

Operational Risks Ascendancy on Water-Sanitation Infrastructure Investments in Kenya

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ABSTRACT

This paper addresses the ascendancy of operational risks on Water-Sanitation Infrastructure investments in Kenya. Deductive reasoning is used to put forward theories that are tested by means of fixed, predetermined research design and objective measures. The study adopts a mixed methodology research design where qualitative and quantitative research approaches are used to test the research hypotheses. From a target population of 127, Total Population Sampling (TPS) was adopted whereby the whole population was studied. Both descriptive and inferential analysis methods were employed in the analysis. The study results show that water service providers are hobbled by weak incentives for better performance, aging infrastructure, ineffective operations and maintenance, weak institutional capacity and little accountability to consumers. From the empirical evidence and conclusion, going forward operational risks would be managed through government enhanced role in absorbing risks aimed at a subsidy plan for investors in Water-Sanitation Infrastructure and strategic pricing through payment for environmental services meant to sustain projects.

Keywords: Operational Risks, Infrastructure Investments, Water and Sanitation, Model risk

I. INTRODUCTION

Globally, access to water and improved sanitation is critical as affirmed by the Millennium Development Goals (MDG), Agenda 63 of AU and Kenya Vision 2030 (African Union Commission, 2015; Ndung'u, Thugge & Otieno, 2011). This has massive contribution towards averting health related costs. Thus investing in the sector is critical. Based on tabled stakeholder briefs governments and other stakeholders have continued to invest resources currently estimated at between \$74 and \$166 billion per year (Hutton & Varughese, 2016). The WHO/UNICEF Joint Monitoring Programme for Water Supply, Sanitation and Hygiene (JMP) recently reported, 2.2 billion people lack access to safely managed drinking water services and 4.2 billion people lack safely managed sanitation services. Around forty percent of the population in Sub-Saharan Africa (SSA) lack access to safe drinking water sources, while sixty-nine percent do not have access to improved sanitation facilities (Africa Development Bank, 2011). The situation is worse in rural areas, where fifty-five and seventy-six percent have no access to safe drinking water and adequate sanitation, respectively (Africa Development Bank, 2011). Low access to sanitation and water supply are root cause of many diseases affecting continent. Access to water and sanitation is a human right, yet numbers show no guarantee to all. By 2025, it is estimated that Africa's population will have grown to approximately 1.34 billion people, and with uneven distribution of water across the continent, where some areas are already suffering lack of fresh water availability, more than 25 African countries will be subject to water scarcity or water stress, with Northern Africa facing the worst predictions (Africa Development Bank, 2011).

In Kenya, the drive towards improvement in water and sanitation infrastructure investments dates back in the late 1960s upon attainment of independent. This has seen investment in basic facilities including water and sewerage nationalized for purposes of improved economic access to water and sanitation services aimed at improving health outcomes (Nyanchaga, 2016). The sector however, continues to face risks as water and sanitation infrastructure investments targets especially in rural coverage is below the expectations as indicated in the Ministry's blueprint. In the National Water Services Strategy, the government aimed at achieving 80% access to safe and reliable water for urban areas and 75% for rural areas by 2015 (WASREB, 2019). The Water, Sanitation and Hygiene (WASH) joint monitoring programme report by the World Health Organization and UNICEF (2020) however show that only 59% of Kenyans have access to basic water services and only 29% have access to sanitary services.

II. THE PROBLEM

Despite capital investments related to Water and sanitation infrastructure ranging between \$74 and \$166 billion per year the World Health Organization and UNICEF (2020) Joint Monitoring Programme for Water Supply, Sanitation and Hygiene recently reported, 2.2 billion people lack access to safely managed drinking water services and 4.2 billion people lack safely managed sanitation services. Around 40 percent of the population of Sub-Saharan Africa still lack access to safe drinking water sources and 69 percent do not have access to improved sanitation facilities (Armah et al., 2018). The situation in rural areas is even worse, with 53 percent and 76 percent not having access to safe drinking water and adequate sanitation, respectively (Armah et al., 2018). The investment required to meet Africa's water needs is estimated at US\$50 billion to US\$54 billion per year for each of the next twenty years (Africa Development Bank, 2011). Forecasts on annual spending required for the water sector reveal a sizeable financing gap.

In Kenya, water supply and sanitation investments only cater for 42 percent and 31 percent of the population (World Bank, 2020). The lack of water and sanitation exacerbated by accelerated inflation, poor cost recovery, Lack of access to financing, weak governance and institutional frameworks adversely affects Kenyan citizens' health, as well as their access to educational, economic opportunities, their work efficiency and labour productivity. Further, Water Service Provider (WSP) responsible for providing water and sanitation services are hobbled by weak incentives for better performance, aging infrastructure, ineffective operations and maintenance, weak institutional capacity, and little

accountability to consumers. Operational risks are better viewed as the risk arising from the execution of an institution's business functions.

III. OBJECTIVE

The study sought to examine the influence of operational risk on water-sanitation infrastructure investment in Kenya by specifically looking at model risk, people risk, legal risk and finally political risk.

IV. LITERATURE REVIEW

A. Theoretical Review

The cost analysis is an incremental cost analysis, with estimation of the costs of extending coverage of water supply and sanitation services to those currently not covered (Haller et al., 2008). Benefits of the water supply and sanitation improvements were classified into three main types: direct economic benefits of avoiding diarrheal disease; Indirect economic benefits related to health improvement; and non-health benefits related to water supply and sanitation improvement (Curry & Weiss 1993; Hanley & Spash 1993; Field 1997). CBA Estimates and totals up the equivalent money value of the benefits and costs to the community of projects to establish whether they are worthwhile.

Cost Benefit Analysis is the primary tool for calculating the viability of projects in both the private and public sectors. (Andrews et al., 2007). These projects may be dams and highways or can be training programs and health care systems. To reach a conclusion as to the desirability of a project all aspects of the project, positive and negative, must be expressed in terms of a common unit. The most convenient common unit is money. This means that all benefits and costs of a project should be measured in terms of their equivalent money value. Breaking even for firms in the business of providing water and sanitation services need to be seen to ensure consistent going concern. Initial outlay needs to be paid back first enough to pave way for profits. The cost-benefit analysis (CBA) is the process used to measure the benefits of a decision or taking action minus the costs associated with taking that action. A CBA involves measurable financial metrics such as revenue earned or costs saved as a result of the decision to pursue a project.

V. METHODOLOGY

In order to address the ascendancy of operational risks on Water-Sanitation Infrastructure investments in Kenya positivism was adopted whereby deductive reasoning was used to specifically quantify the contribution of model risk, people risk, legal risk and finally political risk. Mixed methodology research design was appropriate since qualitative and quantitative data was used to test the supposition. A causal design was used to measure the impact a specific change will have on existing norms and assumptions. As seen in Appendix 1 the target population constitutes entities whose main mandate is water supply-sanitation (WSS) services in Kenya and oversee related infrastructure investments. Total population sampling was adopted whereby the whole population of interest in these case members who share a given characteristic was studied.

Cronbach 's alpha coefficient which is a measure of internal consistency was used to assess reliability. Reliability indices for the pilot study ranged from 0.934 to 0. 962. This suggested acceptable levels of internal consistency. This implies that the items included in measuring different constructs were indicative of the same underlying disposition. Reliability of the constructs is shown in the table below.

Table 1: Reliability Test of Constructs

Variables	Cronbach's Alpha	Number of Items	Reliability
X-Operational risks	.944	23	Accepted

Statistical analysis including Normality tests, homoscedasticity, linearity, multicollinearity tests, measures of Central tendency, Variation, Skewness, Regression and Correlation analysis were used to test the causality and determine the nature of the relation between operational risks and investment in water and sanitation infrastructure. The relationships between model risk, people risk, legal risk and finally political risk and investment in water and sanitation infrastructure was used to determine their contribution.

VI. RESULTS

A. Statistical tests

Normality tests, Homoscedasticity, linearity and multicollinearity tests were conducted. The results summarized in Table 2 indicate Skewness was between -2 to +2 and Kurtosis between -7 to +7. Correlation coefficient was less than 0.7 indicating lack of Multicollinearity. The data distribution has a very tight distribution to the left of the plot, and a very wide distribution to the right of the plot an indication that the data is not homoscedastic. The predictor variables in the regression have a straight-line relationship with the outcome variable.

Table 2: Statistical Test Results related to Operational Risks

Risks	Normality tests		Homoscedasticity test	Linearity test	Multicollinearity test
	Skewness	Kurtosis			
Operational Risks	Y (-0.28) X1(-0.55)	Y (-1.22) X1(-0.16)	From the plot the data is not homoscedastic. The data distribution has a very tight distribution to the left of the plot, and a very wide distribution to the right of the plot.	The predictor variables in the regression have a straight-line relationship with the outcome variable.	Ranges between -0.30829 to 0.55737

Bryne (2010) argued that data is considered to be **normal** if **Skewness** is between -2 to +2 and **Kurtosis** is between -7 to +7. From the analysis in table 2 above the data set is modeled for normal distribution.

From the plot in figure 1 below the data is not homoscedastic. It has a very tight distribution to the left of the plot, and a very wide distribution to the right of the plot.

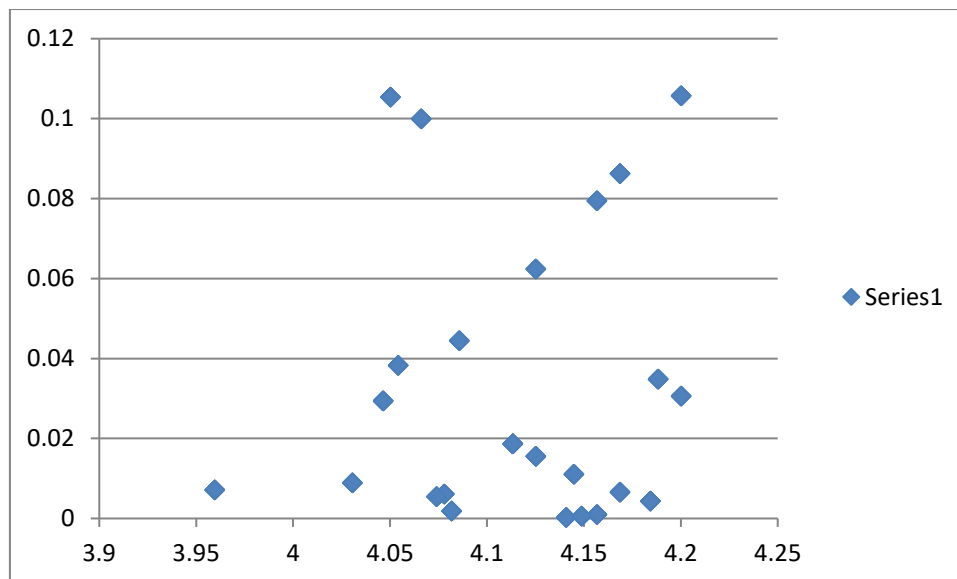


Figure 1: Operational Risk Data Homoscedasticity Test

The predictor variables in the regression have a straight-line relationship with the outcome variable.

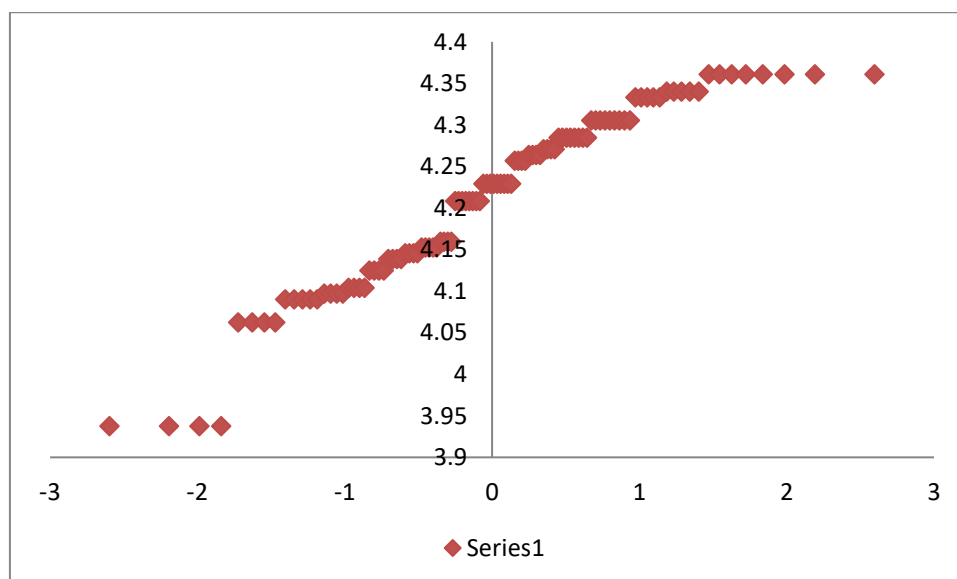


Figure 2: Operational Risk Data Linearity Test

An absolute correlation coefficient of >0.7 among two or more predictors indicates the presence of multicollinearity. Results from table 3 below signify no correlation between Model risk, people risk, legal risk and political risk.

Table 3: Operational Risk Data Multicollinearity Test

	Y	Model	People	Legal	Political
Y	1				
Model	0.557371	1			
People	0.088984	0.162121	1		
Legal	-0.02795	0.19304	0.344114	1	
Political	0.060383	-0.30829	-0.1087	0.035569	1

B. Summary Statistics and Graphs used to present the Operational Risk Properties

106 respondents ascertained the level of influence of model risk, people Risk, Legal Risk and Political Risk on infrastructure investments in water and sanitation as seen in figure 1. From the five-point Likert scale respondents agreed on the influence of model risk at 76.1%, people risk at 55.4%, legal risk at 100% and political risk at 100%.

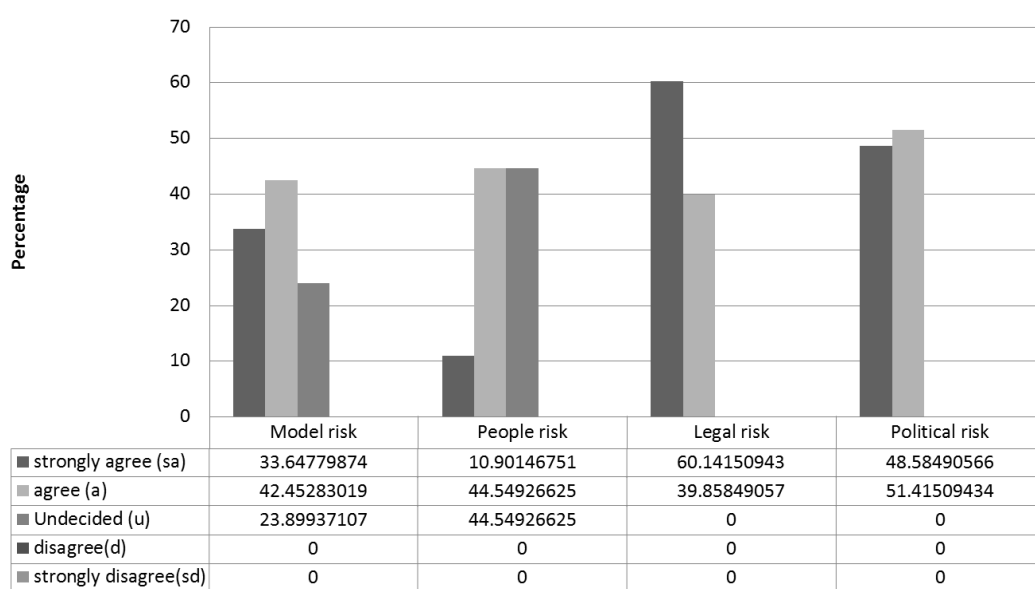


Figure 3: Summary Statistics and Graphs used to present Model Risk, People Risk, Legal Risk and Political Risk.

C. Regression analysis

The results indicate a strong impact of the predicting quality of the coefficient. The results show that Operational risk on Infrastructure investments in Water and Sanitation is significant. The t value at 3.338 for the independent values indicates a strong impact of the predicting quality of the coefficient. With a p-value of 0.001169 statistically is highly significant. We therefore accept our earlier supposition that Operational risks have a significant relationship with Water-sanitation infrastructure investments in Kenya.

Table 4: Regression Statistics results

Multiple R	0.634302
R Square	0.402339
Adjusted R Square	
Square	0.378669
Standard Error	0.15063
Observations	106

ANOVA					Significance
	Df	SS	MS	F	F
Regression	4	1.542693	0.385673	16.998	1.1E-10
Residual	101	2.291623	0.022689		
Total	105	3.834316			

	<i>Coefficients</i>	<i>Standard Error</i>	<i>t Stat</i>	<i>P-value</i>	<i>Lower 95%</i>	<i>Upper 95%</i>
Intercept	0.693898	0.635835	1.091317	0.27773	-0.56743	1.955224
Model	0.655731	0.081314	8.06418	1.57E-12	0.494425	0.817036
People	0.084036	0.089317	0.940873	0.349015	-0.09315	0.261217
Legal	-0.17713	0.076296	-2.32163	0.022261	-0.32848	-0.02578
Political	0.276873	0.080211	3.451824	0.000814	0.117757	0.43599

The results show that operational risk on Infrastructure investments in Water and Sanitation is significant. The regression equation can be used to predict Infrastructure investments in Water and Sanitation. This means that our model explains the Adjusted R Square of the variance in operational risks. The result stipulates that there is a highly significant, direct and positive relationship between the sub-variable and Infrastructure investments in Water and Sanitation. The variable makes a strong unique contribution to explaining risks associated with Infrastructure investments in Water and Sanitation. Correlation analysis at .31113 implies that the risk has a significant positive relationship with the Water and Sanitation Infrastructure investments in Kenya. Operational risks analyzed significantly negatively impacts past and ongoing Water and Sanitation Infrastructure Investments hence the gaps which have seen water supply and sanitation investments only cater for 42 percent and 31 percent of the population respectively.

D. ANOVA Operational Risk and Investment in Water and Sanitation Infrastructure

Table 5: Analysis of Variance

ANOVA					
	<i>Df</i>	<i>SS</i>	<i>MS</i>	<i>F</i>	<i>Significance F</i>
Regression	1	0.371169	0.37116	11.1464	0.001169
Residual	104	3.463147	0.03329		
Total	105	3.834316			

	<i>Coefficient s</i>	<i>Standard Error</i>	<i>t Stat</i>	<i>P-value</i>	<i>Lower 95%</i>	<i>Upper 95%</i>
Intercept	1.724725	0.716336	2.40770	0.01781	0.304204	3.145245
Operational Risk	0.567617	0.170015	3.33862	0.00116	0.23047	0.904764

Results indicate a strong impact of the predicting quality of the coefficient. The results show that Operational risk on Infrastructure investments in Water and Sanitation is significant. The t value at 3.338 for the independent values indicates a strong impact of the predicting quality of the coefficient. With a p-value of 0.001169 statistically is highly significant. We therefore accept our earlier supposition that Operational risks have a significant relationship with Water-sanitation infrastructure investments in Kenya.

E. Comparison of Results Related to Credit Risks

Comparison of test results from measures of Central tendency, Variation, Skewness, Regression Analysis and Correlation analysis in an effort to show the contribution of operational risks explaining infrastructure investments in the water and sanitation sector.

Table 6: Comparison of Results Related to Model Risks, People Risks, Legal Risks and Political Risks

Variable/ Risk	Std. Dev.	Mean	t Stat	P/Sig F	Adj. R ²	Beta	Corr. analysis
X ₁ – Operational	0.01	4.21	3.34	0.00	0.38	0.57	0.31
Sub-var.	Std. Dev.	Mean	t Stat	P/Sig F	Adj. R ²	Beta	Corr. Analysis
Model	0.42-0.45	3.2- 4.7	6.85	0.00	0.30	0.66	0.56
People	0.45-0.48	3.2- 4.3	0.91	0.36	0.00	0.08	0.09
Legal	0.42-0.46	4.2- 4.7	-0.29	0.78	-0.01	-0.18	-0.03
Political	0.45-0.47	4.2- 4.6	0.62	0.54	-0.01	0.28	0.06

Standard deviation results range between 0.42-0.48. This falls within the bracket of ≤ 1.25 which is acceptable. From our 5 point Likert scale the average value /mean of the operational risks data set ranges between 3.2- 4.7. At $|t| \geq 1.96$ the overall t value for the independent values indicates a strong impact of the predicting quality of the coefficient. The overall p-value at less than 0.05 (typically ≤ 0.05) is statistically significant. For the Adjusted R square findings showed that Operational risks explain the variations in water sanitation investments while the difference is explained in other factors not in the model. According to Cohen (1988, 1992), the effect size is weak/low if the value of r varies around 0.1, Moderate/medium if r varies around 0.3, and strong/large if r varies more than 0.5. Model risk makes the strongest unique contribution explaining infrastructure investments followed by political risk, people risk and legal risk making the least contribution.

VII. CONCLUSIONS

The results have demonstrated that there is a significant, direct and positive relationship between the constructs of operational risks in terms of model risk, people risk, legal risk, political risk and infrastructure investments in water and sanitation. Water service providers are hobbled by weak incentives for better performance, aging infrastructure, ineffective operations and maintenance, weak institutional capacity and little accountability to consumers. Observation from Operational risk influence on Infrastructure Investments in Water and Sanitation indicate a significant positive relationship.

As an advancement government enhanced role in absorbing risks will see a subsidy plan for investors in water and sanitation infrastructure, strategic pricing through payment for environmental services meant to sustain projects. Strengthening financial models used in assessing and managing debt and forecasts.

Enhancing Total Quality Management throughout water service providers to ensure adherence to the firm procedures, practices and rules aligned to investments. Harmonization of conflicting laws in a way that transactions do not conflict with legislations. Smooth transition of infrastructure investment projects despite changes in government policies aimed at reducing diverse impacts on investors.

VIII. RECOMMENDATIONS AND AREAS FOR FURTHER STUDY

Observation from Operational risk influence on Infrastructure Investments in Water and Sanitation indicate a significant positive relationship. As an evolution government enhanced role in absorbing risks will see a subsidy plan for investors in water and sanitation infrastructure, strategic pricing through payment for environmental services meant to sustain projects. Future research into emerging theories related to operational risks and investments would address unanswered aspects of the research problem.

In addressing the ascendancy of operational risks on Water-Sanitation Infrastructure investments policy formulators, industry players and stakeholders are guided from a global perspective of water and sanitation infrastructure investment risks to the Kenyan context. Constructing the same research in a new context and addressing a new research problem within the settings of a different sector such as Commercial Facilities Sector, Communications Sector, Critical Manufacturing Sector or Energy Sector would build an all-inclusive and customizable Enterprise risk management strategy paper. To re-assess and expand the research framework future studies would best address the effects of emergence of new evidence and/or other recent phenomena.

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Appendix 1: Sample Size Table

	List of clusters in the target population	Cluster	Managers
1	Eighty-Eight (88) Water Service Providers were in four clusters of water and sanitation providers as guided by the Water services Credit board IMPACT Report No. 11/2019.	Very large water service providers ($\geq 35,000$ Connections)	11
		large water service providers (10,000 -34,999 Connections)	34
		Medium water service providers (5,000-9,999 Connections)	16
		Small water service providers ($\leq 5,000$ Connections)	27
2	State corporations regulating Water and Sanitation Infrastructure Investments.		9
3	Water Infrastructure Financing Institutions and stakeholders offering Grants, Concessional loans, Infrastructure Bonds and Private Equity Placements.		21
4	Water Works Development Agencies charged with the development, maintenance and management of water and sewerage infrastructure in 47 counties.		9
	Total Number of Managers		127