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Transforming Capability as a Predictor of Sustainability in Kenya's Water Service Providers

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Abstract
Sustainability of water utilities is crucial in enhancing access to quality water and safe sanitation services globally. This study evaluated transforming capability as a predictor of sustainability of public water service providers in Kenya. The study used a cross-sectional descriptive research design targeting 332 senior managers from the 88 public water service providers. Primary data was collected using a structured online questionnaire. The instrument was evaluated for stability using Cronbach alpha coefficient and for construct validity using Kaiser-Meyer Olkin Coefficient. The weighted data from 67 WSPs was tested for pairwise linearity, outliers and autocorrelation. A Bivariate Linear Discriminant Analysis was conducted for inferential analysis. This study found that this Linear Discriminant Analysis function between transforming capability and firm sustainability of public water service providers in Kenya achieved a hit ratio of 80.6% for original classification and associated Jack-knife hit ratio of 79.1%. The test of equality of group means has a Wilks' Lambda (Λ) of 0.273, F-Statistic of 85.29 and a p-value of 0.000 at 95% degree of confidence. The canonical correlation for this variable was 0.853. The study concluded that transforming capability has a statistically significant discriminating power on sustainability of WSPs in Kenya. The study recommends that WSPs should enhance their ability to continuously reconfigure their capabilities to seize identified opportunities in the dynamic business environment to guide choices for competitive action as a key strategy towards driving firms' sustainability.

Keywords: Dynamic Capabilities, Transforming, Sustainability, Water Service Providers.

1. Introduction

1.1 Background of the Study

Water is a crucial commodity for the sustenance of life. Access to clean drinking water and safe sanitation is imperative and a widespread global challenge. In order to progressively achieve the

Vol. 10, No.09; 2026

ISSN: 2456-7760

targeted access levels to both sanitation services and quality drinking water, sustainability of Water Service Providers (WSPs) is pivotal (Union, 2015). These institutions operate within a regulated framework. They are also known to face various challenges and pressures (WASREB, 2023). To thrive and achieve superior performance, these institutions should create and leverage on transformation dynamic capabilities which support them to reconfigure their resource base effectively. Therefore, this study focused on regulated public WSPs in Kenya seeking to fill the gap by exploring the effect of transforming capabilities on firm sustainability.

1.2 Problem Statement

UN Sustainable development goals point out that access to water counts for over 6% of the contribution to GDP directly and indirectly and it is a key catalyst and a prerequisite for the attainment of all the SDGs. It is estimated that at least 4.3 Billion people in the globe (33%) live without access to safely managed sanitation. Statistics indicate that by 2050 declining access to water could reduce economic growth by 1/3. These statistics point that in part, sustainability of WSPs is of global interest and concern.

"Africa has the least water distribution across the globe, estimated at 9%, America has 45% which is the highest share of freshwater resources in the globe followed by Asia (28%) and then Europe (15.5%)." The sustainability challenge of WSPs is deeper from a demographic point of view with 87% in the rural Africa experiencing poor access to water compared to 51% in urban populations. The urban population in Africa has a projected growth to 1.3 billion people by 2050 making the achievement of the SDG 6 a pipe dream which can only be surmounted through adequate planning, investments and sustainable WSPs. While the world is focused on reaching the 2030 water target, Sub-Sahara Africa lags behind significantly.

Kenya's Vision 2030 Development Agenda anticipates achievement significant economic growth and improve the nation's overall well-being. Improving firm sustainability and access to water services is a major commitment of the country. Access to water services stands at 59%. There is limited capacity of institutions in the sector to discharge their mandates coupled with, elevated levels of Non-Revenue Water (NRW) adversely affecting financial viability of sanitation and water companies in Kenya. Access to reasonable sanitation and clean water services is deemed a vital component of poverty reduction and public health improvement. The public WSPs in Kenya are facing numerous challenges, resulting in inefficiencies and underperformance. These deficiencies include illegal connections, low water connections, high NRW, limited hours of supply, low revenue collection efficiency, dormant connections, customer dissatisfaction and weak financial status. The sector in Kenya recorded a decline in cost recovery in the last 3 years. Although the increase in costs (8.8%) was marginally higher than the increase in revenues (7.4%), a factor that contributed to the drop, the efficiency of the utilities needs to be addressed. These factors in part point that the firm sustainability of these service providers is at stake.

Developed countries are the primary focus of the existing literature mainly on operational management and financial management. None of the reviewed existing studies has provided insights into what factors can predict firm sustainability of these service providers. These studies

Vol. 10, No.09; 2026

ISSN: 2456-7760

have used models other than LDA which is better suited for classification tasks for example classifying Good vs. Bad performers. The analytical ability to predict this firm sustainability requires the application of robust models such as Linear Discriminant Analysis. This model has so far not been utilized in the reviewed studies and more so in the context of water sector.

This study explored the impact of transforming capabilities on firm sustainability of public WSPs in Kenya. The study employed a discriminant analysis approach with a focus on the water sector within a developing country context, providing insights that are relevant and specific to the challenges faced by public WSPs in Kenya. Consequently, this study sought to generate empirical evidence to analyze transforming capabilities as predictors of sustainability of Water Service Providers in Kenya, with the aim of informing policy, regulatory and managerial interventions as well as addressing the existing knowledge gaps thereby improving sustainability of the entities.

2. Literature Review

2.1 Dynamic Capability Theory

The main objective of conducting this study is to examine the relationship between transforming dynamic capabilities and firm sustainability among public Water Service Providers in Kenya. There are different dynamic capabilities definitions from different authors on their own perspective. Teece et al. (1997) defines dynamic capabilities as the firm's ability to integrate, build and reconfigure internal and external competences to address rapidly changing environments. Dynamic capabilities thus are the organizational and strategic routines by which firms achieve new resource configurations as markets emerge, collide, split, evolve and die (Eisenhardt & Martin, 2017). Dynamic capabilities are essentially change-oriented capabilities that help firms redeploy and reconfigure their resource base to meet evolving customer demands and competitor strategies (Zahra & George, 2004).

Teece et al (1997) classified the capabilities into three main categories namely sensing capabilities, seizing capabilities and re-configuring also known as transforming capabilities.
Transforming capabilities refer to the ability to recombine both tangible and intangible assets so that they meet the demands of markets and technological changes (Li & Liu, 2014; O'Reilly & Tushman, 2008; Teece, 2007). While an enterprise competencies provide competitive advantage at a given time, the changing business environment calls for new competitive assets and thus new competencies. This is especially true today as product and technology lifecycles are shortening, becoming more interdisciplinary and thus more demanding and also because financial requirements are rapidly rising (Rese & Baier, 2011). To be able to respond to these continuous trends, enterprises need to be agile and ready to replace outdated business and management activities with new ones.

2.2 Empirical Literature

In a study by Yang and Yang (2022), the primary objective was to investigate the association between dynamic capabilities (DCs) integrated into Environmental, Social, and Governance

Vol. 10, No.09; 2026

ISSN: 2456-7760

(ESG) management practices adopted by global companies and their corporate performance in an environment characterized by escalating uncertainty. This method is considered an alternative to traditional survey or interview approaches, offering a unique perspective. The study crafted a DCs dictionary by reconfiguring Teece's 12 detailed dimensions of dynamic capabilities into 10 dimensions. The research undertook a fixed-effect panel analysis and the findings underscore the nuanced role of dynamic capabilities embedded in ESG management within global companies. While they can positively impact performance, the research reveals that they also entail costs and benefits simultaneously. For dynamic capabilities to enhance corporate performance, organizations need to adopt a balanced approach that encompasses sensing, seizing, and transforming capabilities. This balance becomes especially crucial in adapting to uncertain conditions. Consequently, business managers are advised to recognize the importance of cultivating a well-rounded set of dynamic capabilities to optimize corporate performance through ESG management in the face of uncertainty.

A study by Liang et al. (2022) in Korea on the dynamic capabilities necessary for firms to execute environmental, social and governance (ESG) strategies and explored the sustainable management performance resulting from these capabilities. Dynamic capabilities theory was applied to merge the domains of sustainable management and ESG literature, proposing a research model and identifying the driving factors for achieving firm sustainability. Their findings revealed that absorptive capability and adaptive capability exerted a significant influence on sustainable management performance, with the implementation of an ESG strategy serving as a mediating factor. A study carried out in Kenya by Kiiru (2015) on "Dynamic capabilities, strategic orientation and competitive advantage of small and medium-retail enterprises in Kenya" noted that there is a statistically significant effect of transforming capabilities on Competitive advantage of small and medium-retail enterprises.

These studies focus on several sectors but none of the reviewed studies addressed transforming capabilities in water utilities in Kenya. The above reviewed studies mainly focused on private sector organisations and not public sector especially the water sector; the studies cover several geographical contexts but they lack a focus on public water utilities in Kenya.

2.3 Conceptual Framework of the Study

Figure 2.1 presents the study's conceptual framework.

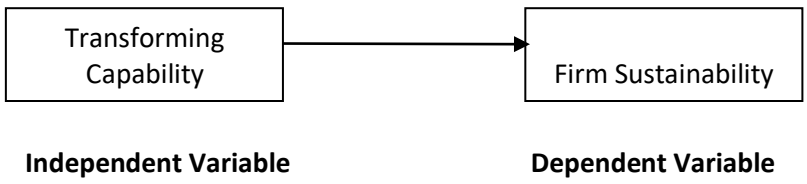


Figure 2.1 Conceptual Framework

Vol. 10, No.09; 2026

ISSN: 2456-7760

2.4 Research Objective

To evaluate the effect of transforming capabilities on firm sustainability of public water service providers in Kenya.

2.5 Research Hypothesis

This study sought to test the null hypothesis:
H0: There is no statistically significant effect of transforming dynamic capabilities on firm sustainability of public water service providers in Kenya.

2.6 Research Gaps

A literature review of the available resources identifies a number of gaps. It is reported that in small firms operating in several sectors in developing and emerging economies, the operationalization of competitive advantage and firm sustainability is usually problematic in many studies (Kiiru, 2015). This is the same case as in the studies focusing on small and medium retail firms of developing countries (Hortinha et al., 2011; Rhee et al., 2010; Tajeddini 2010; Zahra, 2008). Therefore, it becomes very difficult to compare these studies without regard to the context of the study. This presents a contextual gap.

Most of the reviewed studies have used structural equation Modelling (SEM), that is; simple linear and multiple linear regression analysis. LDA will provide better capabilities to discriminate what variables can help in predicting whether an institution or a firm will be sustainable in the future. In addition, there are limited past studies exploring the parameters that inform or enhance suitability potential, owing to the selected inferential modelling. The regression assumption of SEM limits the model to provide predictive power where the assumptions do not hold. This study applied a linear discriminant model and provided inferential insight into the prediction of a water sustainability potential and hence address the methodological and analytical gaps (Hair et al., 2019).

Literature review avails evidence on the need for further research studies to be conducted regarding the relationship between transforming dynamic capability and firm sustainability. The main conceptual viewpoints generated from the literature review are that, in spite of the extensive research conducted on the indicated topic of interest there has been scarcity on studies within the field focusing on firm sustainability of WSPs in Kenya. Given the elevation of Kenya to a developing nation status as a country, there has been limited formal attention aimed at influencing firm sustainability due to the emphasis on high-level development of infrastructural and the consequent impact on the water sector players in Kenya (Cadogan, 2012, Barbosa, Castañeda-Ayarza, Ferreira, 2020). A thorough and in-depth exploration would be conducted to fill the existing empirical and theoretical literature gaps, particularly in developing countries such as Kenya. This study therefore sought to explore the impact of transforming dynamic capabilities on firm sustainability of WSPs in Kenya using discriminant analysis.

Vol. 10, No.09; 2026

ISSN: 2456-7760

3. Method

3.1 Philosophy, Research Design and Measurement and Data collection

Hypothesis in this study is aligned to the study's objective. The hypotheses are grounded by a strategic management theory and were tested using robust statistical tools characterized by the belief that research is preceded by theory (Cooper & Schindler, 2020). This was followed by, statistical validations of conclusions drawn from empirically tested hypotheses. Therefore, this study was aligned to the fundamental principles of positivism approach to a social science study (McMillan & Schumacher, 2020). This study's objective was to assess the transforming capabilities as a predictor of firm sustainability of WSPs in Kenya and the moderating role played by strategic orientation on this relationship. Data largely included average firm sustainability indicators from secondary data for the eight years from 2017 to 2024. Therefore, the study was cross sectional in approach and descriptive in nature. This was achieved through identifying, describing and analyzing the relationships among the study variables.

Data collection is described as the method of collecting of information related to the research objectives of a study, either by observation, group discussions, interviews, narratives, questionnaire, case studies, checklists or surveys (Creswell & Creswell, 2017). A census was adopted no sampling was conducted. Both Primary and Secondary data were collected. Primary data was collected using a structured questionnaire while secondary data from WASREB's annual impact reports was collected using a data collection sheet.

3.2 Reliability and Validity of Data Collection Instrument

Bryman (2016); McMillan and Schumacher (2010) assert that reliability is an indicator of internal consistency. Researchers can employ a variety of approaches to measure the reliability of a specific data collection instrument (Mertens, 2016). Several researchers recommend different methods that can be used to assure reasonable level of reliability; split-half technique, Kuder-Richardson 20 (KR20) and Cronbach's alpha coefficient (Coopers and Schindler, 2014). For this study, KR20 would not be useful and not applicable because it is recommended for use in the case of an instrument using responses that are binary and hence used to estimate reliability of dichotomous items (Coopers and Schindler, 2014). Cronbach's alpha adopts multi-item scale measurement and is what was appropriate for this study and was applied across for each of the constructs to confirm reliability.

The alpha coefficient values range between zero (0) implying (no consistency) to a coefficient of one (1) indicating (complete consistency) and it describes the reliability of factors extracted from the answered questions (Viladrich et al., 2017). Nunnally (1978) suggests that, when using Cronbach's alpha for reliability testing, a rule of thumb is that for items in a study Cronbach alpha values should ideally not fall below 0.7. In this study, reliability coefficients were computed for each item on the Likert scale and the final results are presented for study objective.

In research, "the accuracy with which a measure truthfully represents a concept is referred to as validity" (Zikmund, 2013; Bryman, 2012). To assess validity in a study, four methods are largely

Vol. 10, No.09; 2026

ISSN: 2456-7760

used, "namely face validity, criterion validity, content validity and construct validity" (Zikmund et al., 2018). The subjective agreement among professionals that a measuring tool logically reflects the concept being measured is what is referred to as face validity (Zikmund et al., 2018). In this study, selected research experts were provided with the five-point Likert scaled questionnaire for checking validity of the measures of the different items of the questionnaire.
"The extent to which a measure covers the realm of interest and solves analytical problems is referred to as content validity" (Bradley, 2013). When content validity is ensured, it means that the tool covers the whole scope of a phenomenon under interest and not go beyond. To attain content validity, the correct operational measures were applied for the concepts being studied and measures derived from successful comparative studies is vital (Shenton, 2018).

Criterion validity, according to Zikmund et al. (2018), indicates the extent to which a measure is related to an external standard or criterion. Criterion validity was established using the Known-Groups Validity Method. This method involves comparing the scores of groups that are known to differ on the construct being measured. If the measure accurately distinguishes between these groups, it demonstrates validity (Bryman, 2016). On the other hand, construct validity, concerns the degree to which a measure relates to other measures as theoretically hypothesized (Mugenda, 2023). To establish construct validity, this study used a questionnaire divided into sections, each aligned with specific objectives and the conceptual framework. Factor analysis is a common method for assessing construct validity, as it identifies clusters of items that correlate highly, defining particular constructs (Bhattacharyya, 2019).

"Factor analysis assumes the existence of latent constructs (factors) that account for correlations among observed variables" (Bhattacharyya, 2019). Factor analysis aids in data reduction and the improvement of construct validity (Bryman, 2016; Zikmund et al., 2019). To test for the factorability of the composite measures, the study used Bartlett's test of Sphericity and Kaiser-Meyer-Olkin (KMO) as indicators of sampling adequacy. Factor loadings exceeding 0.4 were considered significant to assess the validity of variable constructs (Montgomery, Peck & Vining, 2001). Principal Component Analysis (PCA) with orthogonal rotation using the varimax method extracted quality constructs for independent variables. The total variance explained, rotated component matrix and scree plots were used generated to ultimately confirm that the final measures applied high quality constructs for the respective variable measure.

3.3 Data Analysis and Presentation of Results

The study's response variable is categorical and classified into three categories. The objective of the study was to assign any new case of a water firm to any of the predictand based on a profile of the study predictor; that is transforming capability. While there are many attributes of each of the WSPs, this study developed a model that can determine the most parsimonious way of distinguishing between the "good" "acceptable" and "not acceptable" based on the model. This study therefore employed a number of descriptive and inferential techniques to successfully identify the linear combinations of attributes known as canonical discriminate functions (equations) which contribute maximally to each of the group separation. A discriminant model creates an equation which minimizes the possibility of misclassifying cases into their respective

Vol. 10, No.09; 2026

ISSN: 2456-7760

predetermined groups or categories (Optimus, 2021). In order to determine the most accurate model of predicting group categories, a number of regression assumption tests were conducted. These tests comprise of, test of normality of predictor, test of independence, test and test of linearity.

4. Results and Discussions

4.1 Response Rate

This study targeted 332 respondents from eighty-three (83) public WSPs in Kenya. Four (4) respondents were targeted for each of the registered public WSPs in Kenya as at December 31, 2024. The response rate obtained in the study was 90.36% with 300 out of the 332 responding to the questionnaire.

4.2 Reliability and Validity

Before carrying out the descriptive and inferential analysis, the study conducted an assessment of the internal consistency of the variables. The reliability test was conducted using Cronbach alpha (a) coefficient.

The variables of the study were developed from a combination of several sub-constructs. All the constructs were Likert's scaled. To assess the content validity of the questionnaire, it was subjected to a qualitative test through a review by three experienced professionals from Kenya School of Government (KSG). Further, when several interval-scaled measures are used in the measurement of a variable in social study, it is deemed crucial to assess the construct validity. In order to assess the study variables' parameters for their construct validity, Kaiser-Meyer-Olkin measure of sampling adequacy was generated together with the associated Chi- Squares, respective degrees of freedom and p-values.

4.2.2 Validity and Factorability Test for Transforming Capability

The independent variable in the study was transforming capability. This variable was measured using eleven quality statements which were grouped into three sub-constructs, that is resources reallocation, strategic alliances and organization adaptability. Resource reallocation was measured using three statements. Strategic alliance was assessed using five (5) statements while organization adaptability was assessed using three (3) statements. All the statements measuring this variable were subjected to Principal Component Analysis (PCA), orthogonal rotation. The purpose of this rotation was to ensure minimization of the number of statements/measures that had high loadings on each factor. Further, varimax method was selected to ensure that the interpretation of the final factors was parsimonious for transforming capability as an independent variable. The results are presented in Table 4.1.

Vol. 10, No.09; 2026

ISSN: 2456-7760

Table 4.1: Validity and Factorability Results for Transforming Capability

KMO and Bartlett's Test		
Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		0.844
Bartlett's Test of Sphericity	Approx. Chi-Square	2012.84
	df	55
	Sig.	0.000

Table 4.5 shows that transforming capability' eleven (11) measures had a Kaiser-Meyer-Olkin (KMO) coefficient of 0.844, higher than the threshold of a KMO of 0.500. In addition, the Table shows that the Bartlett's Chi-square was 2012.84 with 55 degrees of freedom and an associated p-value of $p < .001$. The KMO coefficient implied that the measures had adequate numerical construct validity. The results of the p-value associated with Chi-Square, implied that the correlation matrix of the dataset for the statements used to measure transforming capability as a variable deviates significantly from the identity matrix, meaning that Principal Factor Analysis (PFA) could be applied to further extract the components for the measures and further refine the measures correlations. (Tabachnick and Fidell,2014)

4.3 Principal Factor Analysis for Research Variables

This study examined transforming capabilities and firm sustainability of WSPs in Kenya. The dependent variable in the study was firm sustainability measured using the Balanced Score Card (BSC) Model. The stimulus variable in this study do not have a direct measure and were therefore measured using a five-point Likert scale using the opinions and beliefs of the managers of the WSPs. On the other hand, the response variable was measured using an interval scale.

This study subjected all the interval scaled variable- measures to Confirmatory Factor Analysis (CFA) in order to extract the latent dimensions of each of the variables. This was done because the statistical measures of the test of factorial validity indicated that this test would improve the principal Eigenvectors for each driver. CFA involved the generation of, the proportion of each variables' variance that was explained by the factors in the latent variables (Variance Explained) output, associated Sums of Squared Loadings, Eigenvalue Plot and Factor Loadings Matrix (LM) and the Rotated Factor loadings matrix. The results findings of this analysis and observation for are presented in the following section.

4.3.1 Dimensions for Transforming Capability

Transforming Capability was measured using eleven (11) statements, generated from strategic management knowledge domain and were used to measure transforming capability as a predictor of WSP sustainability. In order to determine the most relevant and quality constructs for measurement of this variable, the constructs were subjected to factor structure test to confirm if each of the measures, adequately fitted the observed data and also make an observation and inference on structure quality of the specific parameters used to measure the variable. The

Vol. 10, No.09; 2026

ISSN: 2456-7760

associated Variance Explained (VE), Eigenvalue Plot and Rotated Loadings Structure Matrix were generated and presented in sections (a), (b) and (c).

(a) Variance Explained for Transforming Capability)

In order to analyze the viability of the data set transforming capability measures that could be attributed to each of the Eigenvectors of the variable, Variance Explained (VE) Table was generated and presented. In this test, initial characteristic roots, Extraction Sums of Squared Loadings (ESSL) and the Rotation Sums of Squared Loadings (RSSL) statistics were generated. The output and the associated findings are presented in Table 4.2.

Table 4.2: Eigenvalues for Transforming Capability

Total Variance Explained

	Initial Eigenvalues			Rotation Sums of Squared Loadings		
Component	**Total**	**% of Variance**	**Cumulative %**	**Total**	**% of Variance**	**Cumulative %**
1	4.534	41.219	41.219	4.400	39.996	39.996
2	2.249	20.448	61.667	2.304	20.947	60.944
3	1.193	10.850	72.517	1.273	11.573	72.517
4	0.799	7.266	79.783			
5	0.603	5.482	85.264			
6	0.476	4.330	89.594			
7	0.352	3.202	92.796			
8	0.311	2.827	95.623			
9	0.202	1.837	97.460			
10	0.176	1.598	99.058			
11	0.104	0.942	100.000			

Extraction Method: Principal Component Analysis.

The results in Table 4.2 are the transforming capability measures output from a maximum variance rotation, after subjecting them to a mathematical algorithm that maximized high- and low-value factor loadings for the variable and equally minimized mid-value factor loadings. These results show that three (3) Eigenvectors were extracted with eigenvalues above the threshold of 1.000. These three dimensions explained a cumulative variance of 72.52% of the distribution of the variance after the varimax-orthogonal rotation of the statements measuring the variable. The results further show that these jointly accounted for a variance greater than 60%, implying that the statements under the components could be refined and obtain adequate measures for the transforming capability variable (Tabachnick & Fidell, 2014).

Vol. 10, No.09; 2026

ISSN: 2456-7760

b) Rotated Component Analysis for Transforming Capability

In order to further examine the number of constructs loading to each of the three (3) dimensions of transforming capability, rotated loading matrix was generated and presented. The factor loadings were ordered from the highest to the lowest in absolute values. In addition, the same were suppressed for all loadings with a threshold of an absolute value of 0.4 loading. The results are presented in Table 4.3

Table 4.3: Factor Loading Matrix Transforming Capability

Rotated Component Matrix[a]

		Component		
		1	2	3
StratAll4	Strategic linkages have been useful towards the company's market positioning.	0.940		
StratAll1	The company has a collaborations and partnership policy	0.885		
StratAll3	The company has a functional active collaboration and linkages office	0.885		
StratAll5	Strategic alliances and linkages is one of our areas of focus in the strategic plan.	0.775		
StratAll2	The firm actively pursues strategic partnerships and alliances	0.520		
OrgAdap1	Our firm has invested in culture assessments for adaptability		0.850	
OrgAdap3	The customer satisfaction targets have been met in the last five years		0.752	
OrgAdap2	The company takes culture audit as one of the key drives of business.		0.609	
ResReal2	It is highly feasible to re-allocate resources from low to higher potential projects in the firm			0.930
ResReal1	The firm has a board approved resource allocation and re-allocation policy			0.918
ResReal3	Management has goodwill to re-allocate resources within projects when feasible			0.883

Extraction Method: Principal Component Analysis.
Rotation Method: Varimax with Kaiser Normalization.

The results in Table 4.3 show that all the five (5) constructs of strategic alliances used to measure transforming capability clustered to the first component with factor loadings ranging from 0.520 to 0.940. Similarly, all the three statement constructs of Organizational adaptability loaded to the second component with factor loading of 0.850 to a low of 0.609. It was further observed that, all the three constructs for resource re-allocation loaded to the third component. The factor loadings ranged from of 0.930 to a low of 0.885.

Vol. 10, No.09; 2026

ISSN: 2456-7760

Further insights on varimax-orthogonal rotation indicated that all the ten constructs measuring transforming capability had factor loading of more (>) 0.40 cut-off. Based on these insights from the loading's matrix, transforming capability was subsequently measured using all the eleven constructs. Reliability re-assessment and structural validity for transforming capability was considered as not necessary as all the statement were retained in the measuring of the variable

c) Scree Plot for Transforming Capability

This study presented a visualization of the eigenvalue table and the number of dimensions for the transforming capability. The purpose was to depict the number of factors to retain for the measurement of this variable in the progressive evaluation of the variable. A Scree Plot was extracted for all (twelve 12) constructs and their associated eigenvalue for each of the construct measuring this independent variable. A line plot for each of the component(s) was also presented and the results are as presented in Figure 4.1.

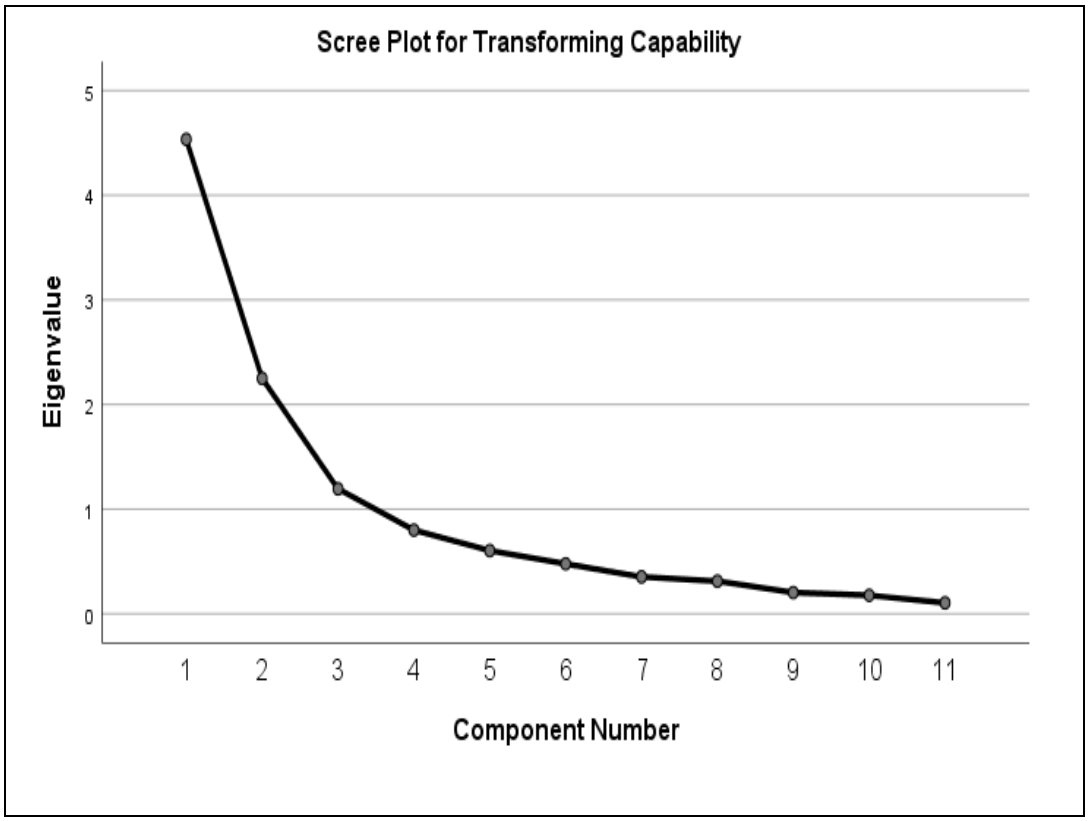


Figure 4.1: Scree Plot for Transforming Capability Measures

Figure 4.1 presents the Eigen coefficient on the ordinate and the number of Eigenvectors along the x-axis. Further the Figure shows a downward plot curve between the first component and the eleventh (11th) component. Further, the line plot is a steep curve up to the fourth component and

Vol. 10, No.09; 2026

ISSN: 2456-7760

that elbows and gradually flatten- out at the forth (4th) component. The corresponding eigenvalue at the point of bend is less than a coefficient of 1.00and coincides with component four. These outcomes reflect that the three (3) Eigenvectors were generated by the analysis for the variable, transforming capability measures. Figure 4.7 implies that all of the eleven (11) statements used to measure transforming capability could be reduced to three (3) Eigenvectors, which would be adequate to measure the variable. (Tabachnick & Fidell, 2014).

4.4 Test of Linear Discriminant Analysis Assumptions

Miles and Shevlin, 2010 and Chatterjee and Simon off, 2013 assert that before subjecting data to inferential analysis, certain tests of statistical assumptions should be carried out to safeguard that the regression errors ("ε") are minimized in the predicting model. Based on this statistical requirement, the assumptions of Linear Discriminant Analysis model were tested before the final inferential analysis, that is; test for outliers, test of pair-wise linearity, test of serial correlation and finally the heteroscedasticity model residuals.

4.4.1 Outlier Detection Test Among Variables

This study subjected the study variables to test of outliers. This diagnostic test was carried out to check the generated linear discriminant model's adequate accuracy and precision. The effect of deviations in an inferential model is; poor fit, inaccurate predictions by either deflating or inflating the predictions. This test was carried out using box plots. The plot generated minimum, first quartile (Q1), median (Q2), third quartile (Q3), and the maximum values. These test results were generated using SPSS Version 27. The box and whisker plot for transforming capability were presented in the box plot which showed that the ranges from the median values (second quartile) for the variable appeared proportionate in each side of the distribution. This box plot showed that the distribution of values was balanced in each of the side of the median values for the variable. After this, the study concluded that the variable did not have outliers and hence safeguarded the validity and accuracy of the model.

4.4.2 Test of Pair-wise Linearity Between Study Variables

This study tested the variables for single dimensionality for the pair of study variables. The weighted scores of the predictor variable were subjected to a pair-wise linearity test using Lm – curve, that is, transforming capability with the predict and (firm sustainability). The purpose of this test was to check that indeed, there existed a linear relationship between this pair of variables. This test was carried out using Python libraries and the respective pair plots and Lm curve were generated. The outcome of this test is presented in Figure 4.2

Figures 4.2 shows that there is a visible upward slopping trend line originating from the intercept and slopping from left to the right-top of the plots. This observation, means that all the predictor had a positive linear relationship with the predict and, firm sustainability, a necessity for application of Linear Discriminant Analysis.

Vol. 10, No.09; 2026

ISSN: 2456-7760

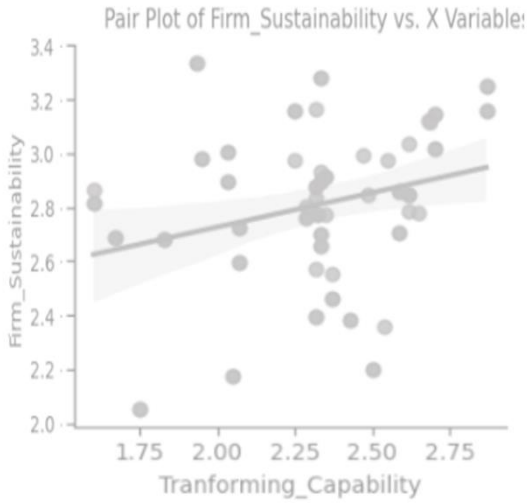


Figure 4.2: Pair Plots and Lm Plot for Variables and Open Innovation

4.4.3 Test of Independence for Explanatory Variables

The test of independence was carried out for the explanatory variable, that is transforming capability using SPSS Version 27. The Durbin-Watson d statistics was extracted for the variable. The Durbin-Watson (d) coefficient of the study variable was 2.040. This d-statistics was within the statistic range of 1.5 and 2.5 for no autocorrelation observations (Garson, 2012). This result indicates that the diagnostic test of absence of first order serial autocorrelation among the study variables was confirmed as a necessary prerequisite. From these observation(s) it was concluded that normal (linear) discriminant analysis could be carried out using these variables without any further transformation to produce valid and reliable results.

4.4.4 Test of Heteroscedasticity

This test was carried out to safeguard that the parametric test-results had a constant variance (no heteroscedastic). The test was carried out by generating variance-covariance Probability – Probability plots. The P-P plots were generated using Python Libraries pandas, NumPy, matplotlib. Pyplot, seaborn and SciPy. Stats. The normal P-P Plots were used to test the null hypothesis that; the given input of variables was generated from a population that is homoscedastic. This implies that this test was used to make a comparison between the empirical cumulative distribution function of the data set with that of the assumed true cumulative probability distribution functions. The P-P plot visuals are presented in Figure 4.3.

The probability-probability output in figure 4.3 shows a linear pattern between the two cumulative distribution functions (CDFs). Both distributions plot well through the unitary line, from the origin (0,0) running to the point (1,1), are largely evenly cumulative suggesting a homogeneity of variance-covariance. It is however observable that it appeared to have

Vol. 10, No.09; 2026

ISSN: 2456-7760

deviations around the middle of the plot, a representation of mild variation from constant variance. Noted equally, was that the residuals appeared to fit in close to the unitary line. Based on this observation, the P-P plot for the affected variable residuals were deemed as not too significant to affect the accuracy of the results of the model.

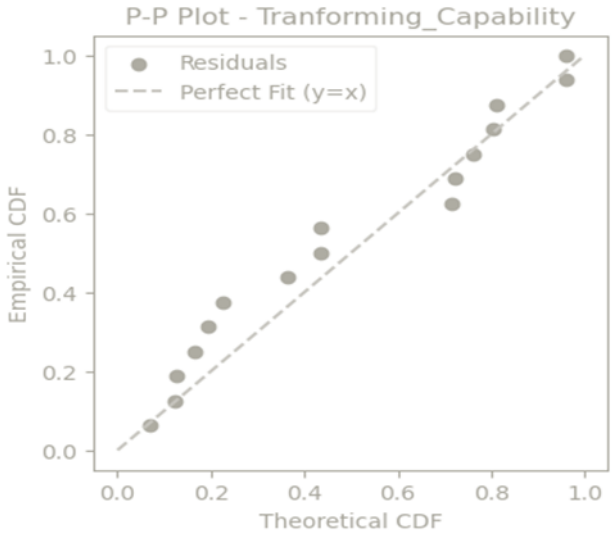


Figure 4.3: Probability- Probability Plots of Variables

4.5 Results and Discussion

4.5.1 Descriptive Analysis for Transforming Capability

The objective of this study sought to investigate the influence of transforming capability on firm sustainability of public WSPs in Kenya. To achieve this, the transforming capability as a predictor was measured using, eleven (11) statements. Out of the eleven statements, the first three focused on resources re-allocation. The next set of five statements focused on strategic alliances and the other three focused on organizational adaptability. The respondents to the questionnaire were asked to indicate on a scale of one (1) to five (5), the level to which they agreed to the statements in each sub-component of transforming capability. The scale was; Not at all (1), to a small extent (2), to a moderate extent (3), to a high extent (4) and to a very high extent (5). The results of the responses are presented in Table 4.4 where the 11 statements are assigned labels TraCap_1 to TraCap_11.

Vol. 10, No.09; 2026

ISSN: 2456-7760

Table 4.4: Descriptive Analysis for Transforming Capability

	Statement(s)	NA	SE	ME	HE	VHE	Mean	Std. Dev
	Resource Reallocation							
TraCap_1	The firm has a board approved resource allocation and re-allocation policy	9.4	9.5	19.7	24.8	36.6	**3.70**	**1.432**
TraCap_2	It is highly feasible to re-allocate resources from low to higher potential projects in the firm	4.4	19.1	11.5	32.3	32.8	**3.70**	**1.224**
TraCap_3	Management has goodwill to re-allocate resources within projects when feasible	21.9	45.7	7.0	8.9	16.6	**2.53**	**1.366**
	Overall - Resource Reallocation						**3.31**	**1.343**
	Strategic Alliances							
TraCap_4	The company has a collaborations and partnership policy	35.4	28.5	5.3	12.3	18.5	**2.50**	**1.524**
TraCap_5	The firm actively pursues strategic partnerships and alliances	1.0	34.1	16.6	30.5	17.9	**3.30**	**1.146**
TraCap_6	The company has a functional active collaboration and linkages office	17.9	43.4	4.6	19.9	14.2	**2.69**	**1.252**
TraCap_7	Strategic linkages have been useful towards the company's market positioning.	10.4	28.5	14.6	21.6	24.9	**3.22**	**1.202**
TraCap_8	Strategic alliances and linkages is one of our areas of focus in the strategic plan.	11.9	10.2	9.0	35.4	33.4	**3.59**	**1.441**
	Overall - Strategic Alliances						**3.06**	**1.317**
	Organization Adaptability							
TraCap_9	Our firm has invested in culture assessments for adaptability	16.6	33.1	5.3	27.2	17.9	**2.97**	**1.409**
TraCap_10	The company takes culture audit as one of the key drives of business.	5.6	34.0	5.6	27.5	27.2	**3.11**	**1.365**
TraCap_11	The customer satisfaction targets have been met in the last five years	10.3	29.5	5.6	24.1	30.5	**3.55**	**1.367**
	Overall - Organization Adaptability						3.21	1.381
	Overall Statistics						**3.19**	**1.352**

Vol. 10, No.09; 2026

ISSN: 2456-7760

4.5.2 Hypothesis testing

The objective of the study evaluated ability of transforming capability in predicting firm sustainability among Public Water Service Providers (WSPs) in Kenya. The study tested the null hypothesis, H_O: There existence no statistically significant effect of transforming capability in predicting sustainability among Public Water Service Providers (WSPs) in Kenya.

In order to test this hypothesis, the weighted scores of this exogenous variable were regressed in a supervised learning model with the classifier of firm sustainability in a linear discriminant model. The study generated group statistics and the equality of means values in order to assess if there were possible linear combinations of features within the transforming capability among the sixty-seven public WSPs that could effectively separate different groups (classes) in a dataset. These were considered useful to provide insight into the possible decision boundaries that could classify either any new or unseen data points for WSPs into the most probable firm sustainability group. The results are presented in Table 4.5.

Table 4.5: Group Statistics and Test of Equality of Means for Transforming Capability

Group Statistics					
WSP_Sustainability		**Mean**	**Std. Deviation**	**Valid N (listwise)** Unweighted	Weighted
1	Transforming_ Capability	2.98174	0.439038	23	23.000
2	Transforming_ Capability	3.57964	0.301433	24	24.000
3	Transforming_ Capability	4.28265	0.156033	20	20.000
Total	Transforming_ Capability	3.58425	0.614202	67	67.000

Tests of Equality of Group Means					
	Wilks' Lambda	F	df1	df2	Sig.
Transforming Capability	0.273	85.288	2	64	0.000

The results in Table 4.5 show the group statistics for the transforming capability across the three different classifiers of WSP_ sustainability. The table shows that the first category of " Not acceptable " was achieved a low mean of 2.99 followed by the "Acceptable" level of sustainability category with 3.58 and finally by a higher mean of 4.28 for the third category of " Good" level of of sustainability. The table further shows that the three categories had a variation

in the standard deviations associated with the group standard deviations, ranging from a low of 0.16 for the " Good" category of sustainabilitys category to a high of 0.44 for the " Not Acceptable " category of WSP_sustainability. These group statistics show that transforming capability as one of the dynamic capability measures among Public Water Service Providers (WSPs) can be a good classifier in the Linear Discriminant Analysis (LDA) model.

Additionally, the Table presents the test of equality of group means for the exogenous variable. The purpose of this output was to determine if the average values (group means) of the three categories of WSP_sustainability were statistically significant from each other. This test checked whether the observed differences in group means were likely to be as a result of a random occurrence or due to a real effect. The Table shows that Wilks' Lambda (Λ) was 0.273, with F- value of of 85.288 at 2 degrees of freedom and an associated p-value of $p<0.001$. This means that 0.273 of the variations in the WSP_sustainability is not explained by the exogenous variable (transforming capability) among WSPs in Kenya. The coefficient of Wilks' Lambda is closer to zero [(→ 0)] and hence implying that transforming capability had a strong discriminant power in the LDA model.

Based on this insight, transforming capability's associated summary of Canonical Discriminant Function coefficients were extracted and the output is presented in Table 4.35.

Table 4.6: Summary of Canonical Discriminant Functions- Transforming_Capability

Eigenvalues

Function	Eigenvalue	% of Variance	Cumulative %	Canonical Correlation
1	2.665[a]	100.0	100.0	0.853

a. First 1 canonical discriminant functions were used in the analysis.

Wilks' Lambda

Test of Function(s)	Wilks' Lambda	Chi-square	df	Sig.
1	0.273	83.130	2	0.000

	Structure Matrix	Canonical Discriminant Function Coefficients	Functions at Group Centroids*		
	Function	Function	WSP_Sustainability Function		
	1	1	1	2	3
Transforming_Capability	1.000	3.069	-1.849	-.014	2.144

Vol. 10, No.09; 2026

ISSN: 2456-7760

(Constant)	-11.002
*	

The output in Table 4.6 reflects that transforming capability as an exogenous variable had an Eigenvalue of 2.67 and an associated canonical correlation of 0.85, meaning that the discriminant function of transforming capability had high discriminant power in the different categories on WSPs_ sustainability and that it explained a higher proportion of variance between the three categories of firm sustainability. This Eigenvalue implies that transforming _ Capability contributed a ratio of 2.665 to the between groups sums of square to the within-group sum of square and the overall classification accuracy of the Linear Discriminate model of this exogenous variable and WSPs sustainability.

The table further shows that Wilks' Lambda associated with the LDA was 0.27 and related p-value of $p<0.001$. This means that approximately 27.3% of the variation in Public WSPs sustainability categories, "Good", "Acceptable" and "Not Acceptable" is not explained by the LDA function between WSP's transforming capability and WSP sustainability among public water service providers in Kenya.

These results mean that the LDA model can explain approximately 72.7% of the variations in the different categories of WSP_sustainability. Based on these statistics, this study rejects the null hypothesis that transforming capability is not statistically significant in predicting sustainability among Public Water Service Providers (WSPs) in Kenya and indeed confirms that transforming capability has a statistically significant discriminant power of sustainability among public WSPs in Kenya.

The table further shows that the structure matrix/ structure coefficient loadings associated with transforming capability 1.00. This indicates that transforming capability contributes a weight of 1.00 in the discriminant model of firm sustainability among the three categories of WSP sustainability. This loading is greater than a loading of 0.30 meaning that it has a strong positive influence (coefficient >0.85) in the discriminant model. Similarly, the table shows the canonical discriminant function coefficients for transforming capability. These coefficients indicate the contribution of transforming capability in the LDA function. The table shows that this exogenous variable is associated with a coefficient 3.069, and a constant of - 11.002.

The coefficient 3.069 is positive meaning that it contributes towards the separation of the three categories of WSPs sustainability "Good", "Acceptable" and "not acceptable". The table also shows that the functions at group centroids for the three categories of WSPs sustainability. The mean associated with WSPs with "Good" level of sustainability was 2.144, followed by -0.014 for those in "Acceptable" level of firm sustainability and finally by a mean of -1.849 for the "Not Acceptable" category of firm sustainability. These centroids show that the classification (centers) in each feature space for the three different categories of WSPs sustainability were well differentiated as the reported centroids do not overlap at all and the difference between any of the

Vol. 10, No.09; 2026

ISSN: 2456-7760

firm sustainability category were greater than |1.863|, that is, the centroid/ the unstandardized canonical means between the "acceptable and the not acceptable category of WSPs.

The table shows the unstandardized canonical discriminant functions evaluated at group means (group centroids). The group centroids indicate that low coefficients of the weighted responses for transforming capability favored the first category of WSP sustainability ("not acceptable") level of sustainability. On the other extreme, high weighted scores in the transforming capability measure favored/ had higher likelihood for "Good" category of WSP sustainability (group_3) classification, while the final category ("acceptable") favored the middle space in the LDA function. In general, these results show that higher measures for transforming capability practices are associated with more WSP-sustainability among public Water Service Providers in Kenya. These statistics imply that the Linear Discriminant Model for transforming capability and WSP sustainability among WSPs in Kenya would be;

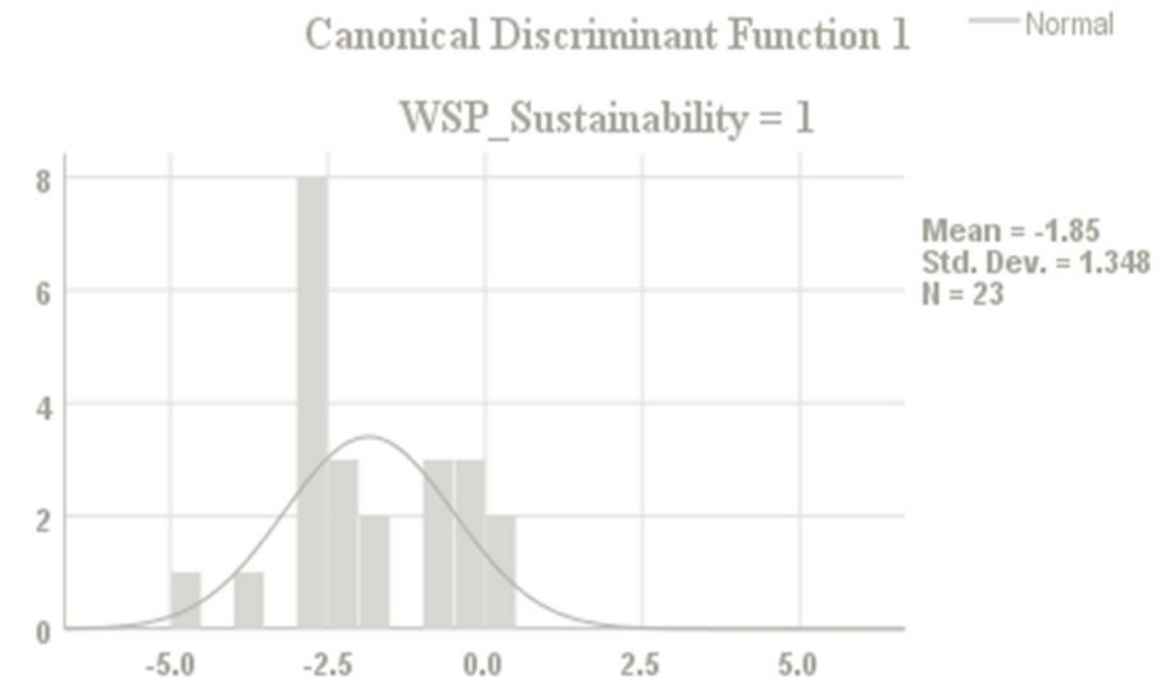
WSP_Sustainability = -11.002 + 3.069 (Transforming_Capability

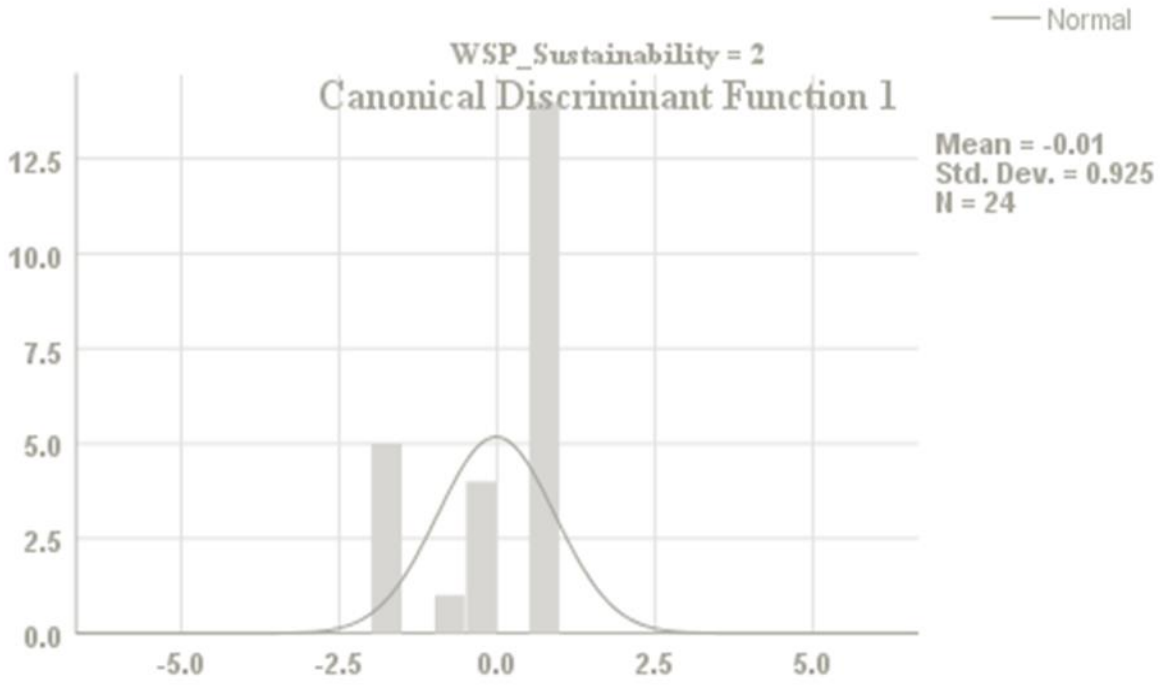
These results agree with a study by Liang et al. (2022) in Korea on the dynamic capabilities necessary for firms to execute environmental, social and governance (ESG) strategies and explored the sustainable management performance resulting from these capabilities. Their findings revealed that absorptive capability and adaptive capability (transformative) exerted a significant influence on sustainable management performance, with the implementation of an ESG strategy serving as a mediating factor. These results also agree with Lee and Poh (2023), Kiiru (2015) and Dentoni and Pascucci (2016). These findings are in alignment with the theoretical proposition by the dynamic capabilities theory and they support the assumptions of the stakeholders' theory and the porter's five forces model as application of these theories embodies transforming capabilities resulting to value creation for the stakeholders and industry players. The findings support the assumptions of the TBL and BSC models in measurement of value creation.

This study further evaluated the classification performance of the Linear Discriminant Analysis model between transforming capability and sustainability among public WSPs in Kenya. First the visual classification of the separate centroids was generated. The separate groups' graph for canonical discriminant functions, together with their associated gaussian distributions are presented in Figure 4.4

Vol. 10, No.09; 2026

ISSN: 2456-7760





Vol. 10, No.09; 2026

ISSN: 2456-7760

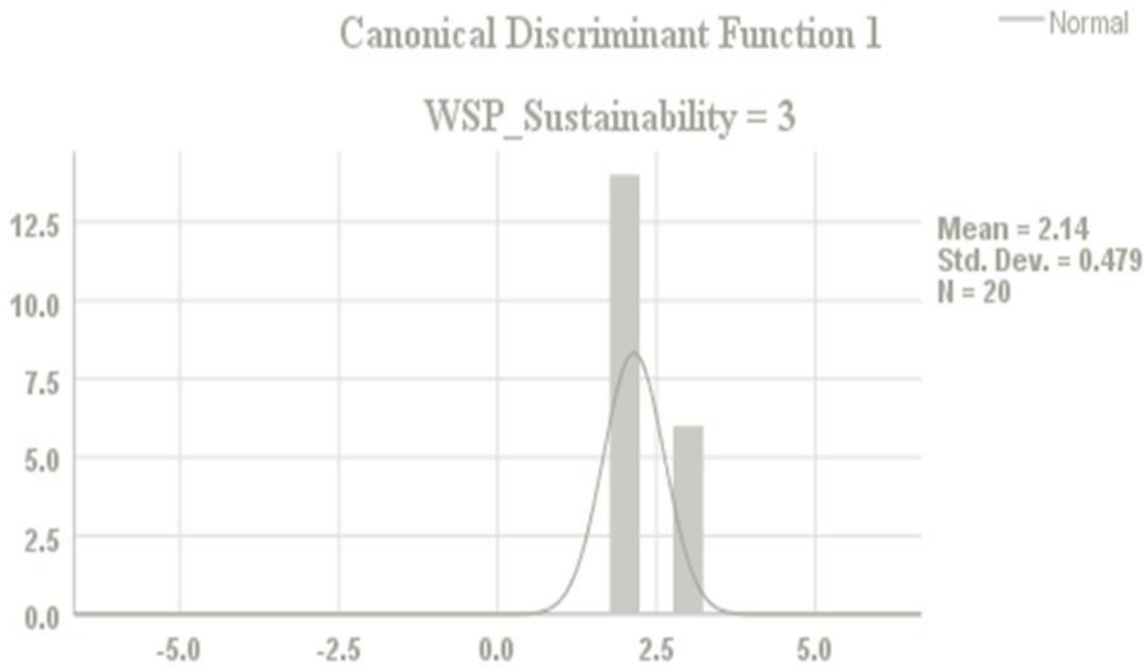


Figure 4.4: Separate Groups Graph for Transforming Capability and WSP Sustainability

The output Figure 4.4 shows that class three discriminant functions had a clear discrimination among the public water service providers in Kenya. On the lower scale, were the "Not Acceptable category", followed by those in cluster 2 "Acceptable" in the middle and finally in cluster 3 "Good" in the higher values, far to the right. In order to evaluate the performance of the LDA function for the transforming capability, this study generated both the confusion table and the 'Jack-Knife'/ cross validated classification table. The results are presented in Table 4.7.

Vol. 10, No.09; 2026

ISSN: 2456-7760

Table 4.7: Confusion Matrix and Jack-Knife Classification Table for Transforming Capability

Classification Results- Transforming Capability[a,c]

			Predicted Group Membership			Total
		WSP_Sustainability	1	2	3	
Original	**Count**	1	15	8	0	23
		2	5	19	0	24
		3	0	0	20	20
	%	1	65.2	34.8	.0	100.0
		2	20.8	79.2	.0	100.0
		3	.0	.0	100.0	100.0
Cross-validated[b]	**Count**	1	15	8	0	23
		2	6	18	0	24
		3	0	0	20	20
	%	1	65.2	34.8	.0	100.0
		2	25.0	75.0	.0	100.0
		3	.0	.0	100.0	100.0

a. 80.6% of original grouped cases correctly classified.
b. Cross validation is done only for those cases in the analysis. In cross validation, each case is classified by the functions derived from all cases other than that case.
c. 79.1% of cross-validated grouped cases correctly classified.

The table shows the observed categories of WSPs sustainability and the predicted categories. The counts and the percentage of corrected predicted cases are presented in the diagonal line and shows that 65.2% of the WSPs under the "Not Acceptable" (count 1) category are correctly classified, 75.0% in the "Acceptable category" (count 2) are correctly classified and that 100% of the cases in "Good category" (count 3) are correctly classified. In order to evaluate and assess how well the LDA model of transforming capability would generalize any new cases and the unseen data, the 'jack-knife' classification results were generated.

The purpose of this step was also to safeguard model from overfitting and hence support make comparison of other endogenous variables in the study. The table shows that 79.1% of the cross validated grouped cases were correctly classified. The cross-validated results show that only the "Good" category of sustainability achieved a 100% correct classification. The "Not Acceptable" (class 1) and "Acceptable" (category 2) achieved a 65.2% and 75.0% correct classification respectively.

From these outputs, the study concluded that the LDA between transforming capability and firm sustainability of public water service providers' sustainability in Kenya achieved a hit ratio of 79.1%. This 'hit ratio' greater than a hit ratio of 33.3% which can be achieved by chance in an equal sample size of the sixty-seven WSPs distributed across the three categories of sustainability. This hit ratio is also greater that a hit ratio of 75% which is the minimum

Vol. 10, No.09; 2026

ISSN: 2456-7760

acceptable for a good classifier (Bentaleb, Houad & Mestari, 2025). They confirm that the LDA between transforming capability and sustainability of public water service providers in Kenya is a useful model in predicting any new cases of WSPs sustainability, based on the transforming capability practices. These results agree with studies by Liang et al. (2022), Lee and Poh (2023), Kiiru (2015) and Dentoni and Pascucci (2016).

5.0 Conclusion

The third study objective focused on transforming capability. This study found that this Linear Discriminant Analysis function between transforming capability and firm sustainability of public water service providers in Kenya achieved a hit ratio of 80.6% for original classification and associated Jack-knife hit ratio of 79.1%. The test of equality of group means has a Wilks' Lambda (Λ) of 0.273, F-Statistic of 85.288 and a p-value of 0.000 at 95% degree of confidence. The canonical correlation for this variable was 0.853. Informed by these statistics, this study rejected the null hypothesis that transforming capability is not statistically significant in predicting sustainability among Public Water Service Providers (WSPs) in Kenya and indeed confirms that transforming capability has a statistically significant discriminant power on firm sustainability among public WSPs in Kenya at 95% level of confidence. The study recommends that WSPs should enhance their ability to continuously reconfigure their capabilities to seize identified opportunities in the dynamic business environment to guide choices for competitive action as a key strategy towards driving firms' sustainability.

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