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BOARD CHARACTERISTICS AND OPERATIONAL EFFICIENCY OF WATER AND SANITATION COMPANIES IN MOUNT KENYA REGION

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Abstract
Board characteristics have become a significant area of scholarly inquiry in both developing and developed economies, as they reflect the relationship between directors and stakeholders. This study aimed to examine the relationship between board characteristics and the operational efficiency of water and sanitation companies in the Mount Kenya Region. Specifically, it assessed the effects of board size, board diversity, board competence, and board meeting frequency on operational efficiency. The study was grounded in agency theory, stewardship theory, stakeholder theory, and transaction cost theory, and adopted a quantitative research design. A census approach was used, covering all 21 water and sanitation companies in the region. Secondary data were collected from financial statements for the period 2019–2024. Panel data regression analysis was employed to evaluate the relationships between variables. The findings revealed that all board characteristics examined have a positive and statistically significant effect on operational efficiency. Board size showed the strongest influence (β = 0.350), followed by board meeting frequency (β = 0.299), board diversity (β = 0.283), and board competence (β = 0.180). The study concludes that board characteristics play a crucial role in enhancing organizational efficiency. It recommends that organizations prioritize appropriate board composition by improving member qualifications, optimizing board size, promoting diversity, and ensuring regular meetings. These measures are essential for strengthening governance and improving operational performance in water and sanitation companies.

Keywords: Board Characteristics, Board Size, Board Diversity, Operational Efficiency, Corporate Governance

1. Introduction

Board characteristics have emerged as a dominant theme in corporate governance scholarship across both developing and developed economies, serving as a critical linkage between directors and stakeholders in shaping institutional oversight on behalf of shareholders (Oduor, 2019). The major components of board characteristics include board size, board diversity, board competence, and board frequency of meetings (Akhtar, 2020). Board size, defined as the total number of directors serving on a company's board, has drawn significant scholarly attention following major corporate failures such as Enron, WorldCom, and Parmalat (Khan et al., 2022). Board diversity refers to the composition of a company's board encompassing varying backgrounds, experiences, skills, and perspectives (Obaje & Abdullahi, 2021), while board competence reflects the capability of the committee responsible for overseeing financial reporting processes (Budiarto, 2021). Board frequency of meeting denotes how often the board convenes within a specified period (Biru, 2021). Despite growing regional willingness to broaden women's presence on boards, their representation remains minimal, with firms in South Africa,

Egypt, Nigeria, Angola, and Morocco achieving only 10 percent women on boards (Khan et al., 2022). Among East African countries, female-led firms are generally smaller in size and exhibit lower risk profiles compared to male-led firms (Lotto, 2019).

Operational efficiency, defined as an organization's ability to reduce operating costs while executing daily functions to achieve set goals (Akhtar, 2020), represents a critical performance metric. The term also refers to management's capacity to maximize output from organizational resources by minimizing waste and optimizing human resource utilization to deliver high-standard goods and services (Kajola, Alao, Sanyaolu & Ojurongbe, 2019). Operational efficiency is achieved through competent human resources, adequate technology, and superior quality provision to clients (Alali, 2019). Indicators such as cost of revenue ratio, asset quality, and firm liquidity are commonly used to assess operational efficiency, ensuring a firm's ability to withstand adverse market conditions (Salina, Zhang & Hassan, 2020). However, while all firms value operational efficiency, few excel at designing, communicating, and managing performance-improvement initiatives, and significant barriers persist even among top performers (Biru, 2021; Budiarto, 2021).

The interrelationship between board characteristics and operational efficiency has been extensively debated in financial literature, though empirical evidence remains mixed (Zhai et al., 2019). Strong board characteristics can control and direct top management toward efficient, effective, and sound operations, thereby improving financial performance, as the board establishes responsibilities and authority levels through which corporate transactions and affairs are conducted (Canyurt & Yüksel, 2020). Empirical evidence confirms that strong board characteristics serve as essential corporate governance mechanisms fulfilling two critical functions: overseeing top management on behalf of shareholders, and providing business resources and evaluation (Kimutai et al., 2019). This linkage is particularly crucial in the Kenyan corporate sector, where multiple firms have collapsed due to fictitious transactions and fraud, eroding investor confidence (Kirimi et al., 2021). The 2002 Water Act introduced reforms in Kenya's water sector, creating regional water boards responsible for overseeing water and sewerage utilities and asset development (Nguyen, 2020). These reforms led to the establishment of 21 Water and Sanitation Companies in Mount Kenya Region, including Nanyuki Water and Sanitation Company, Nyeri Water and Sanitation Company, Mathira Water and Sanitation Company, Meru Water Sanitation Company, Embu Water and Sanitation, Kirinyaga Water and Sanitation Company, and Tetu Aberdare Water and Sanitation Company, among others. Their mandate is to provide clean water and sanitation services in a financially sustainable manner within government regulations (Munge, 2020).

The urgency of this research is underscored by Kenya National Bureau of Statistics reports highlighting a progressive deterioration in operational efficiency among water and sanitation companies in Mount Kenya Region. For example, these firms saw their operational efficiency decrease from 4.5% in 2022 to 3.9% in 2023, and further to 3.3% (KNBS, 2024). A systematic review of existing literature reveals several gaps that justify this research. A contextual gap exists because prior studies on board characteristics and operational efficiency have not been conducted specifically within water and sanitation companies in Mount Kenya Region. A conceptual gap is evident as none of the reviewed studies comprehensively examined the influence of board size, board diversity, board competence, and board frequency of meetings on operational efficiency within this specific context. A methodological gap persists in terms of data type, research design, and sampling techniques employed in previous studies. Furthermore, a geographical gap

is apparent since most related studies were conducted outside Kenya (Ali et al., 2020; Canyurt & Yüksel, 2020; Zhai et al., 2019).

2. Theoretical Background

2.1 Theoretical Framework

The theoretical framework is a structure that holds and supports the theoretical foundation of a research work, as good research should be grounded in theory (Defee, 2010). A theory is a coherent group of tested propositions commonly regarded as correct that can be used as principles of explanation and prediction for a class of phenomena (Kothari, 2004). This study is anchored on four theoretical perspectives that explain the relationship between board characteristics and organizational outcomes: agency theory, stewardship theory, stakeholder theory, and transaction cost theory.

2.1.1 Agency Theory

Agency theory, developed by Michael Jensen and William Meckling (1976), has been fruitfully applied in examining the relationship in a firm that exists between the principal (shareholder) and the agent (manager) (Denise, 2001). Agency theorists argue that to protect the principal's interest, the board of directors must assume an effective oversight function, and this should determine the size of the board (Brennan, 2010). The principal-agent relationship provides benefits by allowing specialization between shareholders as risk bearers and management in the firm's operation. The theory is based on assumptions of goal incongruence between the principal and the agent, focusing on relationships masked by the basic structure of principals and agents who are engaged in cooperative effort but have differing goals and differing attitudes toward risk. When an agent pursues risky projects that may lead to increased asset value, such a move threatens the agent's job security. It is usually assumed that the principal's interest is to maximize wealth (Denise, 2001), while the agent is interested in career goals, large salary, corporate jets, plush offices, and expense account meals. Given this conflict of interests, the agent, if left alone, will pursue his own interests to the detriment of the principal's. Therefore, monitoring solutions by shareholders, especially major ones, constitute an important mechanism for encouraging managers not to deviate from shareholder interests. In the context of this study, agency theory suggests that board characteristics such as board size, diversity, competence, and meeting frequency serve as monitoring mechanisms to ensure that management acts in shareholders' interests, thereby improving operational efficiency.

2.1.2 Stewardship Theory

Stewardship theory, traceable to psychology and sociology, offers an alternative perspective to agency theory. According to Davis, Schoorman, and Donaldson (1997), "a steward protects and maximizes shareholders wealth through firm performance, because by so doing, the steward's utility functions are maximized." Stewardship theory is a special case of accountability concerning the provision of financial statements to shareholders on the use made of their money, and whether the stewards properly managed the organization's assets and liabilities (Gray, Owen & Adams, 2009; Kribat et al., 2013). In this regard, stewards are company managers and those charged with governance who protect and maximize the wealth of the owners. Unlike agency theory, stewardship theory stresses not the perspective of individualism (Donaldson & Davis, 1991), but rather the role of top management as stewards integrating their goals as part of the organization. Stewardship theorists assume that managers are trustworthy and work diligently to attain

high corporate profit and shareholders' returns (Donaldson & Davis, 1994). Under stewardship theory, the board of directors plays an important function, especially in the relationship between the chairperson and the CEO (Tricker, 1984). Owner interests will be safeguarded properly where the board chair is not influenced by the CEO and where the CEO has the same interests as the owners through an appropriately designed incentive compensation scheme (Donaldson & Davis, 1991). In relation to this study, stewardship theory implies that boards with appropriate characteristics will act as responsible stewards, voluntarily working toward improved operational efficiency of water and sanitation companies.

2.1.3 Stakeholder Theory

Stakeholder theory, advanced by Freeman (1984), posits that organizations are accountable to owners as well as other stakeholders. Therefore, the contrasting interests of various stakeholders must be considered, as depending on varying stakeholder interests, this can affect an organization's ability to achieve its goals (Freeman, 1984). According to Boatright (2003), organizations operate for the benefit of various interested parties, including owners, employees, customers, regulators, creditors, and other stakeholders relevant to the organization. Owners have committed their capital, employees have invested their time and intellectual capital, customers have invested their trust, and communities expect infrastructure, environmental conservation, and education (Graves, Waddock & Kelly, 2001). Stakeholder theory holds that business organizations should play an active role in the communities and societies in which they operate (Omran & Ramdhony, 2015) and highlights the importance of all parties affected directly or indirectly by the organization's activities (Wearing, 2005). The ethical facet of stakeholder theory provides that all stakeholders have a right to know about an organization's affairs at all times, achieved through necessary disclosures (Deegan, 2013). For this study, stakeholder theory suggests that effective board characteristics enable water and sanitation companies to balance the interests of diverse stakeholders, including government regulators, customers, employees, and local communities, which in turn enhances operational efficiency.

2.1.4 Transaction Cost Theory

Transaction cost theory, based on the work of Cyert and March (1963), broadly states that the way a company is organized or governed determines its control over transactions. Companies will try to keep as many transactions in-house as possible to reduce uncertainties about dealing with suppliers, purchase prices, and quality. To achieve this, companies will seek vertical integration by purchasing suppliers or producers later in the production process. The theory also states that managers are opportunistic, organizing their transactions to pursue their own convenience and tending to entrench themselves. In the context of water and sanitation companies, transaction cost theory implies that board characteristics influence decisions about vertical integration, outsourcing, and internal control mechanisms, all of which affect operational efficiency.

2.2 Conceptual Framework

The conceptual framework presents a diagrammatic representation of variables showing the relationship between independent variables and the dependent variable (Waiganjo, 2013). In this study, the dependent variable is operational efficiency, while

the independent variables are board size, board diversity, board competence, and board frequency of meetings.

2.3 Empirical Review and Hypothesis Development

2.3.1 Board Size and Operational Efficiency

Board size refers to the total number of directors serving on a company's board and has been a subject of significant research regarding its relationship with firm performance, fueled by prominent business failures such as Enron, WorldCom, and Parmalat (Morten et al., 2006). It is argued that within a certain range, a larger board is more effective in its statutory duties of monitoring management (Sanda et al., 2011). While no one-size-fits-all recommendation exists for optimal board size, a board size of eight to ten directors is often recommended (Yermack, 1996; Sanda, 2005).

Bebeji, Mohammed, and Tanko (2015) surveyed five listed Nigerian commercial banks over nine years (2007-2015), examining how board size and composition influenced financial performance proxied by return on assets (ROA) and return on equity (ROE). Using secondary data from annual reports analyzed through multivariate regression, the study found that board size had a negative but significant influence on both ROA and ROE, meaning that an increase in board size resulted in reduced financial performance. Mohamed and Atheru (2017) studied the effect of board characteristics on financial performance of a mobile service provider in Kenya, collecting primary data from 96 middle and top-level managers. The study concluded that board size had a negative but significant influence on financial performance. Mbalwa, Kombo, Chepkoech, Koech, and Shavulimo (2014) examined how board characteristics influenced performance of sugar manufacturing firms in Kenya, covering nine firms using correlational survey design. In contrast to the previous studies, they found that board size positively influenced financial performance of the sugar industry. These mixed findings suggest that the relationship between board size and performance may be context-dependent, varying by industry, economic environment, and governance framework. Based on the theoretical and empirical review, the following hypothesis is formulated:

H1: There is no significant effect of board size on operational efficiency of water and sanitation companies in Mount Kenya Region.

2.3.2 Board Diversity and Operational Efficiency

Gender diversity is considered in terms of gender diversity index, gender composition of executive positions, and gender representation in board leadership positions. This study uses the proportion of gender represented on the board as the proxy for measuring gender diversity (DiTomaso & Post, 2007; Harrison & Klein, 2007). Most modern firms have acknowledged the significance of gender diversity in the workforce and its influence on upper management; however, only a few women are integrated into top management (European Commission, 2010). Increased performance within women-led boards indicates creativity and innovation endowed in women (Lai, Srinidhi, Gul & Tsui, 2017). Unlike homogenous boards, diverse boards tend to generate more alternative solutions during decision-making, increasing corporate performance (Terjesen, Couto & Francisco, 2016). Companies managed by gender-balanced boards tend to pay more attention to controlling and managing risks (European Commission, 2012). Heterogeneity brings diversity in gender, ethnicity, and cultural differences among directors, promoting more effective decision-making than homogenous boardrooms (Al-Shaer & Zaman, 2016; Carter et al., 2010).

Akpan and Amran (2014) examined board characteristics of 90 listed firms at the Nigerian Stock Exchange, revealing that women on the board had a negative but significant relationship with firm revenues, noting that appointment of women directors was often public relations as their proportion was negligible to create meaningful impact. They recommended enhancing women's proportion on boards to between 30 and 35 percent. Ntim (2015) examined board characteristics of 169 listed firms on the Johannesburg Stock Exchange over five years (2002-2007), finding that board diversity had a positive and significant influence on firm valuation, with more emphasis on ethnicity than gender diversity. Abu, Okpeh, and Okpe (2016) evaluated board characteristics of Nigerian listed banks over ten years (2005-2014) and found that board gender diversity had no influence on Nigerian bank performance. These divergent findings indicate that the effect of board diversity on operational efficiency may depend on regulatory environment, industry characteristics, and the proportion of diverse members relative to critical mass. Based on this review, the following hypothesis is formulated:

H2: There is no significant effect of board diversity on operational efficiency of water and sanitation companies in Mount Kenya Region.

2.3.3 Board Competence and Operational Efficiency

Competency development should begin from analysis of environmental dynamics and core competencies, continuing to identifying resource profiles and ending with identification of necessary competencies for specific functions (Suutari, 2010). Leadership competencies are observed when a person demonstrates self-awareness, self-management, social awareness, and social skills at appropriate times and ways in sufficient frequency to be effective. Emotional intelligence represents a major component of global leadership competency, with personal attributes underpinning how and when knowledge and skills will be used (Cannavaciulo et al., 2003).

Nawafly and Alarussi (2018) examined the relationship between corporate governance components and financial performance of 150 non-financial firms listed in Malaysia, finding that audit committee expertise, independence, and size were all significantly and positively associated with financial performance. Agwor and Onukogu (2018) examined the effect of financial expertise of the audit committee on earnings management of 15 listed food and beverage manufacturing companies in Nigeria over eleven years (2006-2016), revealing a statistically significant negative association between audit committee expertise and earnings management, concluding that audit committee expertise can reduce financial statement misreporting. Oroud (2019) investigated the effect of audit committee characteristics on profitability of 51 industrial companies in Jordan over five years (2013-2017), finding that audit committee expertise had no significant relationship with profitability. Chaudhry et al. (2020) analyzed the influence of financial expertise of the audit committee chairperson on financial performance of 50 non-financial firms listed on the Pakistan Stock Exchange, providing further evidence of the importance of competence in governance roles. The mixed evidence suggests that while competence generally enhances governance effectiveness, its impact may be moderated by contextual factors such as regulatory enforcement, organizational culture, and the specific measures used to assess competence. Based on this review, the following hypothesis is formulated:

H3: There is no significant effect of board competence on operational efficiency of water and sanitation companies in Mount Kenya Region.

2.3.4 Board Frequency of Meetings and Operational Efficiency

Gambo, Bello, and Rimamshung (2018) examined board characteristics of ten listed firms in the Nigerian consumer goods sector over ten years (2006-2015), finding that board frequency of meetings had no influence on ROA. Gómez, Cortês, and Betancourt (2017) evaluated board characteristics of ninety Colombian companies over seven years (2008-2014), finding that board frequency of meetings had no linear relationship with financial performance, though an increase in board meetings indicated commitment to improved performance. Al-Daoud, Saidin, and Abidin (2016) evaluated board meetings of 118 listed firms on the Aman Stock Exchange over five years (2009-2013), finding that board meetings had a positive and significant influence on firm performance. The study supported agency theory predictions that more meetings facilitate greater board monitoring, as directors have more interactions with management and valuable discussions leading to enhanced firm performance. The study noted that some firms had only four meetings per year, well below the Jordanian Stock Exchange minimum recommendation of six meetings annually. These findings indicate that while meeting frequency alone may not guarantee effectiveness, the quality of interactions and adherence to regulatory minimums can influence operational outcomes. Based on this review, the following hypothesis is formulated:

$H_0 4$: There is no significant effect of board frequency of meetings on operational efficiency of water and sanitation companies in Mount Kenya Region.

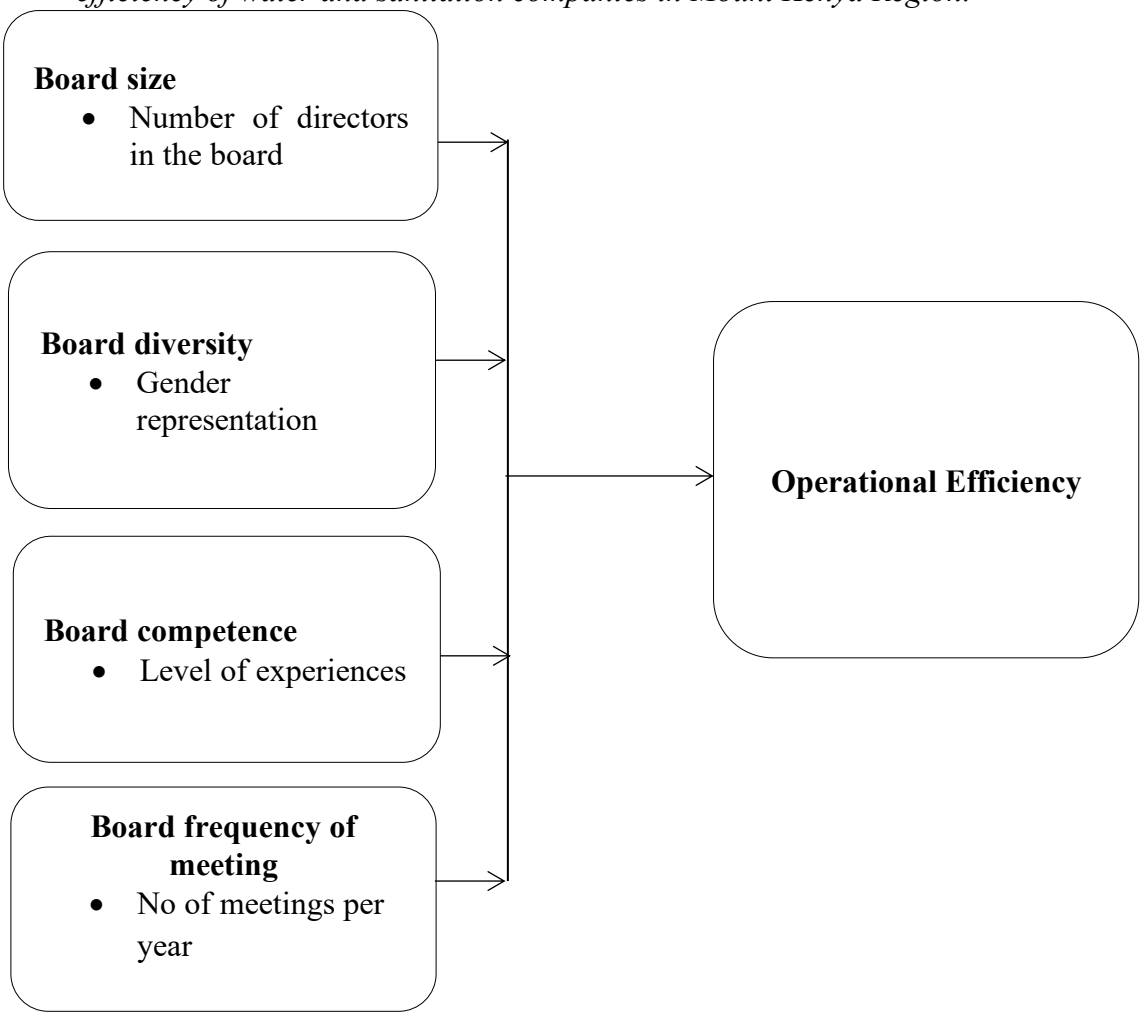

Figure 1. Conceptual Framework

3. Methods

3.1 Research Design

Burns and Grove (2003) defined a research design as a blueprint for conducting a study with maximum control over factors that may interfere with the validity of the findings. Parahoo (1997) described research design as a plan that describes how, when, and where data is to be collected and analyzed. This study adopted a quantitative research design. Creswell (2003) observed that the aim of quantitative research design is to give explanations of quantitative results, and due to the nature of the present study, this design was the most suitable. The study focused more on the quantity of responses as opposed to gaining the more focused or emotional insight that is the aim of qualitative research. Quantitative research was used to quantify the problem by way of generating numerical data or data that can be transformed into usable statistics.

3.2 Population and Sample

A population is the aggregate of all cases that conform to some designated set of specifications (Ngechu, 2019). The population of this study comprised all 21 water and sanitation companies in Mount Kenya Region (WASREB, 2023/2024 impact report). A sampling frame is a set of source materials from which the sample is selected (Bennett, 1993), and Coopers and Schindler (2008) defined sampling frame as a demonstration of the population of the research interest. Thus, the sample is derived from the sampling frame. This study made use of all 21 water and sanitation companies in Mount Kenya Region, hence a census. Research conclusions and generalizations are only as good as the sample they are based on (Kombo & Tromp, 2011). This study used census sampling since the population also constituted the sample, that is, the 21 water and sanitation companies in Mount Kenya Region. The data was authentic since it was secondary data collected by credible agents and published by the Republic of Kenya.

3.3 Data Collection Techniques

The researcher used secondary data in empirical analysis. Kothari (2004) explains that secondary data means data that are already available. Secondary data may either be published or unpublished. Usually, published data are available in public records and statistics, historical documents, and other sources of published information, including technical trade journals. Unpublished data may be found in diaries, letters, unpublished biographies, and autobiographies, among other sources. The study extracted and utilized secondary data from the websites, annual reports, and other audited financial reports of water and sanitation companies. Data is a presentation of facts, concepts, or instructions in a formalized manner suitable for communication, interpretation, or processing by humans or by automatic means (Hicks, 1993). Data is raw material that is transformed into information by data processing (Davis et al., 1985). The period of the study ranged from 2019 to 2024, and the study used financial statements of all 21 water and sanitation companies in Mount Kenya Region.

3.4 Operational Definition of Research Variables

Operationalization of variables is a system that helps in working up associations that exist between variables and showing how such associations can be measured. In this study, the dependent variable is operational efficiency, measured by the ratio of cost of goods sold to total revenue. The independent variables consist of four board characteristics. Board size is measured by the number of directors on the board. Board

diversity is measured by the ratio of women directors to the total number of directors. Board competence is measured by the number of years of experience. Board frequency of meetings is measured by the number of meetings per year.

3.5 Data Analysis Techniques

Kothari (2004) argues that data processing implies editing, coding, classification, and tabulation of collected data so that they are amenable to analysis. The term analysis refers to the computation of certain measures along with searching for patterns of relationship that exist among data groups. Kombo and Tromp (2011) note that data analysis refers to examining what has been collected in a survey or experiment and making deductions and inferences. The data analytical technique used was quantitative in nature, including correlation analysis and panel data regression modeling. The data was analyzed with the help of Stata econometric software. The data analytical techniques used included the test of unit roots for all time series variables, test of multicollinearity using pair-wise correlation matrix, and multiple regression analysis.

This research used a panel data regression model to analyze data. The choice of the model was determined by the fact that this model is used to predict the value of one variable depending on the value of other variables in different periods. The model was specified as follows:

$$Yit = \beta_0 + \beta_1 X_1 it + \beta_2 X_2 it + \beta_3 X_3 it + \beta_4 X_4 it + \varepsilon it$$

Where:
Yit = Operational efficiency
X_1 = Board size
X_2 = Board diversity
X_3 = Board competence
X_4 = Board frequency of meetings
β_0 = Intercept
β_1, β_2, β_3, β_4 = Coefficients of determination
ε = Error term
t = Time period

Several diagnostic tests were conducted to ensure the robustness of the analysis. Multicollinearity was tested using tolerance and variance inflation factor (VIF), where a tolerance value close to 1 indicates little multicollinearity while a value close to 0 suggests multicollinearity is present, and a VIF of around or greater than 5 indicates multicollinearity associated with that variable (Siedlecki, 2020). Autocorrelation was tested because it is a common problem in time series models where error terms in different time periods are correlated (Ajay, 2010; Oribhabor & Anyanwu, 2019). Homoscedasticity was tested using Lagrange Multipliers (LM) at 95% confidence interval, where data is assumed to have a homoscedastic random error term if LM values are higher than 0.05 (Siedlecki, 2020). Normality was assessed both visually through normal probability-probability plots (NPP plots) and through normality tests, as recommended by Ghasemi and Zahediasl (2012). Finally, the Hausman specification test was used to decide between fixed effects and random effects models in the panel data analysis (Baltagi, 2005; Hausman, 1978).

4. Results and Discussion

4.1 Results

4.1.1 Descriptive Analysis Results

Table 4.1 presents the descriptive statistics of all six variables used in this study: operational efficiency (dependent variable); board size, board diversity, board competence, and board frequency of meetings (explanatory variables); and firm size (moderating variable). The analysis involved 21 water and sanitation companies in Mount Kenya Region for the years 2019 to 2024, yielding 126 observations.

Table 1. Panel Variables Descriptive Statistics

Descriptive Statistic	OE	BS	BD	BC	BFM	FS
Mean	0.3032	8.4750	0.2036	0.0666	6.3750	5.1863
Median	0.2955	8.0000	0.2000	0.0429	5.0000	5.2632
Maximum	0.5062	9.0000	0.3636	0.2913	20.0000	6.3201
Minimum	0.1637	7.0000	0.0833	0.0001	4.0000	4.0110
Std. Dev	0.0701	1.3592	0.0777	0.0683	3.1638	0.5304
Observations	126	126	126	126	126	126

Source: Processed data (2024)

Table 4.1 shows that operational efficiency of water and sanitation companies ranged from a minimum of 16.37 percent to a maximum of 50.62 percent, with a mean of 30.32 percent. The standard deviation of 7.01 percent indicates moderate variation around the mean. Board diversity results revealed that water and sanitation companies had an average of one woman director for every five directors. The maximum ratio was one woman in every three directors, while the minimum was one woman in every twelve directors, indicating that all companies in the study had at least one female director on their boards. Board size had a mean of eight directors, ranging from a minimum of seven to a maximum of nine directors, with a standard deviation of one. Board competence had an average of 6.66 percent, ranging from 0.01 percent to 29.13 percent. Board frequency of meetings averaged six sessions per year, with a maximum of twenty meetings and a minimum of four meetings.

4.1.2 Diagnostic Tests

Autocorrelation Test. To determine whether the errors of the models used in the analysis were not correlated, the Durbin-Watson test was conducted. The Durbin-Watson statistic ranges between 0 and 4, where a value of 2 indicates complete absence of serial correlation. Following Field's (2009) recommendation that values greater than 1 but less than 3 indicate no serial correlation in error terms, Table 4.2 shows a DW statistic of 1.7936547. Since this value falls between 1 and 3, it is concluded that there is no autocorrelation in the data.

Table 2. Durbin-Watson Test for Autocorrelation

Model	DW Statistic
1	1.7936547

Source: Processed data (2024)

Multicollinearity Test. This study utilized variance inflation factors (VIF) and tolerance indices (TI) to examine individual predictor variables for contributions to multicollinearity. The general rule of thumb is that VIF exceeding 4 requires investigation, while VIF above 10 indicates serious multicollinearity (Chatterjee & Simonoff, 2013). Table 4.3 shows that VIF for all predictor variables is well below 4, and

corresponding tolerance indices are all above 0.1. This indicates that the dataset has no multicollinearity problem.

Table 3. Variance Inflation Factors Table

Variable	Tolerance Index	VIF
Board size	0.387	2.582
Board diversity	0.701	1.427
Board competence	0.950	1.053
Board frequency of meeting	0.730	1.370

Source: Processed data (2024)

Heteroscedasticity Test. The detection of heteroscedasticity involved a formal test to quantify its severity. If the p-value corresponding to the Chi-Square test is less than 0.05, heteroscedasticity is present. Table 4.4 indicates a p-value of 0.0530 exceeding 0.05. Therefore, it is concluded that there is no heteroscedasticity in the data.

Table 4. Test of Heteroscedasticity

Model	Chi-Square	p-value
1	4.10	0.0530

Source: Processed data (2024)

Normality Test. For normally distributed data, data points are expected to lie as close as possible to the diagonal line in normal probability-probability (P-P) plots. Figure 4.1 shows the normal P-P plot for the model, where data points are close to the diagonal line, suggesting fulfillment of the normality assumption. To supplement the graphical assessment, the Shapiro-Wilk Test of Normality was conducted. Table 4.5 shows that all explanatory variables have p-values greater than 0.05, thus fulfilling the normality requirement.

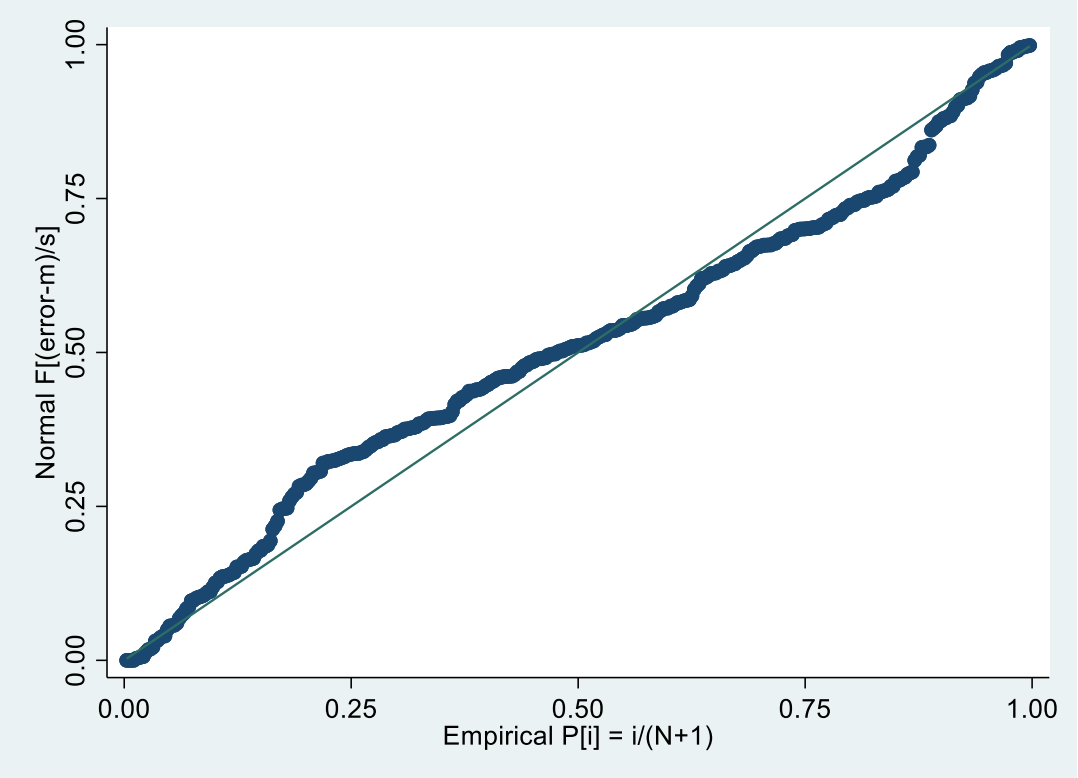

Figure 1. Normal P-P Plot of Regression Standardized Residual (Dependent Variable: Operational Efficiency)
Source: Processed data (2024)

Table 5. Shapiro-Wilk Test for Normality

Variable	Obs	W	V	Z	Prob > Z
Operational efficiency	126	0.93614	16.712	6.683	0.5320
Board size	126	0.944818	14.609	6.364	0.7846
Board diversity	126	0.97951	5.363	3.986	0.8210
Board competence	126	0.99059	2.464	2.140	0.6162
Board frequency of meeting	126	0.99768	0.606	-1.189	0.8827

Source: Processed data (2024)

Hausman Specification Test. The study selected between random effects and fixed effects models using Hausman's specification test (1978). Table 4.6 reveals a chi-square of 5.60 and a p-value of 0.2312. Since the p-value is statistically insignificant at the 5% level, the random effects model is selected for this study.

Table 6. Hausman Random Test for Random and Fixed Effects (Dependent Variable: Operational Efficiency)

Variable	(b) Fixed	(B) Random	(b-B) Difference	sqrt(diag(V_b-V_B)) S.E.
Board size	6.154319	2.368167	3.786152	4.642177
Board diversity	-9.42823	-15.33	5.901754	5.092194
Board competence	-4.61644	-2.01704	-2.599398	1.847248
Board frequency of meeting	-33.2721	-17.7489	-15.52319	22.66803
$chi^2(4)$	5.60			
Prob > chi^2	0.2312			

Source: Processed data (2024)

4.1.3 Correlation Analysis

Table 7. Correlation Matrix

Variable	Operational Efficiency	Board Size	Board Diversity	Board Competence	Board Frequency of Meeting
Operational efficiency	1				
Board size	0.758	1			
Board diversity	0.602	0.273	1		
Board competence	0.770	0.231	0.342	1	
Board frequency of meeting	0.802	0.215	0.204	0.30	1

Source: Processed data (2024)

Table 4.7 shows that the correlation between the independent variables and the dependent variable is high and positive: 0.758 for board size, 0.602 for board diversity, 0.770 for board competence, and 0.802 for board frequency of meetings. The correlations among independent variables are low to moderate, with no value exceeding 0.8, indicating that multicollinearity is not a concern.

4.1.4 Regression Results

Model Summary. Table 4.8 presents the model fit values: R = 0.800, R Square = 0.640, and Adjusted R Square = 0.628. These values indicate a strong relationship between the

board characteristics and operational efficiency. The R Square value of 0.640 means that 64 percent of the variation in operational efficiency is explained by the four board characteristics included in the model.

Table 8. Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	0.800	0.640	0.628	0.86025

Source: Processed data (2024)

Analysis of Variance (ANOVA). Table 4.9 indicates that the overall model is a good fit, with an F-statistic of 53.769 and a p-value of 0.000, which is less than 0.05. This suggests that all four independent variables are jointly relevant in explaining operational efficiency.

Table 4.9 Analysis of Variance

Model	Sum of Squares	df	Mean Square	F	Sig.
Regression	159.163	4	39.791	53.769	0.000
Residual	89.543	121	0.740		
Total	248.706	125			

Source: Processed data (2024)

Significance of Independent Variables. Table 4.10 presents the coefficients, standard errors, t-statistics, and p-values for each independent variable.

Table 10. Significance of Independent Variables

Model	Coefficients (Beta)	Std. Error	t-statistic	p-value
(Constant)	2.086	0.240	8.692	0.000
Board size	0.350	0.037	9.422	0.000
Board diversity	0.283	0.033	8.469	0.000
Board competence	0.180	0.034	5.216	0.000
Board frequency of meetings	0.299	0.038	7.778	0.000

Source: Processed data (2024)

The fitted regression model based on Table 4.10 is:

$$Y = 2.086 + 0.350X_1 + 0.283X_2 + 0.180X_3 + 0.299X_4 + \varepsilon$$

Where Y = Operational efficiency, X_1 = Board size, X_2 = Board diversity, X_3 = Board competence, X_4 = Board frequency of meetings, and ε = Error term.

Table 11. Summary of Hypothesis Testing Results

Hypothesis	Statement	Decision
H1	There is no significant effect of board size on operational efficiency	Rejected
H2	There is no significant effect of board diversity on operational efficiency	Rejected
H3	There is no significant effect of board competence on operational efficiency	Rejected
H4	There is no significant effect of board frequency of meetings on operational efficiency	Rejected

Source: Processed data (2024)

4.2 Discussion

Board Size. The results from Table 4.10 show that board size has a positive coefficient of 0.350 and is statistically significant (p = 0.000). This finding indicates that larger boards are associated with higher operational efficiency in water and sanitation

companies in Mount Kenya Region. This finding supports agency theory (Jensen & Meckling, 1976), which posits that larger boards provide better monitoring functions and oversight of management. According to Gemmill (2017), good board composition enhances effective decision-making as well as improving accountability. The finding is consistent with Bebeji, Mohammed, and Tanko (2015), who found that board size significantly influenced financial performance of Nigerian commercial banks, and with Mbalwa et al. (2014), who found that board size positively influenced financial performance of sugar manufacturing firms in Kenya. The board size range of seven to nine directors observed in this study aligns with Yermack (1996) and Sanda (2005), who recommended an optimal board size of eight to ten directors. However, the finding contrasts with Mohamed and Atheru (2017), who found a negative relationship between board size and financial performance in a Kenyan mobile service provider, suggesting that the optimal board size may vary by industry and context. The positive relationship found in this study suggests that water and sanitation companies benefit from larger boards due to the diverse expertise and perspectives that additional directors bring, which is particularly valuable in the complex regulatory environment of the water sector.

Board Diversity. The results from Table 4.10 show that board diversity has a positive coefficient of 0.283 and is statistically significant (p = 0.000). This finding indicates that a higher proportion of women on the board is associated with greater operational efficiency. This positive relationship supports stakeholder theory (Freeman, 1984), which emphasizes that organizations benefit from considering diverse stakeholder interests. The finding suggests that increased board diversity enhances transparency, accountability, and decision-making quality. Terjesen, Couto, and Francisco (2016) similarly found that diverse boards generate more alternative solutions during decision-making, increasing corporate performance. Lai, Srinidhi, Gul, and Tsui (2017) also reported that increased performance within women-led boards indicates creativity and innovation endowed in women. The finding is consistent with Ntim (2015), who found that board diversity had a positive and significant influence on firm valuation of South African listed firms. However, it contrasts with Akpan and Amran (2014), who found a negative relationship between women on boards and firm revenues in Nigerian listed firms, and with Abu, Okpeh, and Okpe (2016), who found no influence of board gender diversity on Nigerian bank performance. The positive finding in this study may reflect the unique context of water and sanitation companies in Kenya, where gender diversity has been actively promoted through regulatory frameworks, and where community-oriented service delivery may benefit from diverse perspectives.

Board Competence. The results from Table 4.10 reveal that board competence has a positive coefficient of 0.180 and is statistically significant (p = 0.000). This finding indicates that more competent boards are associated with higher operational efficiency, though this variable had the least influence among the four independent variables. A study by Miring'u (2021) suggested that board competence holds potential for managers to solve organizational problems as it enables managers to identify gaps within the organization. The finding aligns with Nawafly and Alarussi (2018), who found that audit committee expertise was significantly and positively associated with financial performance of Malaysian listed firms, and with Agwor and Onukogu (2018), who revealed that competence reduces financial misreporting. However, it contrasts with Oroud (2019), who found that audit committee expertise had no significant relationship with profitability of Jordanian industrial companies. The positive but relatively smaller coefficient for board competence in this study suggests that while competence is important, its impact

on operational efficiency may be indirect or may require interaction with other board characteristics such as size and meeting frequency to be fully realized. The wide variation in board competence observed in Table 4.1 (ranging from 0.01% to 29.13%) indicates that some companies may need to focus on appointing more experienced directors.

Board Frequency of Meetings. The results from Table 4.10 show that board frequency of meetings has a positive coefficient of 0.299 and is statistically significant (p = 0.000). Board frequency of meetings was the second most influential variable in the model. This finding supports agency theory, which predicts that more frequent board meetings facilitate greater monitoring of management (Jensen & Meckling, 1976). Nwankwo (2014) supported that stakeholder decision-making requires management support. The finding is consistent with Al-Daoud, Saidin, and Abidin (2016), who found that board meetings had a positive and significant influence on firm performance, supporting the view that more meetings facilitate greater board monitoring as directors have more interactions with management and valuable discussions leading to enhanced performance. The finding is also supported by the observation that water and sanitation companies in this study averaged six meetings per year, which meets the Jordanian Stock Exchange recommended minimum (Al-Daoud, Saidin & Abidin, 2016). However, the finding contrasts with Gambo, Bello, and Rimamshung (2018), who found that board frequency of meetings had no influence on return on assets of Nigerian consumer goods firms, and with Gómez, Cortês, and Betancourt (2017), who found no linear relationship with financial performance of Colombian companies. The positive finding in this study may be explained by the fact that the water and sanitation sector in Kenya faces complex regulatory and operational challenges that require frequent board oversight and timely decision-making.

5. Conclusion

This study sought to determine the relationship between board characteristics and operational efficiency of water and sanitation companies in Mount Kenya Region. The specific objectives were to examine the effect of board size, board diversity, board competence, and board frequency of meetings on operational efficiency. Based on the analysis of 21 water and sanitation companies over the period 2019 to 2024, the following conclusions are drawn.

The study concludes that board size is a key determinant of operational efficiency of water and sanitation companies in Mount Kenya Region. The descriptive results indicated agreement among respondents on the effect of board size on operational efficiency. The regression results revealed that board size has a strong positive influence on operational efficiency, with a coefficient of 0.350 and a p-value of 0.000. This finding supports agency theory, which posits that larger boards provide better monitoring functions. Water and sanitation companies in Mount Kenya Region are therefore encouraged to be keen on deciding board composition as part of their strategies to enhance operational efficiency.

The study concludes that board diversity is a key determinant of operational efficiency of water and sanitation companies in Mount Kenya Region. The descriptive results indicated agreement among respondents on the effect of board diversity on operational efficiency. The regression results revealed that board diversity has a strong positive influence on operational efficiency, with a coefficient of 0.283 and a p-value of 0.000. This finding supports stakeholder theory, which emphasizes that organizations benefit from considering diverse stakeholder interests. Organizations are therefore encouraged to

focus on board diversity to enhance transparency as a strategy for improving operational efficiency.

The study concludes that board competence is a key determinant of operational efficiency of water and sanitation companies in Mount Kenya Region. The descriptive results indicated agreement among respondents on the effect of board competence on operational efficiency. The regression results revealed that board competence has a positive influence on operational efficiency, with a coefficient of 0.180 and a p-value of 0.000. Although this variable had the least influence among the four board characteristics, its effect remains statistically significant. Business owners and stakeholders should consider selecting competent personnel who will add value to organizational decision-making.

The study concludes that board frequency of meetings is a key determinant of operational efficiency of water and sanitation companies in Mount Kenya Region. The descriptive results indicated agreement among respondents on the effect of board frequency of meetings on operational efficiency. The regression results revealed that board frequency of meetings has a strong positive influence on operational efficiency, with a coefficient of 0.299 and a p-value of 0.000. This variable was the second most influential factor in the model, confirming that regular board meetings facilitate better monitoring and decision-making.

Since the results revealed that board characteristics are influential on operational efficiency, there is need for all stakeholders to be aware of this. Board characteristics are vital for the success of an entity. Therefore, owners and key stakeholders need to be keen when selecting board members. In particular, board size, board diversity, board competence, and board frequency of meetings were found to have a statistically significant effect on operational efficiency. This study recommends that organizations need to improve the qualifications of board members to address operational efficiency problems. The study further recommends that board size and board frequency of meetings deserve special attention as they were found to be the most influential variables.

The regression model revealed that the variables included in this study were able to explain 64 percent of the variation in operational efficiency as indicated by the R Square value (Adjusted R Square of 0.628). This means that 36 percent of the variation is explained by other factors not captured in this study. Therefore, this study recommends the improvement of this model by including more variables that are relevant in explaining the variation in operational efficiency of water and sanitation companies in Mount Kenya Region, such as board independence, CEO duality, audit committee characteristics, ownership structure, and external regulatory factors.

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