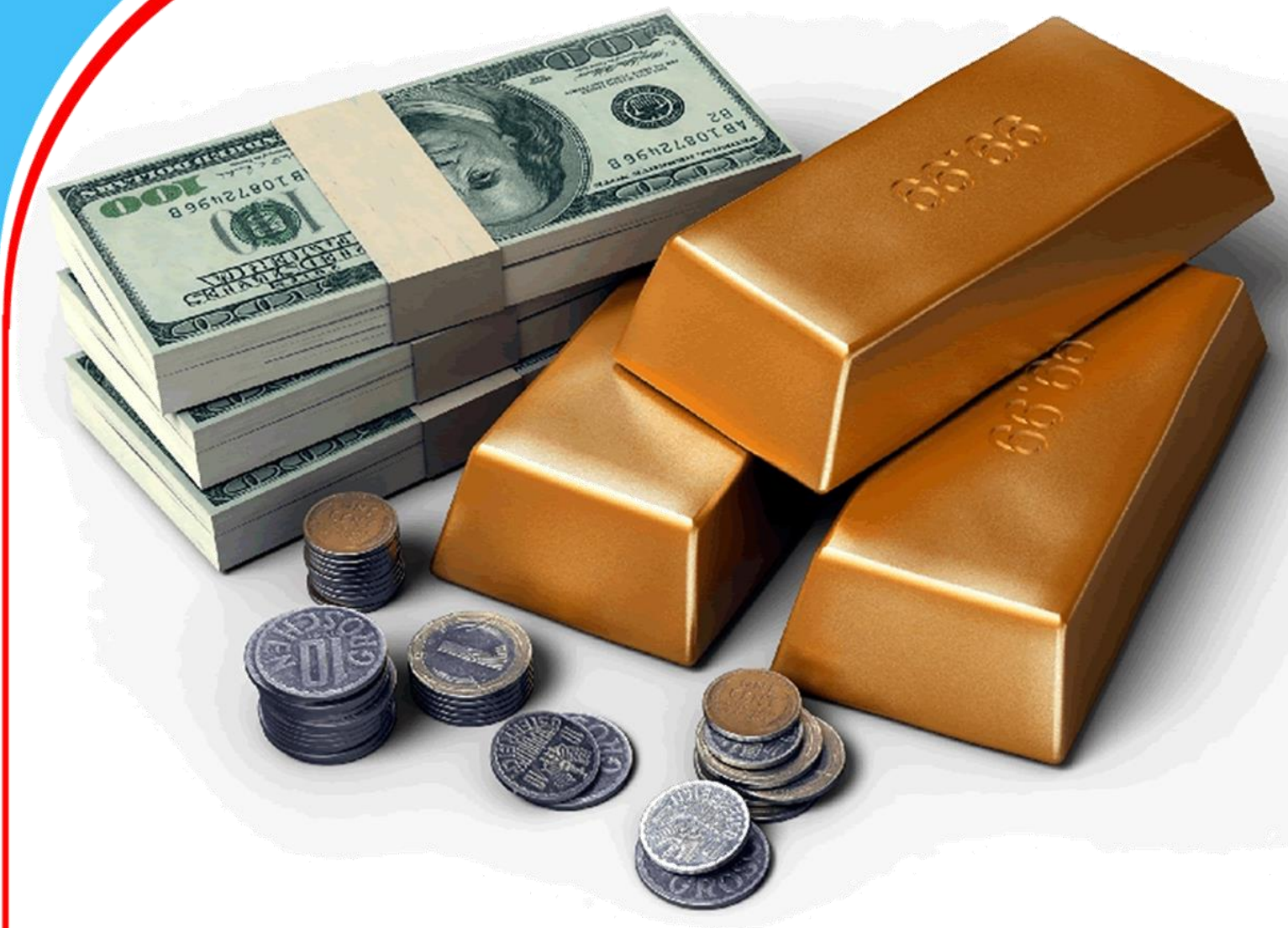
American Journal of
Finance
(AJF)



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American Journal of Finance
ISSN 2520-0445 (Online)
Vol. 11, Issue 2, pp 19 - 35, 2025
www.ajpojournals.org

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Article History
Submitted 23.04.2025 Revised Version Received 28.05.2025 Accepted 25.06.2025

Abstract

Purpose: The study investigates the effect of implementation capacity on the relationship between the internal, external and PPP infrastructure financing methods and the success of public capital projects in Kenya.

Materials and Methods: Using positivistic approach, the study adopted descriptive cross-sectional design to analyze data from high-impact infrastructure projects in the roads, energy, and water & sanitation sectors under Kenya's Medium-Term Plans (MTP I and MTP II). A sample of 313 projects were purposively and randomly selected covering the three types of infrastructure projects and ensuring representation across all regions of the country from projects developed in the three sectors over the 10 year period. A response rate of 260 high-impact infrastructure projects (representing 83%) was achieved with secondary data on cost and time overruns, for each of the three identified infrastructure financing methods analyzed using ratio scale, and primary data collected from the project managers' perceptions of implementation capacity using Likert Scale of 1 to 5 where 1 was the lowest and 5 was the highest.

Findings: The study findings show that the effect of implementation capacity on the relationship between internal financing and success of public capital project in terms of costs overrun was negative; for external infrastructure financing positive; and for PPP financing negative. In the case of time overruns the effect on internal infrastructure financing was positive; for external financing the effect was negative; and on PPP infrastructure financing the effect was negative. The study also notes that out of the four factors explaining the implementation capacity, payment to the contractors exhibits the highest risk.

Unique Contribution to Theory Practice and Policy: The study recommended that the government prioritize external financing over internal financing; strengthen implementation capacity by improving the payment to contractors; and further study be made on PPP financing once more capital projects are developed using this mode of financing.

Keywords: *Internal Infrastructure financing; External Infrastructure Financing; PPP Infrastructure Financing; Implementation capacity; public capital projects; cost and time overrun*

JEL Codes: *H54, H63, H72, O21*

INTRODUCTION

Infrastructure is a critical catalyst to the Kenya's realization Vision 2030, the country's agenda for transformation to a middle-income economy by 2030, as it is pivotal in ameliorating transport, water and sanitation, and energy sectors which are critical for accelerated economic development (World Bank, 2023). Evidence shows that, though the country has been allocating significant budgets on capital projects development every year, the infrastructure contribution to Kenya's economic growth has remained relatively low compared to other middle-income countries (African Development Bank, 2022). Research shows that the infrastructure financing in Kenya like most of other African countries is through governments own revenues, loans and grants from development partners and private sector capital (Cirolia, Pollio, & Pieterse, 2021). Therefore, the relatively poor contribution of infrastructure development despite the high budget raises important questions regarding the effectiveness of financing including its sources and hence the need to investigate factors beyond mere financing and sources which may contribute to successful project implementation.

Infrastructure financing is any method of funding construction of an asset which could also involve the renewal, rehabilitation or reconstruction of an existing asset (Ploeg, 2006). Methods of securing capital for infrastructure development can either be traditional or innovative financing, which Ploeg (2006) opines that it could be through 'pay-as-you-go' or borrowing. Implementation capacity is the ability to coordinate projects, administer them, and supervise procurement and other implementation factors sustainably (Asian Development Bank (ADB), 2005; Babatunde, et al., 2014). Infrastructure implementation is the process that begins at planning and approvals stage through financial allocations, physical construction, detailed engineering to commencement of operations (World Bank, 2007; Abura and Omwenga, 2022). Success of public capital projects is where an infrastructure achieves the required quality standards and has no or minimal cost and time overruns (Gbahabo and Ajuwon, 2017; Atkinson, 1999). Pinto and Slevin (1987) defines successful implementation of capital project if it is completed without budget and time overruns, meets the expectation of the users, and its design goals and objectives. According to Ashley, Laurie and Jaselskis (1987) a capital project is considered successful when developed within the time span and at higher than expected value for money.

Research shows that despite the availability of financing, which is important for successful public capital projects, other factors such as implementation capacity, governance quality, and external socio-political environments contribute significantly to the success of capital projects (Xu et al., 2021; Akinyemi & Adewale, 2023). Other studies undertaken in China (Zhao & Feng, 2020) have emphasized that successful implementation of capital projects by any country depends not merely on the infrastructure finance availability or source, but also on the efficiency and commitment of implementation capacity of the implementing agencies, coupled with conducive external environment. Amadi & Nwachukwu, (2022) studies show that even with sufficient infrastructure financing, or even the best source of the financing, if there are cost overruns, delays or project abandonment will negatively affect the infrastructure project contribution to the economic development of the country. Kenya has been facing these challenges (as demonstrated above), whereby despite heavy investments under Vision 2030, the country struggles with unsuccessful project implementation with high cost and time overruns that hinder its progress toward achieving its economic growth goals.

Therefore, this study was motivated by the tenacious unsuccessful Kenya's public capital projects implemented in the past, and the country continues to experience infrastructure development inefficiencies despite high budgetary allocations (Kenya National Bureau of

Statistics, 2023). Although existing research has to a great extent examined the role of infrastructure financing and that of enabling the external environment towards the success of capital projects, the role of implementation capacity and its effect to the relationship of the various sources of infrastructure financing to the achievement of successful capital project has been limited. Previous studies have emphasized issues like corruption, political instability, and governance deficits as major hindrances to infrastructure success (Mwangi, 2021). However, few have explored how implementation factors such as supervision capacity, planning capacity, and procurement efficiency, and ability of the implementing agencies in paying contractors timely impact on infrastructure delivery through the various financing models in Kenya. This is a gap in the literature that this study sought to address.

Well-designed policies and strategies can be implemented badly if they lack appropriate administrative resources and organizational structures, contributed by issues like Poor budgeting and planning, inadequate financial allocation, lack of adequate project supervision, lack of coordination among the construction designers (Steinebach, 2022). Badu, Edwards, Owusu-Manu and Brown (2012) provided several variables to explain the implementation capacity challenges of infrastructure, to include the law enforcement of a country, the maintenance and replacement of the country's infrastructure assets as well as the fiscal prudence that leads to poor budgeting and planning and inadequate long-term financing (at fixed interests) and corruption.

Problem Statement

This study aims to investigate the role of implementation capacity and how this affects the relationship between various modes of infrastructure financing and the successful delivery of public infrastructure projects. Mutua et al., (2022) did indicate the need to further investigate the Kenya's institutional and implementation capacity, towards the development of infrastructure projects. Odhiambo & Wamuyu, (2021) also notes in their study that while financial and external factors are crucial, the operational efficiency of implementing agencies, with reference to procurement processes, and their capacity in project planning and coordination has a direct effect on the success of capital projects, and hence the need to undertake more detailed study in these areas. This study has therefore recognized that undertaking research on these institutional weaknesses is essential for understanding the broader challenges affecting Kenya's infrastructure ambitions.

The contribution of this study is in its practical implications by the policymakers in Kenya, as it focused on how the institutions capacities could be strengthened to improve governance structures and hence enhance the use of available infrastructure financing in its effectiveness and impact on economic growth (UNCTAD, 2023). Furthermore, the study's findings will contribute to the broader academic discourse on infrastructure development, particularly in low- and middle-income countries, and provide lessons that can be applied to other developing economies facing similar challenges.

Theoretical Framework and Literature Review

This study draws mainly from two theoretical frameworks, the pecking order theory, to explain the organizational preferences in funding decisions (Myers & Majluf, 1984), and agency theory, to highlight the relationships and conflicts between the principal and the agents involved in infrastructure projects development, (Jensen & Meckling, 1976). The pecking order theory states that "a firm financing decisions adapts to mitigate the information asymmetry between insiders (managers) and outside investors, with the firm turning first to the financing sources where differences in information matter least" (Meyers, 2003). According to Acharya, Parlatore, and Sundaresan, (2022) governments' optimal financing of infrastructure is

determined by the double moral hazards of (it) the government desire for expropriation of rent and the private sector firms that manage infrastructure and the private firms need for incentives to implement projects well. This therefore determines how much the governments are willing to borrow or even finance the infrastructure through PPP. Further as explained by Acharya and Sundaresan (2014), different countries have differing infrastructure financing models which all tends to adopt to the pecking order theory with countries with less information asymmetry adopting higher debt and PPP model of financing e.g. the United States, the United Kingdom, France, and most of the developed economies. On the other had most of the developing countries, due to higher level of information asymmetry tend to adopt an infrastructure financing method skewed more to pay-as-you-go from the local revenue sources (Platz, 2009; Ploeg, 2006). Thus in Kenya most of the infrastructure financing is through own generated revenues with moderate debt financing from major development agencies like the World Bank, African Development Bank (AfDB), the European Bank for Reconstruction and Development, etc with minimal PPP financing.

The agency theory founded by Alchian and Demsetz (1972) and later applied by Jensen and Meckling (1976), states the principals (the less informed) hires the agents (the more informed) to perform work through delegation of responsibilities, with the agent expected to perform the acts to the best interest of the principal. Agency Theory aims to explain how conflicts of interest arise within organizations and to identify mechanisms that can mitigate the associated costs (Silveira, 2021). Shareholders or the public in the case of governments, delegate decision-making authority to managers or the executive arm of the government expecting that the executives will act in their best interests of the public, but in practice, managers or agents in most of the times especially in the case of developing countries adopts disclosure policies that serve their own objectives (Jensen and Meckling 1976; Healy and Palepu 2001; Panda and Leepsa 2017).

Closing the infrastructure gap in Africa and other developing countries remains one of the major challenges and continues to garner increasing attention by the policy makers. Studies on capital projects development in Africa have identified major hinderances causing the high level of infrastructure gaps caused by inefficiencies, poor feasibility studies, budget overruns, and project abandonments contributing to an estimated 80% project failure rate (Misiko and Nyabaro, 2015; Gbahabo & Ajuwon, 2017; Lakmeeharan et al., 2020; Chinzara et al., 2023). Most of the studies, however, have not addressed adequately the causes of the gaps which may be attributable to the internal institutional capacities of infrastructure development agencies that would drive efficiency and success. This study fills this gap by analyzing how the implementation capacities of implementing agencies affects the relationships between various modes of infrastructure financing and the success of capital projects in Kenya.

In Iran Ahmadabadi and Heravi (2019) examined the critical success factors (CSF) of PPP projects. The study aimed at assessing success factors monitored throughout construction, operation, and final transfer stages against what had been documented as the CSFs considered during the procurement stage of the PPP project. The study carried out an opinion survey in Iran on the effects of CSFs on the success of PPP projects using PLS-SEM model. The study also validated the proposed model using data collected from national highways developed using PPP mode of financing. The results established critical success factors including the need to have the private sector party with adequate capacity during the construction and a public sector party with adequate capacity during operationalization of the infrastructure. In addition the study noted that the CSFs to be considered in designing a PPP project should include transparent bidding process, risk allocation and good partnering. The study though it noted the various important CSFs, to be considered in developing a road infrastructure project which is

similar to the PPP financing considered in this study, it did not critically review the specific implementation capacities of both the private and the public parties which in this this study have been assessed including capacities on procurement, supervision, planning and overall governance of the agencies.

Meng, Ye and Wang, (2024) undertook a study to establish financing and investing mechanism for development of sustainable infrastructure which would enable the countries achieve the United Nations Sustainable Development Goals. The study adopted the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) to analyze the financing and investment adopted based on 4308 publications covering a period of 14 years from 2009 to 2023. The published literature covered, while assuming a worldwide distribution, most of it was concentrated in Europe, Asia, and North America, bulk highest volume of research contribution coming from China, the United Kingdom, and the United States. The study concentrated on the financing and investment in social and economic infrastructure, where social infrastructure included health, education, cultural facilities, and security services; while economic infrastructure covered including transport road, railway, ports), supply (energy and water), disposal (waste management), and communication including telecommunications. The study findings were that green finance including bonds and other similar finances were significantly the dominant vehicle which financed sustainable infrastructure projects. This study, while it reviewed all other types of infrastructure financing, did not establish the risks associated with each type nor did it establish how each affect positively or negatively the success of the capital projects. Further the study did not consider how the implementation capacity of the agencies affected the relationship between the financing mechanism and the success of the capital projects. This study considered the three infrastructure financing modes of internal, external and PPP and how each is affected by the implementation capacity of the implementing agencies.

Leshore and Minja, (2019) undertook a study to establish factors affecting implementation of the Vision 230 projects in Kenya. The study focused on the successful implementation of the mega irrigation projects measured by the Kenya's ability to improve on its food security. The study was based on establishing the factors which lead to the failure of the Galana-Kulalu irrigation scheme, which in its design was touted to irrigate 1 million acres but had only achieved a coverage of 5,000 acres. The study objectives were to assess how cost related factors influenced the implementation of vision 2030 projects; how contractor specific issues affected the implementation; and assessed the importance of evaluation in the implementation of these projects. The finding of the study was that cost related factors, contractor related factors and monitoring and evaluation all significantly affected the implementation of vision 2030 projects. The study was based on one of the vision 2030 projects while this study is based on three flagship infrastructure sectors of the vision 2030 including roads, power and water and sanitation. Also the project was based on the assessment of cost related factors and how these were monitored, which was basically one of the subfactors considered in this study which includes the implementation capacity of the agencies in terms of procurement, planning, supervision and overall governance of the agencies.

Obeng et al. (2021) undertook a study focusing on governance in Ghana's infrastructure projects, which included corruption, planning, and political interference, which were considered as the underlying factors causing project failures. While this study examined these factors as critical governance-related issues, except planning which is an institutional issue, the other two factors are external environment factors. Therefore, critical governance issues which affect the institutional capacity like procurement and project supervision, and payment to the contractors were not considered which are essential for successful project delivery. This study

builds upon these findings by integrating both governance and external environment factors, thus providing a more comprehensive evaluation of the institutional bottlenecks that impede Kenya's infrastructure development. Obeng et al. (2021) study also did not consider the various modes of financing (internal, external and PPP) considered in this study on how each is affected by the implementation capacity in their relationship with the success of capital projects.

The underlying issues among the literature reviewed in this study show a consistent gap in addressing the institutional implementation capacities that influence the success of public capital projects. The literature also consistently shows lack of consideration of the various types of infrastructure financing and how each of them is affected by the different levels of institutional capacities to achieve success in the implementation of the capital projects. The study by Meng, Ye and Wang, (2024) though it aimed at identifying the type of infrastructure financing and investment which would achieve the highest level of successful development of capital projects, it did not establish the risks involved in countries adopting each type of financing instrument. Furthermore, it did not consider the internal institutional capacities as enablers in achieving the development of sustainable infrastructure. Also, the study by Ahmadabadi and Heravi (2019) considered the critical success factors associated with PPP type of financing, reviewed interinstitutional factors but did not consider internal institutional factors which would be considered in assessing the CSFs.

The findings of the study were significant to the government and the quasi-government institutions responsible for the development and implementation of the public capital projects as it informed them on the major areas of concern for the implementation of public capital projects. With the knowledge from this study, the managers were expected to take appropriate actions to ensure optimal choice of infrastructure financing method; and adequate implementation capacity for the agencies responsible for the infrastructure development. The study also informed the policy makers on factors to consider when making decisions on infrastructure financing; developing implementing institutional capacity. The government should have been able to increasingly develop successful public capital projects, directly reducing the infrastructure gap, and therefore increasing the chances of achieving the Vision 2030 development objectives.

This study further contributed to the literature existing on infrastructure finance and development and provided additional knowledge to future academicians and researchers in this area of study. The findings offered useful empirical basis to pursue further studies in the area of infrastructure financing which continues to provide challenges in most of the developing countries in the world. Areas which would benefit from further study arising from the findings of this study were the development of standard models for countries to use in assessing the most optimal method or combination thereon of infrastructure financing methods; and measures to be employed for planning and continuous assessment of other factors to ensure that capital projects were implemented with efficiency and at least cost to the public.

This study therefore is conceptualized to establish if there are any relationships between each of the three methods of infrastructure financing (independent variable), and the success of implementation of public capital projects (dependent variable), given the intervening effect of the implementation capacity. The dependent variable was measured in terms of actual cost and time overruns per each of the public capital project included in the sample. The independent variable was the proportional ratios of each type of infrastructure financing used in financing each of the sampled public capital projects. The implementation capacity was a weighted average of the various implementation capacity factors measured using Likert Scale of 1 being the lowest and 5 being the highest. They included: efficiency in settlement of contractors' bills;

procurement capacity; project supervision capacity; and the planning capacity of the implementing agency. The study hypothesis were: H_{01} = implementation capacity does not significantly intervene on the relationship between internal infrastructure financing and success of public capital projects in Kenya; H_{02} = implementation capacity does not significantly intervene on the relationship between external infrastructure financing and success of public capital projects in Kenya; and H_{03} = implementation capacity does not significantly intervene on the relationship between PPPs infrastructure financing and success of public capital projects in Kenya.

MATERIALS AND METHODS

This study adopted a positivist approach, where quantitative data were collected, and hypotheses tested to form conclusions and generalizations (Golafshani, 2003). Despite the dependent and independent variables having been measured using time series data corrected over the last 10 years of implementation of the MTP I and MPT II capital projects, the study adopted descriptive cross-sectional research design so that inferences about the population were made and relationship between dependent variable and independent variable were established based on relative performance of each of the sampled project without consideration of the time/period. By using this research design, the study used descriptive, factor analysis and multiple linear regression to establish the correlation matrix between the dependent variables and the independent variables.

The relationship between the dependent variables (cost and time overruns) and the methods of infrastructure financing (internal, external and PPP) were expressed with the first set of equations on cost overruns in the first three models as follows:

$$\text{COST\_Overrun}_i = \beta_0 + \beta_1 \text{IIF}_i + \beta_2 \text{IC}_i + \varepsilon_1 \quad \ldots\ldots 1$$

$$\text{COST\_Overrun}_i = \beta_0 + \beta_1 \text{EIF}_i + \beta_2 \text{IC}_i + \varepsilon_1 \quad \ldots\ldots 2$$

$$\text{COST\_Overrun}_i = \beta_0 + \beta_1 \text{PIF}_i + \beta_2 \text{IC}_i + \varepsilon_1 \quad \ldots\ldots 3$$

Where $COST\_Overrun_i$ is the i^{th} excess of the final actual public capital project cost over the initially budgeted cost of developing the infrastructure measured in local currency (Kenya shillings). IIF_i Is the internal infrastructure financing variable of the i^{th} public capital project that is measured as a categorical variable. EIF_i Is the external infrastructure financing variable of the i^{th} public capital project that is measured as a categorical variable. PIF_i is the PPP infrastructure financing variable of the i^{th} public capital project that is measured as a categorical variable.

IC_i = is the components of implementing capacity representing procurement capacity, supervision capacity, planning capacity and efficiency in payment to contractors. β_0= is the intercept term;

β_1 is the coefficient for infrastructure financing mode; and β_2 = is the coefficient for implementing capacity components.

The second set of equations representing time overrun are indicated in the following three models:

$$TIME\_overrun_i = \beta_0 + \beta_1 IIF_i + \beta_2 IC_i + \varepsilon_i \quad \ldots\ldots 4$$

$$TIME\_overrun_i = \beta_0 + \beta_1 EIF_i + \beta_2 IC_i + \varepsilon_i \quad \ldots\ldots 5$$

$$TIME\_overrun_i = \beta_0 + \beta_1 PIF_i + \beta_2 IC_i + \varepsilon_i \quad \ldots\ldots 6$$

Where $TIME\_overrun_i$= is the i^{th} excess of the final actual time taken to construct a public capital project, over the budgeted initial time estimated to be taken to implement the public capital project. The rest of the variables are defined in the first set of three models.

Data collection, used secondary data on cost overruns, time overruns, and mode of infrastructure financing, whereby a sample of projects was selected from a population of 637 projects (526 from the roads sector, 20 from the power sector and 91 from the water and sanitation sector) implemented and published by each of the agencies involved in development of capital projects in the three leading sectors covering the 10 years period under which MTP I and MPT II. For the implementation capacity, primary data from project managers involved in the development of the sampled projects using a Likert Scale of 1 to 5 with 1 being the lowest and 5 being the highest, was collected. A sample of 313 projects were selected based on the Krejcie and Morgan's (1970) procedures for selection of small samples, whereby with a combined of purposive and random sampling 220 projects from the road sector, 20 from the power sector, and 73 from the water and sanitation sector were selected. Purposive sampling ensured broad geographic representation across Kenya, while random sampling within each sector minimized bias and enhanced the generalizability of the findings. Respondents on implementation capacity factors were selected for their independence and knowledge of the projects, and project managers were purposively chosen to provide primary data.

Structured questionnaires were used to gather both the secondary and primary data. For the secondary data, questionnaires were designed to collect project-specific details, while for the primary data, questionnaires were designed to be completed by the project managers based on their perceptions of implementation capacity factors which included procurement capacity, supervision capacity, planning capacity and efficiency in payment to the contractors. Ratio scales were used to measure infrastructure financing variables and also the success of public capital projects (SICP), in terms of cost and time overruns. Response rate was 260 representing 83.07% of the respondents who completed the questionnaires, with 187 from the road sector (accounting for 84.09 percent), 18 from power sector (or 90 percent), and 57 from the water and sanitation sector (or 78.08 percent). The response rate of more than 78 percent was therefore over the 50 percent which is acceptable threshold (Mugenda and Mugenda, 2003; and Dixon, 2012).

The validity and adequacy test for the implementation capacity data, was undertaken using the Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy, whose results were 0.6349, which exceeded the critical value of 0.5 and confirming data validity for analysis. For the reliability test of the implementation capacity variables, Cronbach's alpha coefficient test was done, yielding a coefficient of 0.7859, which was greater than the acceptable reliability coefficient of 0.7. The linearity test was done using a correlation matrix which indicated a significant correlation between the independent and dependent variables. Multicollinearity tests were done using both VIF and tolerance of the variables, all yielding a VIF result of less than 10. Hair, Black, Babin, and Anderson (2019) notes that multicollinearity does not affect linear regression analysis if VIF is less than 10. Final test was on homoscedasticity using the Breusch–Pagan test, where all the variables had their p–value equal to 0.0000, which was less than the level of significance alpha (α) of 0.05, implying that the assumption of homoscedasticity was violated. This means that heteroskedasticity was a serious problem in the study's data. To solve for heteroscedasticity, robust standard errors were used in the regression.

FINDINGS

Descriptive Statistics

The descriptive statistics results included the analysis for the dependent variables (cost and time overruns) the independent variables (internal, external and PPP infrastructure financing methods), and for the intervening variable, (implementation capacity). Table 1 presents the descriptive statistics analysis for the dependent variables.

Table 1: Descriptive Statistics for Cost (Kshs. Million) and Time (Months) Overruns

Sub-Variables	Statement	Mean	Standard Deviation	Coefficient of Variation (Percent)
Cost overrun	Road sector	656	1790	272.87
	Energy sector	28.4	92.9	327.11
	Water and sanitation sector	127	169	133.07
	Overall	**496**	**1530**	**308.47**
Time overrun	Road sector	12	14	117.68
	Energy sector	10	11	109.25
	Water and sanitation sector	11	9.5	71.19
	Overall	**12**	**13**	**108.03**

Table 1 shows the overall mean for cost overrun in Kenya infrastructure development was about Kshs. 496 million, and a time overrun mean of 12 months. The overall standard deviation in both cases was noted to be quite high at Kshs 1.53 billion for cost overrun and 13 months in the case of time overrun, indicating significant variability in both project cost and time overruns in the country. In terms of overall risk assessment based, the results indicated a higher risk in capital project implementation from a cost overrun perspective within an overall coefficient of variation of 308.47% than time overrun which had an overall coefficient of variation of 108.03%. From a sector perspective, the road sector had the highest mean on cost overrun of Kshs 656 million and time overrun of 12 months, with a high standard deviation of Kshs 1.79 billion in terms of cost overrun and 14 months in terms of time overrun. The water and sanitation sector followed, with a mean cost overrun of Kshs 127 million and time overrun of 11 months, while the standard deviation was moderately low at Kshs 169 million in the case of cost overrun and 9.5 months in the case of time overrun. The energy sector had the lowest mean in terms of cost overrun at Kshs 28.4 million, and time overrun at 10 months, while the standard deviation for cost overrun was Kshs 92.9 million and for time overrun being 11 months. However in terms of the sector which exhibited the highest risk, the energy sector was the riskiest in the case of cost overruns, with a coefficient of variation of 327.11%, followed by the road sector at 308.07%, and the least risky being the water and sanitation sector at 133.07%. In the case of time overruns, the road sector exhibited the highest coefficients of variation of 117.68% followed closely by the energy sector with 109.25% and the water and sanitation sector again the least risky with 71.19%. The high mean and standard deviation on cost and time overruns as exhibited in the road and energy sectors and the associated risks, portrays a situation where the country is unable to successfully meet its development objectives due to unprecedented project delays, abandonment and thus increasing the gap on infrastructure development necessary for the country to achieve its 2030 vision of being a middle income country. This finding aligns with previous studies by Nabil, A., (2024), Larsen et al. (2016),

Senouci et al. (2016), Adam et al. (2015, 2017), which associated such cost and time overruns with project delays, abandonment and thus poor levels of infrastructure development.

Table 2 below shows the results of descriptive statistics for the three modes of infrastructure financing in Kenya. Overall the internal funds carry the bulk of financing infrastructure in Kenya with a mean of 68.39%, followed by debt (external) fund at 31.31% and PPP which has only 0.06%. The standard deviation for both internal and external funding are very close at 40.93% and 40.91% respectively. Though PPP mode of infrastructure financing has a low standard deviation of 0.41%, it was noted to carry the highest risk based on its coefficient of variation of 684.33% followed by external type of financing with a risk factor of 130.66% with the internal type of financing carrying the lowest risk of 59.95%. In terms of proportionate sector financing, the road sector got most of its funding from internal funds with a mean of 87.66 percent, standard deviation of 24.57% and a minimal risk of getting this type of financing indicated by the low coefficient of variation of 27.91%. On the other hand the road sector debt financing was low with a mean of 12.13% with a standard deviation of 24.51% and indicated a high risk on ability for the country to raise this kind of funding for the sector based on the high coefficient of variation of 202.06%.

The source of financing results for the energy sector indicated almost equal proportion from the internal and external funding each indicating a mean of 50.17% and 49.83% respectfully and with equal standard deviation of 18.79%. Water and sanitation on the other hand had its bulk source of financing from the external funds with a mean of 87.72% and low standard deviation of 33.11% and an equally low risk of getting this type of funding as indicated by the coefficient of variation of 37.75%. The remaining source of infrastructure financing for the water and sanitation sector came from internal sources with a mean of 12.28% and a standard deviation of 33.11%. The source also indicated a high risk of water and sanitation projects accessing internal funds with a coefficient of variation of 269.63%. The PPP type of infrastructure financing was meager and only available for the road sector as indicated above and had a high risk of an indicated by the high coefficient of variation of 612.50%. It is important to note that the PPP type of financing included in this study was an innovative tool structured in an annuity financing model with contractors (private party) bidding for the public roads selected for this type of funding.

Table 2: Descriptive Statistics (Percent) of Mode of Infrastructure Financing for Capital Projects

Sub-Variables	Statements	Mean	Standard Deviation	Coefficient of Variation
Internal funds	Road sector	87.66	24.57	27.91
	Energy sector	50.17	18.79	37.45
	Water and sanitation sector	12.28	33.11	269.63
	Overall	**68.39**	**40.93**	**59.85**
Debt loan	Road sector	12.13	24.51	202.06
	Energy sector	49.83	18.79	37.71
	Water and sanitation sector	87.72	33.11	37,75
	Overall	**31.31**	**40.91**	**130.66**
Public Private Partnerships	Road sector	0.08	0.49	612,50
	Energy sector	--	--	
	Water and sanitation sector	--	--	
	Overall	**0.06**	**0.41**	**684.33**

Table 3 provides the descriptive statics for implementation capacity main components which included procurement capacity, supervision capacity, planning capacity and payment to contractors. An important feature of these results overall payment to contractors had the lowest mean of 3.419 and a very high standard deviation of 1.231 indicating that the respondents on average neither agreed nor disagreed with the statement that the infrastructure development agencies pay their contractors timely. The high deviation indicates that there was a wide variability among the respondent scores, which also based on coefficient of variation of 36% was the riskiest meaning that there was a high likelihood of most of the agencies not processing the payment contractors in time and hence contributing to project delays and cost overruns. The variables which contributed highly to this risk under the payment to contractor's component were the question whether funds for projects were released in time by the funding agents; whether project funds were ringfenced before the contractor commenced the project; and whether there were delays in processing the payment to contractors for approved funds. The second component in terms of risk as indicated in Table 4 was planning capacity with a coefficient of variation of 19.94, notwithstanding that on average the respondents score it as adequate. The variable which made planning capacity have this high level of risk was the issue of ringfencing projects funds before tendering, which also featured under the payment to the contractors.

Table 3: Descriptive Statistics of Implementation Capacity

Main Component	Mean	Standard Deviation	Coefficient of Variation (Percent)
Overall Procurement capacity	4.301	0.559	13.0
Overall for Supervision capacity	4.377	0.717	16.38
Overall Planning capacity	4.704	0.938	19.94
Overall for Payment to contractors	3.419	1.231	36.0

Factor Analysis

The results on factor analysis in relation to implementation capacity were extracted using KMO, which indicated 11 factors with eigenvalue greater than 1 with a total variance explained by the extracted factors being 77. 7 percent. Factor one was summarized as project preparation and financing with main explaining variables being under the payment to contractors and planning components. Factor two was summarized as project implementation and funding with main variables from the project supervision capacity, planning capacity and payment to contractors. Factor three was summarized as project payment with all the explaining variables drawn from payment to the contractors' component. Factor four was summarized as securing project funds made of variables drawn from planning capacity components. Factor five was summarized as establishing project guidelines which were composed of variables from procurement capacity components. Factor six was summarized as project contractor procuring whose main variable was drawn from the procurement capacity component. Factor seven was summarized as project management drawn from the supervision capacity component. Factor eight was summarized as independent tendering with its main variable drawn from procurement capacity component. Factor nine was summarized as tender evaluation with its main variable from procurement capacity component. Factor ten was summarized as project procurement procedures whose variables were mainly from the procurement capacity component. Finally was factor eleven which was summarized as efficiency in disbursement drawn from payment to contractors component. The eleven factors resulting from the analysis aligns with the risk matrix noted in the descriptive statics where the issue of funding and payment to the contractors was noted to be the area of concern in relation to the implementation capacity of the institutions.

Regression Analysis

The regression results for the effect of implementation capacity on the relationship between internal infrastructure financing and success of public capital projects had a coefficient of determination (R2) for both cost and time overruns of 0.0132 and 0.0030 or 1.32 percent and 0.30 percent respectively, which indicated that both internal infrastructure financing even with the intervention of implementation capacity had no explanatory power to both the cost and time overruns. That there were other variables accounting for 98.68 and 99.70 outside this model explaining the changes in cost and time overruns respectively. However both cost and time overruns were significant as the p-value =0.0000 was less than α–value of 0.05. Also the internal financing and implementation capacity were significant as the p-value =0.0000 was less than α–value of 0.05. As such, the null (Ho_1) implementation capacity does not significantly intervene on the relationship between internal infrastructure financing and success of public capital projects, was rejected and the alternative (H_{11}) that implementation capacity significantly intervened on the relationship between internal infrastructure financing and success of public capital project in Kenya was accepted.

$$COST\_Overrun_i = 198{,}000{,}000 + 4{,}353{,}266IIF_i + 12{,}300{,}000IC_i + \varepsilon_1 \ldots\ldots\ldots\ldots\ldots\ldots 7$$

(R^2 = 0.0132) (P-value=0.0000) (P-value=0.0000)

$$TIME\_overrun_i = 13 - 0.014IIF_i + 0.153IC_i + \varepsilon_i \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots 8$$

(R2 = 0.003) (P-value=0.0000) (P-value=0.0000)

Model 7 and 8 above shows the equation showing the relationship between internal infrastructure financing and the success of capital projects and how this relationship is intervened by the implementation capacity. One of the key observations in the two equations is that the constant terms are quite high (Kshs 198 million for cost overruns and 13 months for

time overruns). The high constant may well explain the lack of explanatory power by both internal financing and implementation capacity. The second issue is that a change by one unit in case of internal infrastructure financing the cost overrun will increase by about Kshs 4.4 million negatively affecting the success of capital projects. Same effect is noted in case of an increase of a unit in implementation capacity as the cost overrun will increase by over Kshs 12 million. From Model 8 an increase in a unit of internal infrastructure financing reduces the time overrun by 0.014 months, positively impacting on success of capital projects, while an increase in one unit of implementation capacity increases time overrun by 0.153 months, negatively impacting on the success of capital projects in Kenya.

The regression results for the effect of implementation capacity on the relationship between external infrastructure financing and success of public capital projects indicated R2 for both cost and time overruns of 0.0134 and 0.0032 or 1.34 percent and 0.32 percent respectively, which indicated that both external infrastructure financing, even with the intervention of implementation capacity had no explanatory power to both the cost and time overruns. That there were other variables accounting for 98.66 and 99.68 outside this model explaining the changes in cost and time overruns respectively. However both cost and time overruns were significant as the p-value =0.0000 was less than α–value of 0.05. Also the external financing and implementation capacity were significant as the p-value =0.0000 was less than α–value of 0.05. As such, the null (Ho_2) implementation capacity does not significantly intervene on the relationship between external infrastructure financing and success of public capital projects, was rejected and the alternative (H_{12}) that implementation capacity significantly intervened on the relationship between external infrastructure financing and success of public capital project in Kenya was accepted.

$$COST\_Overrun_i = 634{,}000{,}000 - 4{,}385{,}818EIF_i + 12{,}400{,}000IC_i + \varepsilon_1 \ldots\ldots\ldots\ldots\ldots\ldots 9$$

(R^2 = 0.0134) (P-value=0.0000) (P-value=0.0000)

$$TIME\_overrun_i = 11.663 + 0.013EIF_i + 0.154IC_i + \varepsilon_i \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots 10$$

(R^2 = 0.0032) (P-value=0.0000) (P-value=0.0000)

Models 9 and 10 are equations showing the relationship between external infrastructure financing and the success of capital projects and how this relationship is intervened by the implementation capacity. Model 9 on cost overrun shows that external infrastructure financing has a much higher constant term of Kshs 634 million compared to the internal infrastructure financing model 7 above. On the other hand model 10 on time overrun indicates a lower constant term of 11.7 months compared to model 8 in relation to internal infrastructure financing. The higher constant may well as indicated earlier explain the lack of explanatory power by both external financing and implementation capacity. Model 9 shows that a change by one unit in external infrastructure financing the cost overrun will decrease by about Kshs 4.4 million positively affecting the success of capital projects, opposite of the effect noted in the case of a unit change in internal infrastructure financing (model 7 above). However as shown in model 9 an increase of a unit in implementation capacity will increase the cost overrun by over Kshs 12 million just as the case in internal infrastructure financing model 7. In the case of time overrun model 10 an increase in one unit on external infrastructure financing increases time overrun by 0.013 negatively affecting the success of capital projects in Kenya, which was noted to be opposite of the effect when one unit of internal infrastructure financing is increased. At the same time, as shown in model 10, a one unit increase in implementation capacity has the same directional effect as in the case shown in model 8 under internal financing with as it

increases the time overrun by 0.154 months negatively impacting on the success of capital projects in Kenya.

The regression results for the effect of implementation capacity on the relationship between PPP infrastructure financing and success of public capital projects in Kenya indicated R2 for both cost and time overruns of 0.0127 and 0.0035 or 1.27 percent and 0.35 percent respectively, which indicated that both PPP infrastructure financing even with the intervention of implementation capacity had no explanatory power to both the cost and time overruns. That there were other variables accounting for 98.73 and 99.65 outside this model explaining the changes in cost and time overruns respectively. However both cost and time overruns were significant as the p-value =0.0000 was less than α–value of 0.05. Also the PPP financing and implementation capacity were significant as the p-value =0.0000 in the case PPP financing and p-value=0.0100 in the case of implementation capacity were less than α–value of 0.05. As such, the null (Ho_3) implementation capacity does not significantly intervene on the relationship between PPP infrastructure financing and success of public capital projects, was rejected and the alternative (H_{13}) that implementation capacity significantly intervened on the relationship between PPP infrastructure financing and success of public capital project in Kenya was accepted.

$$COST\_Overrun_i = 474{,}000{,}000 + 467{,}000{,}000PIF_i - 838{,}267\beta_2 IC_i + \varepsilon_1 \ldots\ldots\ldots\ldots 11$$

(R^2 = 0.0127) (P-value=0.0000) (P-value=0.0100)

$$TIME\_overrun_i = 11.985 + 1.522PIF_i + 0.169IC_i + \varepsilon_i \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots 12$$

(R^2 = 0.0035) (P-value=0.0000) (P-value=0.0000)

Models 11 and 12 are equations showing the relationship between PPP infrastructure financing and the success of capital projects and how this relationship is intervened by the implementation capacity. As in the case of the other cost overrun models analyzed above, model 11 shows that PPP infrastructure financing had also a significantly high constant term of Kshs 474 million. Also as model 12 on time overrun showed, a significantly high constant term of 12 months was analyzed. Like in the last two cases, there was a lack of explanatory power by both PPP financing and implementation capacity. Model 11 showed that a change by one unit in PPP infrastructure financing the cost overrun will decrease significantly by about Kshs 467 million positively affecting the success of capital projects, and much higher than in the case of internal infrastructure financing (model 7). However an increase of a unit in implementation capacity will marginally decrease the cost overrun by about Kshs 838 thousand. Model 12 on time overrun also indicated a significant increase in time overrun of 1.522 months for every one unit increase on PPP infrastructure financing negatively affecting the success of capital projects in Kenya. However, as shown in model 12, a one unit increase in implementation capacity has similar effect to the time overrun like the other two as it increases the time overrun by 0.169 months negatively impacting on the success of capital projects in Kenya.

CONCLUSION AND RECOMMENDATIONS

Conclusion

The findings of this study confirmed that implementation capacity significantly affect the relationship between internal, external and PPP infrastructure financing with the success of public capital projects in Kenya. Increasing internal and PPP infrastructure financing methods have the tendency of increasing the time and cost overruns through the results showed that PPP mode of financing has a much higher tendency to increase the cost overrun and therefore much

negatively impacting on the success of capital projects in Kenya. Therefore the two types of infrastructure financing methods do not seem to be favorable to the long term objectives of achieving vision 2030 despite the indicative positive effect on time overruns arising out of an increase in the internal infrastructure method. On the other had increase on the debt or external financing of infrastructure development in Kenya seems to have a positive effect to the success of capital projects in Kenya despite the increase on time overruns associated with increase in external infrastructure financing methods in the country.

While implementation capacity significantly affects the relationship between all the three infrastructure financing methods in their relationships with the success of public capital projects, the analysis indicated that increasing the institutions implementation capacity negatively affect the success of public capital projects in Kenya. This means that the current implementation capacity in the institutions is higher than optimal meaning that what is required is not increasing the capacity but reforming the institutions to make the variables more efficient and effective. The descriptive statistics and factor analysis seem to confirm this conclusion. The descriptive statistics findings showed various variables for each of the components – procurement capacity, supervision capacity, planning capacity, and payment to contractors – needing reforming so as to reduce the risks associated and hence enhancing the efficiency and effectiveness of the current implementation capacities in these institutions. For example, major issues noted in relation to improving the payments to contractors (which would effectively improve the efficiency and effectiveness of the implementing institutions) include ensuring that all project funds are disbursed efficiently, ringfencing efficiently paying all certified contractors certificates, etc. Also the factor analysis provided the 1 rotated factors explaining over 77% of the variables affecting the efficiency and effectiveness of implementation capacity. The study thus concludes that the main variables affecting the components describing the implementation capacity of the institutions have no relationship with increasing the capacities but reforming the institutions to effectively manage and efficiently implement the public capital projects in Kenya.

The study also concludes that neither any of the infrastructure financing methods nor the implementation had any explanatory power to both cost nor time overruns. That there were other factors and variables not considered in this study that explains the bulk of cost and time overruns. As noted in the study the high constant terms in all the models tend to indicate that there are other factors which explain the bulk of cost and time overruns. Further as noted in the study coefficients in relation to the internal and external infrastructure financing methods are fairly low in relation to the constant terms meaning that any change does not reduce or increase the cost and time overruns effectively. Finally the PPP infrastructure financing method was very limiting, and its results tended to have contradicting results from those undertaken in relation to PPP infrastructure financing methods in other countries (Ahmadabadi & Heravi, 2019; Babatunde, et la., 2014; Ismail & Haris, 2014).

Recommendations

The study recommends that for Kenya to enhance its success in public capital projects, the government should place greater emphasis on external infrastructure financing method and minimize the internal method which currently is the dominant method of infrastructure financing. To reduce the negative effect of external financing associated with the time overruns due to delays associated with stringent oversight, monitoring mechanisms, and conditionalities institutional reforms proposed below on implementation will greatly improve the international financiers confidence. Given the complexities associated with the current PPP infrastructure financing method, there is a need for policymakers to review the current innovative road

infrastructure financing method in line with the developed country PPP strategy. Further, the success of public capital projects hinges not only on financing but also on effective implementation. The study therefore recommends the infrastructure implementing agencies to review the various variables affecting the key capacity components on procurement, supervision, planning and payment to contractors with a view to implementing reforms which would reduce the current associated risks. By undertaking these reforms the study notes that the agency's ability to raise external funds for infrastructure development especially for road will be greatly improved.

The study recommends further studies which would incorporate more independent respondents knowledgeable on capital project development but not associated with the institutions involved in the infrastructure development as a way of getting more independent view on the various study variables. This, according to this study would be able to unveil the factors which explains the causes for cost and time overruns in Kenya. The study further recommends that PPP infrastructure financing method be further studies when the country has substantive infrastructure projects developed using PPP method, this will have the possibility of overcoming the current bias which may have been in this study caused by including the unconventional PPP type financing.

Declaration of interests

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper. The authors declare the following financial interests/personal relationships which may be considered as potential competing interests.

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