These hypotheses form a basis for further investigation into the specific context of mining firms in Ghana and their operational performance in relation to supply chain integration.

Empirical Review

Supply chain integration (SCI) has emerged as an essential strategy for firms aiming to enhance operational performance across various industries (Alfalla-Luque et al., 2013; Munir et al., 2020; Yu, 2015). However, inconsistencies in findings related to SCI's impact on operational performance and the lack of industry-specific insights, particularly in the mining sector, call for a more nuanced investigation (Liu et al., 2018; Turkulainen and Ketokivi, 2012). This review will critically assess recent studies in the context of the mining industry in Ghana, aiming to provide a more comprehensive understanding of SCI's effect on operational performance. Several theoretical perspectives, such as the resource-based view and relational view, have been employed to understand the role of SCI (Ganbold et al., 2021; Yu et al., 2021). Studies highlight the importance of internal, customer, and supplier integration in enhancing operational performance (Pham et al., 2023; Hendijani et al., 2023). Despite widespread recognition of SCI's economic, social, and environmental significance, research focusing on the mining industry in Ghana and the transformation of resources through SCI for sustainable supply chains remains limited (Pagell and Shevchenko, 2014; Gimenez et al., 2012). Empirical research has revealed mixed findings regarding SCI's impact on operational performance. While some studies demonstrate a positive association between IT capabilities, integration, and performance (Ganbold et al., 2021; Yu et al., 2021), others suggest curvilinear or insignificant relationships (Tan et al., 2017; Huo et al., 2014). Specific research conducted by Pham et al. (2023) indicates that manufacturing and demand risks negatively impact operational performance, with internal and customer integrations playing a mitigating role. An emerging realization in the literature is that the success of SCI may be context-dependent (Wiengarten et al., 2019). The interplay of integration, flexibility, and coordination reveals dynamic capabilities in responding to environmental uncertainty (Rehman et al., 2023). However, studies often overlook contingency factors influencing the SCI and operational performance relationship, limiting generalizability (Gimenez et al., 2012). In particular, the influence of disruptive conditions, such as the COVID-19 pandemic, on SCI and firm performance has been recently addressed (Hendijani et al., 2023). There is a clear gap in understanding SCI's role in specific industry contexts, such as the mining industry in Ghana. The lack of consensus on how to measure innovation in supply chains and the direct impact of innovation on performance adds complexity (Iddris, 2016; Michalski et al., 2019). The absence of an analytical model that captures the interplay between SCI, operational performance, and exogenous control factors contributes to fragmented and inconsistent research outcomes (Flynn et al., 2010).

III. METHODS

The study utilized a quasi-non experimental design to investigate the influence of supply chain integration on the operational performance of 157 large and small mining firms in Ghana. To ensure the validity of the sample, the researchers obtained data from the Minerals Commission database to identify licensed mining firms in Ghana. The selection was further narrowed down to companies involved in gold, bauxite, and diamond mining and had a minimum of 10 years of operation. The study collected data from middle managers of supplier companies using an online survey administered through Google Forms, with a survey duration of 45 days. The questionnaire was developed based on the theoretical framework and hypotheses of the study. A thorough review of the existing literature and methodologies informed the choice of a 5-point Likert scale, following the approach used by Flynn et al. (2010) and Lu et al. (2018). Structural Equation Modeling (SEM) was selected as the methodology, which influenced the choice of a Likert scale. The questionnaire consisted of three main sections. The first section collected demographic information from the respondents, including age, position, qualification, experience, and gender. The second section focused on the three exogenous variables of the study: customer integration, supplier integration, and internal integration. The third section included questions related to the operational performance, the endogenous variable of the study. Reliability refers to the consistency with which a questionnaire measures the concept of interest (Saunders et al., 2007). Cronbach's alpha is commonly used in the literature to assess the reliability of data. Respondents were given the option to accept or decline participation in the survey on the online platform. The study aimed to examine the impact of three supply chain integration variables (customer integration, supplier integration, and internal integration) on operational performance using a hierarchical regression model, following the approach of Flynn et al. (2010) and Lu et al. (2018). The regression equation was specified as:

$$OP = \gamma_1 + \gamma_2 CI + \gamma_3 SI + \gamma_4 II + \varepsilon$$

In this equation, γ_1 represents the intercept term, and γ_2, γ_3, and γ_4 represent the coefficients of customer integration (CI), supplier integration (SI), and internal integration (II), respectively. ε represents the error term. The regression equation was analyzed using the structural part of Confirmatory Factor Analysis (CFA) and path analysis within the SEM framework. Contingency theory was the principal theoretical model tested in this study, following the research conducted by Flynn et al. (2010). The regression equation in the structural equation modeling represented a Generalized Method of Moments (GMM) regression analysis. A hierarchical regression analysis was employed to determine if it would improve the predictive power of the model. Principal Component Analysis (PCA) and factor analysis of the observed variables were performed in SPSS version 22 to validate the relevance of the observed variables in measuring the latent variables and to assess sampling adequacy using the Kaiser-Meyer-Olkin (KMO) test. The data cleaning process was conducted to ensure data quality. CFA and path analysis within the SEM framework were performed using Stata 16.

IV. Results

Demography Information

The table presents the demographic characteristics of the study participants. The demography is categorized based on the respondents' positions, gender, experience, age, and qualification. In terms of positions, the study collected data from top managers, middle-level managers, and junior managers. There were 40 respondents who held top managerial positions, accounting for 25.5% of the sample. Middle-level managers constituted the largest group with 72 respondents, representing 45.9% of the sample. Junior managers comprised 45 respondents, making up 28.7% of the sample. Regarding gender, the study captured information on male and female respondents. There were 75 male respondents, accounting for 47.8% of the sample, while 70 female respondents represented 44.6% of the sample. The participants' experience was categorized into different ranges. The study included respondents with 1-5 years of experience (24 respondents, 15.3% of the sample), 6-10 years of experience (39 respondents, 24.8% of the sample), and above 10 years of experience (46 respondents, 29.3% of the sample). There were also 48 respondents (30.6% of the sample) who did not specify their experience. The age of the respondents was divided into three ranges: 16-30 years, 31-45 years, and 46-60 years. There were 50 respondents in the 16-30 age group, representing 31.8% of the sample. The 31-45 age group had 60 respondents, accounting for 39.5% of the sample. The 46-60 age group consisted of 43 respondents, making up 27.4% of the sample. Qualification categories included basic education, secondary education, and tertiary education. The study had 3 respondents with basic education, representing 1.9% of the sample. There were 50 respondents with secondary education, accounting for 31.8% of the sample. The majority of the participants had tertiary education, with 104 respondents (66.2% of the sample) holding this qualification (see table 4.1).

Table 4.1: Demographic Information

		Number of Employees	Percentage of Respondents
Position	Top manager Middle Level Manager Junior Manager	40 72 45	25.5 45.9 28.7
Gender	Male Female	75 70	47.8 44.6
Experience	1-5 years 6-10years Above 10 years Not specified	24 39 46 48	15.3 24.8 29.3 30.6
Age	16-30 years 31-45 years 46-60 years	50 60 43	31.8 39.5 27.4
Qualification	Basic education Secondary education Tertiary education	3 50 104	1.9 31.8 66.2

Source (Extracts from SPSS, 2023)

Goodness of Fit Test Statistic for Haman's Single Factor Model

To assess non-response bias in the data set, a t-test was conducted comparing early responders to late responders. The results of the t-test indicated no significant non-response bias in the data set, which suggests that the respondents who responded early and those who responded later did not differ significantly in their responses (Flynn et al., 2010). To address common method bias (CMB), a confirmatory factor analysis (CFA) was performed on all 27 indicators as a single latent variable using Harman's single-factor model (Sanchez and Brock, 1996). The goodness-of-fit results from Harman's single-factor model showed $\chi 2$ (324) = 2557.706, Non-Normed Fit Index (NNFI) = 0.323, Comparative Fit Index (CFI) = 0.375, Root Mean Square Error Approximation (RMSEA) = 0.212, and Standard Root Mean Square Residual (SRMR) = 0.168, as indicated in table 4.2. However, according to Hu and Bentler (1999), a good-fitting model should have RMSEA < 0.06, NNFI > 0.95, CFI > 0.95, and SRMR < 0.08 for both categorical and continuous variables. Based on these criteria, it can be concluded that the single-factor model is unacceptable and significantly worse than the measurement model, indicating that common method bias (CMB) is not a significant issue in this study (See table 4.2).

Table 4.2: Goodness of Fit indices

Fit Statistic	Value
Likelihood ratio	
Chi2_ms(324)	2557.706
P> chi2	0.000
Chi2_bs(351)	3926.838
p>chi2	0.000
Population error	
RMSEA	0.212
90% CI, lower bound	0.000
Upper bound	
pclose	
Information criteria	
AIC	11450.383
BIC	11696.376

Baseline Comparison	
CFI	0.375
TLI	0.323
Size of Residuals	
SRMR	0.168
CD	0.942

Source: SEM result from Stata 16

Model Measurement Indicators

To assess the distribution of the data (see table 4.3 and 4.4), cumulative proportions of each variable were plotted against cumulative proportions of various test distributions. The data showed approximately normal distribution, which is in line with Flynn et al. (2010). The sample size of the study, which included 157 participants, was considered large enough for structural equation modeling using confirmatory factor analysis (CFA) and path diagrams. The sample size-to-variable ratio fell within the range of 5:1 to 20:1, and it exceeded the minimum threshold of 100 suggested by some researchers. Validity and reliability of the data were also tested. Cronbach's alpha values were computed to assess the scale reliability, and the values ranged from 0.882 to 0.9275, indicating good reliability as they exceeded the benchmark value of 0.7. The Kaiser-Meyer-Olkin (KMO) test of validity was used to assess the validity of the constructs. The KMO values ranged from 0.8820 to 0.9275, indicating that the constructs were valid as they exceeded the benchmark value of 0.5 according to Lu et al. (2018). Exploratory Factor Analysis (EFA) revealed strong factor loadings for each variable on the construct it was supposed to measure, indicating unidimensionality of the constructs. Convergence validity was examined through confirmatory factor analysis (CFA) using maximum likelihood approach. The factor loadings of each indicator were statistically significant ($p < 0.05$), ranging from 0.53 to 0.96, indicating the presence of convergence validity. Average variance extracted (AVE) was also computed, and all constructs had AVE values greater than 0.5, indicating strong convergent validity. Discriminant validity was assessed by comparing the AVE of each construct to ensure it exceeded 0.5, as recommended by Lu et al. (2018) and Farrell (2010). In our study, the AVE of each construct ranged from 0.56 to 0.7, confirming discriminant validity. Additionally, the square root of the AVE for each construct exceeded the correlation between any pair of constructs, providing further evidence of satisfactory discriminant validity (Flynn et al., 2010; Lu et al., 2018; Fornell and Larcker, 1981).

Table 4.3 : Correlation coefficients

	Customer Integration	Supplier Integration	Internal Integration	Operational Performance	Cronbach Alpha	KMO
Customer Integration	1.0000000				0.876	0.8930
Supplier Integration	0.6557398	1.0000000			0.851	0.8820
Internal Integration	0.3858019	0.4815659	1.0000000		0.744	0.9213
Operational Performance	0.3854913	0.2750105	0.5412248	1.0000000	0.927	0.9275
Mean	3.4667	3.5330	3.8670	3.9840		
Standard Deviation	0.8065	1.3310	1.3840	1.0538		

Variable	Mean	Standard Deviation	Factor Loading	AVE	Composite Reliability
Customer Integration	3.31	1.055		0.5656	0.8644
Customer1		1.009	0.6840***		
Customer2		0.917	0.7174***		
Customer3		0.920	0.9052***		
Customer4		0.938	0.898[illegible]***		
Customer5			0.7764***		
Supplier Integration	3.44	0.931		0.5045	0.8557
Supplier7		0.980	0.7045***		
Supplier8		0.925	0.9067***		
Supplier9		0.902	0.9052***		
Supplier10		0.926	0.8140***		
Supplier12			0.5124***		
Internal Integration	3.73	1.025		0.6293	0.8934
Internal16		1.042	0.8075***		
Internal17		1.040	0.8733***		
Internal18		1.033	0.9019***		
Internal20		1.173	0.8014***		
Internal21		1.012	0.7166***		
Internal22			0.7750***		
Operational Performance	3.72	1.208		0.7064	0.9228
Performance23		1.124	0.9090***		
Performance24		0.997	0.9696***		
Performance25		0.940	0.9319***		
Performance26		1.000	0.8254***		
Performance27			0.5727***		
Note *** indicates statistical significance at $p < 0.001$					

Source: SEM result from Stata 16

Table 4.4 Descriptive for Exogenous Observed Variables and their Factor Loadings

Source: SEM result from SPSS v22

According to table 4.5 The likelihood ratio chi-square (chi2) test compares the fit of the proposed model to two reference models: the saturated model and the baseline model. The chi2_ms value of 766.455 represents the chi-square difference between the proposed model and the saturated model, and the chi2_bs value of 3274.331 represents the chi-square difference between the proposed model and the baseline model. Lower p-values indicate a better fit, and in this case, the p-values are 0.000, suggesting that the proposed model fits significantly better than the saturated and baseline models. The root mean squared error of approximation (RMSEA) measures the discrepancy between the proposed model and the population covariance matrix. The RMSEA value of 0.0233 indicates a good fit, as it falls below the recommended threshold of 0.06. The 90% confidence interval (CI) provides a range of plausible values for the RMSEA, with the lower bound at 0.133 and the upper bound at 0.155. The Pclose value of 0.000 indicates that the probability of the RMSEA being less than or equal to 0.05 is essentially zero, further indicating a good fit. The Akaike's information criterion (AIC) and Bayesian information criterion (BIC) are used to compare models based on their goodness of fit and complexity. Lower AIC and BIC values indicate a better balance between model fit and parsimony. In this case, the AIC value is 6791.781, and the BIC value is 7001.331. The comparative fit index (CFI) and Tucker-Lewis index (TLI) compare the fit of the proposed model to the baseline model. Values closer to 1 indicate a better fit. Here, the CFI value is 0.910 and the TLI value is 0.962, suggesting a relatively good fit. The standardized root mean squared residual (SRMR) measures the average discrepancy between the observed and predicted covariances. A lower SRMR value indicates a better fit, and in this case, the SRMR is 0.050, indicating a reasonably good fit. The coefficient of determination (CD) value of 0.9850 indicates that the proposed model accounts for approximately 98.50% of the variance in the observed data. To assess multicollinearity, variance inflation factor (VIF) values were examined. VIF measures how much the variance of an estimated regression coefficient is increased due to multicollinearity. The results showed that all variables had VIF values below the threshold of 10, indicating the absence of significant multicollinearity among the variables.

Table 4.5: Goodness of fit Statistics for CFA

Fit statistic	Value	Description
Likelihood ratio		
chi2_ms(183)	766.455	model vs. saturated
p > chi2	0.000	
chi2_bs(210)	3274.331	baseline vs. saturated
p > chi2	0.000	
Population error		

RMSEA	0.0233	Root mean squared error of approximation
90% CI, lower bound	0.133	
upper bound	0.155	
Pclose	0.000	Probability RMSEA <= 0.05
Information criteria		
AIC	6791.781	Akaike's information criterion
BIC	7001.331	Bayesian information criterion
Baseline comparison		
CFI	0.910	Comparative fit index
TLI	0.962	Tucker-Lewis index
Size of residuals		
SRMR	0.050	Standardized root mean squared residual
CD	0.9850	Coefficient of determination

Source: SEM result from Stata 16

Contingency Analysis of Supply Chain Integration on Operational Performance from the Hierarchical Regression Result

The data in table 4.6 describes the regression models and results used to test the relationship between supply chain integration variables (customer integration, supplier integration, and internal integration) and operational performance. The study follows the approach outlined in Flynn et al. (2010) and employs a hierarchical regression model to examine the contingencies and interactions among these variables. Internal Integration is regressed directly on Operational Performance. The coefficient (β) of 0.3987 indicates that a one-unit increase in Internal Integration is associated with a 0.3987-unit increase in Operational Performance. The t statistic of 6.74*** shows that this relationship is statistically significant. The R2 value of 0.966 suggests that Internal Integration explains 96.6% of the variability in Operational Performance. The F statistic of 290.46*** indicates that the overall model is highly significant. Supplier Integration is regressed directly on Operational Performance. The coefficient (β) of 0.1723 indicates that a one-unit increase in Supplier Integration is associated with a 0.1723-unit increase in Operational Performance. The t statistic of 3.23** shows that this relationship is statistically significant. The R2 value of 0.967 suggests that Supplier Integration explains 96.7% of the variability in Operational Performance. The F statistic of 176.45*** indicates that the overall model is highly significant. Customer Integration is regressed directly on Operational Performance. The coefficient (β) of 0.2854 indicates that a one-unit increase in Customer Integration is associated with a 0.2854-unit increase in Operational Performance. The t statistic of 4.81*** shows that this relationship is statistically significant. The R2 value of 0.967 suggests that Customer Integration explains 96.7% of the variability in Operational Performance. The F statistic of 250.56*** indicates that the overall model is highly significant. Customer Integration and Supplier Integration are simultaneously regressed on Operational Performance. The coefficients (β) for Customer Integration and Supplier Integration are 0.2862 and 0.1773, respectively. These coefficients indicate the unique contribution of each variable in explaining Operational Performance. Both variables have statistically significant relationships with Operational Performance, as indicated by the t statistics of 4.76*** and 3.4**. The R2 value of 0.967 suggests that Customer Integration and Supplier Integration together explain 96.7% of the variability in Operational Performance. The F statistic of 952.91*** indicates that the overall model is highly significant. Supplier Integration, and Internal Integration are simultaneously regressed on Operational Performance. The coefficients (β) for Customer Integration, Supplier Integration, and Internal Integration are 0.2939, 0.1879, and 0.4135, respectively. These coefficients indicate the unique contribution of each variable in explaining Operational Performance. All variables have statistically significant relationships with Operational Performance, as indicated by the t statistics. The R2 value of 0.966 suggests that Customer Integration, Supplier Integration, and Internal Integration together explain 96.6% of the variability in Operational Performance. The F statistic of 1398.91*** indicates that the overall model is highly significant. In addition to the main effects, a three-way interaction term (IIxSIxCI) is included in the regression. The coefficients (β) indicate the unique contribution of each variable and the interaction term. All variables and the interaction term have statistically significant relationships with Operational Performance. The R2 value of 0.967 suggests that the combination of Customer Integration, Supplier Integration, Internal Integration, and the three-way interaction explains 96.7% of the variability in Operational Performance. The F statistic of 925.400*** indicates that the overall model is highly significant. The coefficients of determination (R2) for all models indicate a high level of explanatory power, with values ranging from 96% to 97%. This suggests that the exogenous variables (supply chain integration) explain a significant portion of the variability in the endogenous variable (operational performance).

V. DISCUSSIONS

Customer Integration on Operational Performance

The findings of the study indicate a significant positive impact of customer integration on operational performance in the mining firms in Ghana. The coefficient value of at least 0.28 suggests that an increase in customer integration leads to a corresponding increase in operational performance. This finding aligns with prior research that has demonstrated the positive relationship between customer integration and firm performance (Kumar et al., 2018; Anjum et al., 2016; Flynn et al., 2010). For example, Lu et al. (2018) found a positive relationship between customer integration and firm performance in the automotive manufacturing industry in China. The contingency theory and previous studies support the notion that customer integration plays a vital role in enhancing operational performance. By closely collaborating with customers and involving them in product development and design, firms can better understand customer needs and preferences. This leads to the creation of value and cost reduction in detecting changes in demand. The study's results confirm the positive impact of customer integration on operational performance, reinforcing the importance of integrating customer perspectives in the mining firms' operations (Lu et al., 2018; Mose, 2015). Furthermore, the findings align with the principles of dynamic capability theory, which emphasizes the importance of firms adapting to dynamic environments and effectively integrating internal and external resources through supply chain integration. By integrating with customers, mining firms can leverage external resources and insights to enhance their operational performance (Beske et al., 2014; Helfat et al., 2007; Augier and Teece, 2009). Stakeholder theory also supports the significance of collaboration and network relationships, highlighting the role of customer integration in improving operational performance. By considering customers as key stakeholders and fostering cooperation and mutual understanding, mining firms can enhance their communication, coordination, and problem-solving capabilities, ultimately leading to improved operational performance (Svensson et al., 2018; Moghaddam et al., 2018; Freeman, 1984; Prakash et al., 2020). The findings of the study provide empirical evidence for the positive influence of customer integration on the operational performance of mining firms in Ghana. The results support the theoretical frameworks of dynamic capability theory and stakeholder theory, emphasizing the importance of adapting to the changing environment, integrating resources, and establishing collaborative relationships with customers to enhance operational performance in the mining industry.

Supplier Integration on Operational Performance

The findings of the study demonstrate a significant positive relationship between supplier integration and operational performance in mining firms in Ghana. This aligns with the theoretical framework of contingency theory and previous research studies. Supplier integration, characterized by collaboration, strategic partnership, and information sharing with major suppliers, contributes to a smooth flow of supplies and inter-firm management of business processes (Mose, 2015; Wong et al., 2011). The coefficient value of at least 0.17 indicates that an increase in supplier integration leads to an improvement in operational performance. This finding is supported by the argument that strong supplier integration reduces product returns and facilitates the flow of information, resulting in enhanced operational performance (Mostert et al., 2017). The positive relationship between supplier integration and operational performance observed in this study is consistent with prior research, such as the study by Omoruyi and Dhurup (2016) that found a significant positive relationship between supplier integration and firm performance in South Africa. However, it contradicts the findings of Swink et al. (2007) and Flynn et al. (2010), who reported a negative or no significant relationship. The inconsistency in results may be attributed to differences in research methodologies, sample characteristics, or the inclusion of moderating factors. The study's direct and indirect effect analysis further confirms the direct relationship between supplier integration and operational performance, with no moderating effect. These findings reinforce the relevance of contingency theory in explaining the relationship between supplier integration and operational performance in mining firms in Ghana. Configuration theory supports the importance of well-integrated configurations within the supply chain, including supplier integration, for achieving superior performance. Supplier integration enables mining firms to establish collaborative relationships, share information, and work jointly with suppliers towards mutual success. By integrating suppliers into their supply chain operations, mining firms can benefit from improved coordination, communication, and knowledge sharing, leading to advantages such as timely delivery, quality control, and cost optimization. These factors contribute to enhanced operational performance (Cao et al., 2015; Drazin and Van de Ven, 1985; Sinha and Van de Ven, 2005; Flynn et al., 2010; Kaliani Sundram et al., 2016; Vereecke and Muylle, 2006; Liu et al., 2018; Wiengarten et al., 2019). Furthermore, contingency theory emphasizes the importance of considering contextual factors that influence the relationship between supply chain integration and performance. Supplier integration plays a crucial role in this relationship, as it contributes to the fit between a firm's internal structure and its external environment. By aligning supplier integration with the specific context of mining firms in Ghana, a better understanding of the relationship between supplier integration and operational performance can be achieved (Sousa and Voss, 2008; Donaldson, 2001; Donkor et al., 2021; Yu et al., 2013; Flynn et al., 2010). Based on the theories of configuration and contingency, it can be concluded that supplier integration has a positive influence on the operational performance of mining firms in Ghana. By effectively integrating suppliers into their supply chain activities and considering contextual factors, mining firms can achieve improved performance outcomes such as cost reduction, quality enhancement, and overall supply chain effectiveness.

Internal integration influence on Operational Performance

The findings of the study indicate a significant positive relationship between internal integration and operational performance in mining firms in Ghana. Internal integration, characterized by collaboration, communication, and cooperation among functional areas within an organization, plays a crucial role in enhancing operational performance (Lu *et al.*, 2018; Tarifa-Fernandez et al., 2017;; Mose, 2015; Flynn et al., 2010). The coefficient value of 0.398 signifies that an increase in internal integration processes within a firm lead to an improvement in operational performance. This positive relationship is expected as strong internal integration facilitates information sharing, teamwork, and a better understanding of customer needs, enabling firms to respond effectively to market changes (Lu et al., 2018). The findings of this study align with the predictions of contingency theory and prior research studies that have reported a positive relationship between internal integration and operational performance (Shou *et al.*, 2018; Mose, 2015; Flynn et al., 2010). While some studies, such as Koufteros et al. (2005), have suggested that the relationship between internal integration and operational performance may not be direct, the direct and indirect effect analysis conducted in this study reveals that internal integration has a direct significant impact on operational performance. This finding supports the notion that internal integration plays a crucial role in driving operational performance without the need for mediation through other variables. Configuration theory highlights the importance of internal integration within the supply chain for achieving improved performance outcomes in mining firms. By effectively integrating internal activities, relationships, functions, and processes, mining firms can streamline their operations, reduce redundancies, and improve resource allocation and communication. These factors contribute to enhanced operational performance, including increased productivity, cost-effectiveness, and overall organizational effectiveness (Cao et al., 2015; Drazin and Van de Ven, 1985; Sinha and Van de Ven, 2005; Flynn et al., 2010; Kaliani Sundram et al., 2016; Vereecke and Muylle, 2006; Liu et al., 2018; Wiengarten et al., 2019). Furthermore, dynamic capability theory emphasizes the importance of internal integration for developing dynamic capabilities that enable firms to adapt to a changing environment and create value. By effectively integrating internal resources and fostering coordination and collaboration, mining firms can enhance their ability to respond to market demands, technological advancements, and competitive pressures, leading to improved operational performance (Beske et al., 2014; Helfat et al., 2007; Augier and Teece, 2009). Based on the theories of configuration and dynamic capability, it can be concluded that internal integration positively influences the operational performance of mining firms in Ghana. By effectively integrating internal activities, relationships, functions, and processes, mining firms can achieve improved performance outcomes such as increased productivity, cost-effectiveness, and overall organizational effectiveness. Additionally, the development of dynamic capabilities through internal integration enables mining firms to adapt to the changing environment of the industry and gain a competitive advantage.

VI. CONCLUSIONS

The findings of the study provide empirical evidence for the influence of customer integration, supplier integration, and internal integration on the operational performance of mining firms in Ghana. Customer integration was found to have a significant positive impact on operational performance, highlighting the importance of integrating customer perspectives and collaboration in improving operational performance. Supplier integration was also found to have a significant positive relationship with operational performance, emphasizing the value of collaborative relationships with suppliers and effective supply chain management. Internal integration was found to positively impact operational performance, indicating the significance of internal coordination, communication, and cooperation within the organization. These findings are supported by the theoretical frameworks of contingency theory, configuration theory, and dynamic capability theory. The contingency theory suggests that the relationship between integration and performance is contingent upon the fit between internal and external factors. Configuration theory highlights the importance of well-integrated configurations within the supply chain, while dynamic capability theory emphasizes the role of integration in developing dynamic capabilities for adaptation and value creation. The results of this study contribute to the existing body of knowledge on supply chain management and operational performance in the mining industry. The findings reinforce the importance of integrating external and internal stakeholders, including customers and suppliers, in enhancing operational performance. The implications of these findings suggest that mining firms in Ghana can improve their operational performance by strengthening customer integration, supplier integration, and internal integration processes. However, it is important to acknowledge the limitations of this study.

VII. RECOMMENDATIONS

Based on the findings regarding the influence of customer integration, supplier integration, and internal integration on operational performance in mining firms in Ghana, the following recommendations can be made:

- Mining firms should focus on enhancing customer integration by actively involving customers in product development and design processes. This can be achieved through regular communication, collaboration, and information sharing with customers. By understanding customer needs and preferences, firms can better tailor their operations to meet customer demands and improve operational performance.
- Mining firms should establish strong collaborative relationships with their suppliers and promote supplier integration. This involves strategic partnerships, information sharing, and joint product development initiatives. By improving coordination and communication with suppliers, mining firms can enhance the flow of supplies and streamline their supply chain processes, leading to improved operational performance.
- Firms in the mining sector should prioritize internal integration by promoting collaboration, communication, and cooperation among different functional areas within the organization. This can be achieved through cross-functional teams, shared information systems, and interdepartmental coordination. By aligning internal processes and improving intra-firm relationships, mining firms can enhance operational performance and responsiveness to market changes.
- The mining industry should recognize the importance of developing dynamic capabilities through integration efforts. Dynamic capabilities refer to a firm's ability to adapt and respond to changing market conditions. By integrating internal and external resources effectively, mining firms can develop the agility and flexibility needed to navigate the dynamic mining industry. This can be achieved through continuous learning, innovation, and resource reconfiguration.
- Mining firms should consider the specific context in which they operate when implementing integration strategies. Factors such as organizational culture, industry dynamics, and regulatory environments should be taken into account. By aligning integration efforts with the unique characteristics of the mining industry in Ghana, firms can maximize the impact of integration on operational performance.

VIII. IMPLICATIONS TO THEORY AND PRACTICE

The study contributes to contingency theory by providing empirical evidence of the positive relationships between customer integration, supplier integration, and internal integration with operational performance in the context of mining firms in Ghana. This reinforces the theoretical foundation of contingency theory and its applicability to the mining industry. The findings support the principles of dynamic capability theory by highlighting the importance of integrating internal and external resources to enhance operational performance. This expands the understanding of how dynamic capabilities can be developed through integration efforts in the mining sector. The study aligns with stakeholder theory by emphasizing the significance of collaboration and network relationships, particularly with customers and suppliers, in improving operational performance. This underscores the importance of considering stakeholders as key contributors to the success of mining firms.

The findings highlight the importance of actively involving customers in product development and design processes. Mining firms in Ghana can benefit from closer collaboration, information sharing, and understanding customer needs to tailor their operations accordingly. This can lead to improved customer satisfaction, increased value creation, and cost reduction. Mining firms should focus on establishing strong collaborative relationships with their suppliers and promoting supplier integration. This can lead to a smooth flow of supplies, reduced product returns, and improved information sharing, ultimately enhancing operational performance. Enhancing internal integration through improved collaboration, communication, and cooperation among functional areas within mining firms can improve operational performance. This can be achieved through the implementation of cross-functional teams, shared information systems, and interdepartmental coordination.

The study's findings have implications for community development in mining areas in Ghana. By improving operational performance through customer integration, supplier integration, and internal integration, mining firms can create a positive impact on the local communities. Strengthening customer integration can lead to the development of products and services that better meet the needs and preferences of the local community. This can result in increased employment opportunities, economic growth, and improved livelihoods for community members. Supplier integration can contribute to the development of local supply chains and the involvement of local businesses in the mining industry. This can promote entrepreneurship, capacity building, and economic diversification in the community. Enhancing internal integration can lead to improved organizational efficiency and effectiveness, which can positively impact the management of social and environmental responsibilities. Mining firms can integrate sustainability practices and community engagement initiatives more effectively, leading to more sustainable community development.

IX. LIMITATION OF THE STUDY

The findings of this study are specific to mining firms in Ghana, and caution should be exercised when generalizing the results to other industries or geographical contexts. The unique characteristics of the mining industry in Ghana may influence the relationships between integration and operational performance differently in other settings. Also, the study's findings are based on a specific sample size and selection criteria. The sample may not fully represent all mining firms in Ghana, limiting the generalizability of the results. Future studies could include a larger and more diverse sample to enhance the external validity of the findings. The study adopts a cross-sectional design, capturing a snapshot of the relationships between integration and operational performance at a specific point in time. Longitudinal studies or experimental designs could provide a better understanding of the causal relationships and temporal dynamics between integration and operational performance. The study focuses on the direct relationships between integration and operational performance, neglecting potential mediating and moderating variables that could influence the relationships. Future studies could explore the mediating mechanisms and identify moderating factors that may influence the strength and direction of the relationships.

Future studies could conduct comparative studies across different industries and countries to examine how the relationships between integration and operational performance vary in diverse contexts. This would help identify industry-specific factors and country-specific characteristics that may impact the relationships. Also future studies could investigate the relationship between integration and sustainability performance, as well as the social impact of integration practices in mining firms. Examine how integration efforts can contribute to sustainable development, community well-being, and environmental stewardship in mining areas.

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