International Journal of Scientific Research and Management (IJSRM)
||Volume||13||Issue||08||Pages||2573-2586||2025||
Website: https://ijsrm.net ISSN (e): 2321-3418
DOI: 10.18535/ijsrm/v13i08.ec05

Investigating the Relationship between Cost of IT Investment and Benefits Realized from the IT Project Implementation within the Public Sector

Fredrick Bitta[1], Robert Oboko[2], Christopher Chepken[3]

[1,2,3]The Faculty of Science and Technology, Department of Computing & Informatics, The University of Nairobi, Kenya

Abstract:
There has been a long history of failed Information Technology (IT) projects within the public sector and various reasons have been attributed to these failures in previous studies. The lack of a shared theoretical foundation explains why scholars have looked at many causes for these failures without tying their findings to a larger theoretical framework. This study therefore seeks to investigate the relationship between the cost of major IT projects and the benefits realized thereof within the public sector in Kenya. The research adopted a mixed methodology starting with a qualitative study to anchor the research variables followed by a quantitative study. The parameters identified qualitatively for measuring IT benefits realized included return on investment (ROI), customer service delivery and the number of customers. The correlation results found a negative correlation between cost of an IT project and ROI implying that as the cost of IT projects increased the value of ROI decreased and vice versa. The correlation between both the number of customers, customer service delivery and the independent variable cost was negative and insignificant. The multivariate regression analysis results revealed that cost had a significant negative effect on the ROI. The study found that cost had a significant effect on customer service delivery implying that a unit increase in the cost led to an increase in the level or quality of customer service delivery. Therefore, senior management needs to manage IT costs prudently to maximize ROI in addition to allocating more funds for implementation of customer facing systems.

Keywords: Benefits Realization, Cost of IT Investments, Return on Investments, Customer Service Delivery, Mixed Methodology.

1. Introduction

Advancements in technology and innovation continue to drive modern economic growth and social development in many parts of the world. Most government administrations are rapidly adopting and adapting new technologies to achieve effective and efficient service delivery to the citizens [1]. ICT driven digital transformation has been a key anchor for the Kenya government's bottom-up economic transformation agenda [2]. Resulting from this and the ever-changing concept of digital transformation, digitalization of government services has become a high-risk, high-return venture that can no longer be ignored across administrations [1]. While the value of IT expenditures and the overall effectiveness of IT had not been completely understood, many businesses continued to raise their IT investments [3]. The need to continuously review the benefits derived from IT investments is critical for all organizations and the public sector in particular [4].

The study by [5], examined the rate of failure of public sector IT projects and found that 75% of the IT project managers lacked confidence in the IT project success and believed that the projects were destined to fail from the start. In addition, 55% of their respondents believed that budget overruns was the number one reason for the IT project failures and institutions that had developed a strong project management culture were two and a half times more likely to succeed. According to [6], IT systems implemented within the public sector were huge and attracted major capital investments in terms of IT project costs therefore it was

critical that they realize benefits for their respective public entities both internally and to the wider general public.

[7] posits that evaluating life cycle costs of IT investment is a difficult process due to the many aspects that are aligned to the IT investment life cycle costs. Therefore, they defined the cost of IT investments as costs related to acquisition, development, integration change management, loss of productivity due to new system introduction and the cost of training system users before rollout and go-live. The dimensions of cost of IT project in this research included actual cost of the IT project implemented, the projected value of the IT project, IT cost budgeting, IT cost benchmarking, IT cost control, IT cost estimation as well as IT cost funding by the organization.

The Project Management Institute (PMI) defines IT benefits as the advantages and assets gained by the firm and other stakeholders as a result of the program's results [7]. Projects, according to the PMI, produce value and benefits in companies, and business value is defined as the net measurable benefit obtained from a business initiative, and the value could be both tangible and intangible [8].

There has been a long history of failed Information Technology (IT) projects within the public sector in Kenya. Various reasons for these failures have been reported in previous studies on the subject. The lack of a shared theoretical foundation explains why scholars have looked at many causes for these failures without tying their findings to a larger theoretical framework [9]. The parameters identified for measuring benefits realized from IT projects within the public sector included Return on Investment (ROI), Level of Customer Service Delivery and growth/decline in the Number of Customers. This study therefore sought to investigate the relationship between the cost of major IT projects and the benefits realized thereof within the public sector in Kenya.

2. Literature Review

2.1. Empirical Literature

[10] examined the role IT enabled digital technologies played in improving accountability and efficiency in public service delivery in Kenya. The objective of the research was to evaluate the impact of digitalization on efficiency and accountability of public sector accounting systems. The findings revealed the existence of a strong positive correlation between digitalization of accounting processes and improved service delivery with associated cost savings.

[11] evaluated successful IT projects in the public sector using a case study of benefits management practices. The main objective of their research was to provide evidence-based information as a contribution to better IT projects benefits management. The study revealed that a high number of IT projects carried out some element of a cost-benefit analysis except that the scope and quality of the analysis varied from one IT project to another. The results further pointed to a delayed use of the cost-benefit analysis in IT benefit assessment during the IT project implementation.

[7] investigated how benefits were realized in public sector IT projects. They sought to investigate scenarios when IT project implementation benefits were most likely to be realized and how benefits management practices could be used to achieve a positive effect on the success of IT projects with regards to benefits realization. The study revealed that internal benefits to the implementing organization had the highest degree of being realized while those with the lowest degree of realization were the public facing or societal benefits. They further found that IT projects which had accountable, specific, measurable and realistically documented benefits were more successful at realizing those benefits. Their research findings underscored the need to address the lowest degree of benefits realization for public facing systems through accountable, realistic and measurable parameters for both tangible and intangible benefits.

[12] investigated the public perceptions on benefits and challenges to the utilization of capital cost IT driven digital governance services provided by the Ghanaian government. The study evaluated the public's perception of the capital cost digital technologies which had been implemented by the administration with respect to their benefits as well as challenges. The results revealed that the digital initiatives had enabled increased service delivery and the general public's interaction with online citizen service platforms. In addition, it has also reduced corruption within the government.

For IT advantages to be realized and sustained, a procedure akin to risk management and stakeholder engagement was explored by [13] in his investigation into IT benefits as a necessity for delivering business value. Because the activity involved delivering monetary value to the organizations, the benefits evaluation procedure was proactive in nature. Tangible and intangible benefits were distinguished; among the tangible

and financial benefits were a return on investment, a rise in net profits, the availability of resources with the required capabilities, new clients, emerging markets, cost reduction, and net present value. An increase in customer satisfaction, improved employee morale, strategic alignment and recognition of legal or regulatory compliance were among the identified intangible benefits of the IT project.

[14] carried out research using PRISMA methodology on digitally induced change within the public sector in Finland. They sampled public sector organizations on digitally induced change and provided evidence for their drivers, operational processes and results. The study found that incremental customer service delivery benefits were realized in public organizations that had embraced digital technologies with the resultant cumulative digital transformational benefits felt by the public in its entirety. This research contributed in supporting customer service delivery as an indicator for IT benefits realization; an intangible benefit arising from digitalization of public services.

2.2. Theoretical Literature

2.2.1 DeLone and McLean Updated Information Systems Success Model

DeLone and McLean theory and the Modern Portfolio theory by [15] were adopted for this research. The theory was pioneered by [16] in an attempt to establish a holistic definition of Information System (IS) success characteristics that spanned all dimensions of evaluating information systems. Their model identified six dimensions for evaluating information systems namely; Data/Information quality, System quality, Service quality System utilization, User satisfaction, and Net Benefits. The relevant parts of the theory that was adopted in the research and contributed majorly on the design of the conceptual framework included user/customer satisfaction as well as net benefits realization. The quality of service was also adopted as a measure of the level of service delivery to customers in the research. Both information and system quality were also adopted as a measure of customer satisfaction in the model. [15] was credited with developing modern portfolio theory (MPT) which was built around two variables: risk and return on investments. Both the two dimensions of this theory namely risk management and return on investments (ROI) were equally adopted in coming up with a conceptual framework for the research.

2.2.2 Conceptual Framework for Cost and Benefits Realization

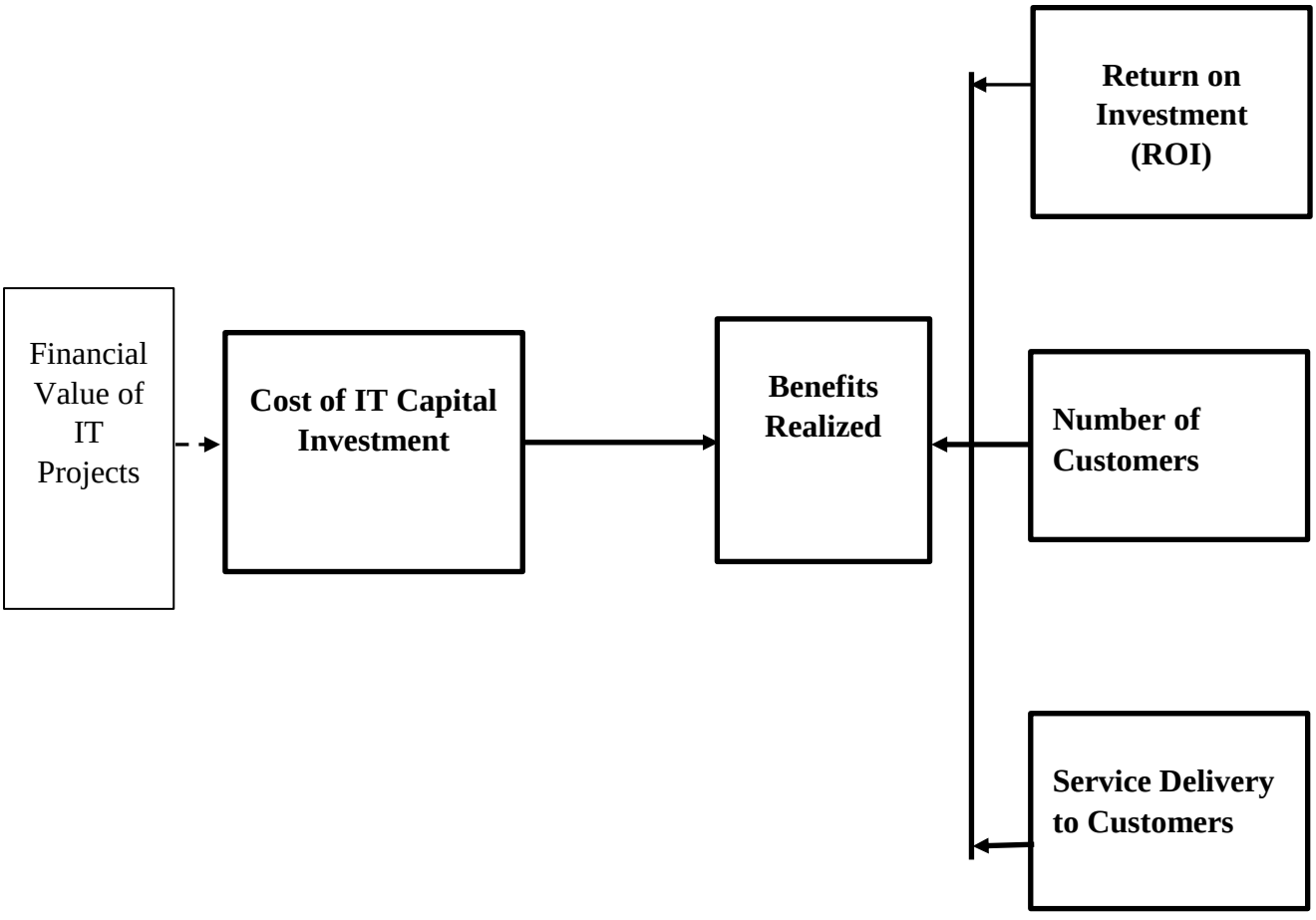

Fig. 1: Conceptual Framework for Cost of IT Investments Benefits Realization

The conceptual framework detailed the relationship between the various variables within the benefits realization framework. It captured the independent variable cost of major IT investment and explained its relationship with the dependent variable benefits realization. One of the indicators for the dependent variable benefits realization was the increase or decrease in customer numbers attributable to customer happiness or dissatisfaction with IT-enabled service delivery innovations. In addition, it also recognized the other two indicators of the dependent variable benefits realization including service delivery to customers and ROI which was the ratio of expected profit from the initial IT investment. The cost of IT Capital Investment was the Independent Variable representing the cost of a major IT investment undertaken by the public entity. It had a monetary value attached to it for purposes of indicating the IT Capital investment value as well as modelling the dependent sub-variable return on investment (ROI).

Benefits Realization was the Dependent Variable for measuring value of an IT investment. Its relationship was tested with the independent variable Cost of IT capital investment. The dependent variable was measured in terms of ROI, Number of customers and Service delivery to customers. Return on Investment (ROI) was the dependent variable indicator representing the ratio of expected profit from the initial IT capital investment. It had a monetary percentage value calculated as follows; ROI= Net Income/Cost of Investment *100%. Number of Customers was the second dependent variable indicator for benefits realized. An increase in the number of customers accessing services online courtesy of an IT project implementation was a benefit to the public organization. Service Delivery to Customers was the third indicator of the dependent variable benefits realization and was used to assess the number of closed customer service requests, time spent to effectively close the customer service requests among other service delivery

Research Methodology

The research adopted a mixed methodology starting with a qualitative study to anchor the research variables. This was then followed by a quantitative study and hypothesis testing of the IT benefits realization variables identified from the qualitative data analysis. A preliminary qualitative investigation was conducted to get an understanding of the variables in the research and to identify any additional variables that were not accounted for in the study on IT-enabled benefits realization. The research adopted majorly the exploratory approach in the qualitative study to get a feel of the issues around benefits realization for IT enabled investments. The qualitative research questionnaire was administered through online google platform to 20 sampled key IT experts in the public sector to facilitate unearthing of more information on IT enabled benefits measurement parameters in the public sector. Thematic analysis was used for data analysis of the qualitative data collected to identify and analyze patterns and establish valuable insights from the data. This was then followed by statistical analysis of quantitative data through hypothesis testing.

2.3. Qualitative Method Population and Sample Size Calculation

A preliminary qualitative investigation was conducted to get an understanding of the variables in the research and to identify any additional variables that were not accounted for in the study on IT-enabled benefits realization. Purposive sampling method was employed. The selection of the respondents was based on their in-depth understanding of IT project management in the public sector as well as responding exhaustively to the research questionnaire. In addition, the respondents met the following sampling criteria; they were charged with the responsibility of managing major IT projects within the respective public sector organizations and offering strategic direction on matters IT, they were trained IT professionals who had practiced extensively within the public sector and were members of senior management within their respective public entities holding positions of director, deputy director, general manager, senior manager or manager within the IT departments or directorates [17]. According to the [18], it had been established that there were 194 State Corporations and Semi-Autonomous Government Agencies (SAGAs) in Kenya out of which 20 were sampled. From each of the sampled public entities, 20 key IT experts working as Heads of IT or IT Audit departments were randomly sampled as respondents representing 10% of all the State Corporations and SAGAs.

2.4. Quantitative Method Population and Sample Size Calculation

The population for the quantitative study were all public sector organizations within the Republic of Kenya. Data from the National Treasury Annual Consolidated Financial Statements Report for 2019 showed that

there were 517 public entities in Kenya. The public entities were categorized into three namely: Ministries, Departments and Agencies which constituted 69 in number; State Corporations, Semi-Autonomous Government Agencies (SAGAs) and Public Funds which constituted 401 in number; and County Governments which were 47 in number totaling to 517 public entities [18]. Each public entity had at least one IT system running its operations. The sample size for the quantitative research was calculated using the following formula;

$$= \frac{\boldsymbol{Z^2 \times P(1-P)}}{\boldsymbol{d^2}} \quad (1)$$

Where n was the required sample size, Z the Level of Confidence at 95%, P the expected level of IT implementation in the public sector at 50% and d the margin of error or desired precision at 5%. Based on the above assumptions, the calculated sample size was 221. That notwithstanding and in order to achieve more accurate results, there was an oversampling and the total sample obtained was 309 representing 60% of all the public entities in Kenya. Stratified random sampling was used to achieve representation across the various public entities namely SAGA's, State corporations, public funds, County governments, Universities and other learning institutions among others. The overall research objective was to Investigate the relationship between the cost of major IT Investments and the benefits realized thereof in a public sector entity.

The main hypothesis tested stated that; H_{01}: There was no significant relationship between the cost of a major

IT investment and the dimensions of benefits realized from the IT project implementation.

The three sub-hypotheses tested stated that;

1. H_{010}: There was no significant relationship between the cost of a major IT investment and return on investment (ROI)
2. H_{011}: There was no significant relationship between the cost of a major IT investment and the number of customers
3. H_{012}: There was no significant relationship between the cost of a major IT investment and customer service delivery

3. Results and Findings

4.1 Qualitative Data Analysis Results

The main objective of the qualitative data analysis was to validate the parameters that were used to model benefits realization for major IT investments in the public sector. The variables included; Return on Investment (ROI), Customer service delivery and increase or decrease in number of customers as parameters for measuring benefits for IT projects within the public sector. The analysis further sought to qualitatively establish through theme analysis from the IT experts the existence or not of any relationship between Cost of IT project and benefits realized from the IT project.

The qualitative questionnaire with open-ended questions was administered online through google forms to all the 20 targeted key IT experts leading IT departments in the public sector. From the 20 subject matter experts sampled, 17 responses were received representing a response rate of 85% based on the targeted sample. The comprehensive thematic analysis revealed that subject matter experts were largely in agreement on the need to carry out research on the following research IT enabled benefits realization variables;

The relationship between the Cost of IT investment and ROI where all the 17 respondents were in agreement that indeed the relationship existed and there was need for further research to investigate how the two variables affected each other. No objection was recorded from any of the respondents. The existence or not of the relationship between the Cost of an IT investment and an increase or decrease in the number of consumers where 16 respondents agreed and 1 respondent dissented expressing the non - existence of the relationship without offering any further explanation on the same. The existence or not the relationship between the value of an IT investment and customer service delivery where 16 respondents were in agreement and 1 respondent disagreed on the basis that the output of an IT investment was not dependent on the financial value of the investment but rather the level of efficiency and reliability the system achieved.

The existence or not of the relationship between the Cost of an IT investment and the benefits derived from the IT project implementation where 15 experts agreed, 1 expert provided a yes and no answer and thus was considered neutral and 1 expert dissented. The neutral respondent further argued that an under-

investment in IT projects could be costly but that did not necessarily mean that an over-investment in IT derived the best results from IT projects and therefore the projects needed to be properly costed with a carefully crafted cost-benefit analysis. The only dissenting respondent argued that benefits from IT projects were dependent on the reliability, efficiency and support received from the teams using the system as well as senior management support.

4.2 Discussion of Qualitative Data Analysis Results

Table 1: Thematic Analysis Results

Theme	No of Experts in Support	No of Experts Dissenting	Conclusion
To determine the existence of a relationship between the cost of IT investment and the return on investment (ROI)	17	0	There existed relationship between the cost of IT investment and the Return on Investment (ROI), therefore the effect of the variables on each other needed to be investigated
To determine the existence of a relationship between the cost of IT investment and the growth or decrease in the total number of customers.	16	1	There existed a relationship between the cost of IT investment and the increase or decrease in the number of consumers and so the impact needed to be evaluated through further research
To establish the existence of a relationship between cost of IT Investment and customer service delivery	16	1	There existed a relationship between cost of IT Investment and customer service delivery and the effect of the two variables needed to be subjected to further research
To establish the existence of a relationship between cost of IT Investment and benefits realized thereof	15	2	There existed a relationship between cost of IT Investment and the benefits realized from the same but the effect of this relationship needed further investigation

From thematic analysis it was evident that there existed a relationship between the cost of IT investment and the Return on Investment (ROI) although the effect of this relationship could not be verified qualitatively and thus the need for further investigation. The emerging themes also established the existence of a relationship between the cost of IT investment and the increase or decrease in the number of consumers although their impact needed to be evaluated through further research.

The analysis also established the existence of the relationship between cost of IT Investment and customer service delivery although the effect of the two variables could not be qualitatively verified. The above findings were consistent with those of [11] who evaluated successful IT projects in the public sector using a case study of benefits management practices and found that the cost-benefit analysis was not consistently used in IT benefit evaluation during the IT project implementation. The findings also concurred with [7] who investigated how benefits were realized in Public IT projects and found that IT projects which had accountable, specific, measurable and realistically documented benefits were more fruitful on realizing those benefits.

The results from this analysis therefore anchored and validated the research variables for modelling IT benefits realization for major IT investments namely; Return on Investment (ROI), Customer service delivery and Number of customers as sub variable indicators for measuring benefits realized from IT projects within the public sector a dependent variable. The independent variable Cost of IT project was also validated by the findings resulting from the theme analysis.

4.3 Quantitative Data Analysis Results

Table 2. Response Rate

Questionnaires	Number	Percentage
Filled	309	88.29%
Non -response	41	11.71%
Total	350	100%

The targeted number of respondents for the research was 350 and the actual number of responses received was 309. This represented a total of 88.29% response rate. According to [19], a response rate of 70 percent was acceptable as a good representation of a targeted population. Therefore, a response rate of 88.29% was higher than the recommended threshold of 70%.

Table 3. Highest Level of Education

	Frequency	Percentage
Secondary Level	1	0.3%
Diploma	23	7.4%
Bachelor's Degree	151	48.9%
Master's Degree	125	40.5%
Doctoral Degree	9	2.9%
Total	309	100%

The data on levels of education in table 3 showed that most of the respondents in the public sector had Bachelor's degree at 48.9% followed closely by those with Master's degree at 40.5%. The respondents with Doctorate Degrees stood at 2.9% while Diploma level education stood at 2.5%. This showed that the area of research was largely dominated by well educated professionals at 92.3% who were competent and knowledgeable in public sector IT to provide insightful responses to the research questionnaire

Table 4. Years of Experience in IT Public Sector

	Number of years	%
Working Experience in IT projects within the public sector.	1 - 5 Years	22.3%
	6 - 10 Years	23.9%
	11 - 15 Years	32.7%
	15 Years and Above	21.0%
	Total	100.0%

Table 4 showed that majority of the respondents at 32.7% had between 11-15 years of experience working within IT in the public sector. Further analysis showed that most of the respondents at 54.1% had more than 10 years' experience in the IT indicating that they had sufficient knowledge and expertise on IT matters within the public sector.

	Not at all	Low extent	Moderate extent	Large extent	Very Great extent
IT Cost budgeting- Costing for the entire IT project was done prior to IT project initiation	1.0%	4.5%	20.7%	30.1%	43.7%

IT Cost budgeting- entailed sum of all cost components of the project	1.3%	6.8%	25.9%	35.3%	30.7%
IT Cost benchmarking- Costing of the IT project was benchmarked with other similar projects	4.5%	7.1%	33.0%	34.3%	21.0%
IT Cost control - The organization prepares regular and timely IT Projects	4.9%	12.3%	27.5%	36.6%	18.8%
IT Cost estimation- The total project cost was based on an estimation	1.6%	12.0%	22.3%	38.5%	25.6%
IT Cost Funding - The project was adequately funded as per the budget	4.2%	8.4%	20.7%	33.7%	33.0%

Table 5 above captured the extent to which public sector organizations sampled carried out cost planning of their IT investments. The results showed that 43.7% of the institutions did prior budgeting of the IT projects to a very great extent while 30.1% did the same to a great extent indicating that 73.8% of the public sector organizations did prior budgeting for their IT projects. A proportion of 30.7% of the public sector institutions did cost summation of all components of an IT project to a very great extent while 35.3% did the same to a great extent indicating that 66% of the sampled public sector entities were doing sum aggregation of all cost components of an IT project. A total of 55.3% of public entities did cost benchmarking for the IT projects; 34.3% to a great extent and 21.0% to a very great extent. Further, 55.4% of the institutions did cost control for IT projects; 36.6% to a great extent and 18.8% to a very great extent. In addition, 64.1% estimated the costs of the IT projects; 38.5% to a great extent and 25.6% to a very great extent and 66.7% of the sampled public sector entities adequately funded the IT projects; 33.7% to a great extent and 33.0% to a very great extent. The results showed substantial efforts to do proper costing of IT projects in the public sector. However, some of the aspects of costing of IT projects was not done in a number of public institutions namely cost benchmarking, cost control and cost funding.

3.3.1 Preliminary Test to Determine the Suitability of the Variables for Hypothesis Testing

1. **General Diagnostic Tests:** To facilitate inferential and hypothesis testing of the collected data, the data was converted into composite variables. This involved weighting and averaging of the raw data collected for ordinal scale variables for each study case. This generated ratio scale variables, which was used for more complex analysis. After generation of the composite variables the following diagnostic tests were done to ascertain their suitability for inferential test.
2. **Shapiro Test of Normality:** The first diagnostic test carried out was the Shapiro Test of Normality. From the results all the variables had a P value of than 0.05 ($p<0.05$) indicating that the data distribution of the variables was significantly different from a normal distribution. This meant that all the variables failed the normality test and thus required a method of transforming them to a normally distributed distribution.
3. **Data Transformation:** In order to address the issue of non-normality in the data variables, the dataset underwent transformation using the logarithmic method. Importantly, the addition of this constant did not impact the variance of the data, thus preserving the integrity of the data's distribution while facilitating a more accurate analysis of the relationships among the variables. This transformation allowed for more reliable statistical testing and inference in the study.
4. **Multicollinearity Diagnostic Test:** The second diagnostic test done was the multicollinearity test. [20] held that the presence of multicollinearity in a model interferes with the internal validity of multiple regression analysis and increases the likelihood of errors in hypothesis testing. The study used two indicators to test the presence of multicollinearity. Tolerance and Variance Inflation Factor (VIF). [21] argued that if the VIF value for one of the variables was around or greater than 5, then

there was multicollinearity associated with that variable. A tolerance value of less than 0.3 also confirmed presence of multicollinearity in a model. From the results none of the variables had a VIF of more than 5.0 and none of the variables had a tolerance value of less than 0.3 as per Martz (2013). This therefore meant that none of the variables showed any sign of high correlation. This results further suggested that there was no problem of multicollinearity among the independent variables.

3.3.2 Relationship between the Cost of a Major IT Investment and the Dimensions of Benefits realized from the IT project

1. Correlation Tests

In order to determine the relationship between cost of IT investment and benefits realized in terms of ROI, number of customers served and the level of service delivery, a Pearson correlation test was carried out between the cost and the anticipated benefits. Table 6 shows the Pearson correlation results between ROI, number of customers served and the quality of customer service delivery.

Table 6. Pairwise Correlations ROI, Customer Number Served, Service delivery and Cost of IT

Variables	(1)	(2)	(3)	(4)
(1) ln_ROI	1.000			
(2) ln_Customer served	0.066	1.000		
(3) ln_service_delivery	0.009	0.083	1.000	
(4) ln_cost	-0.249	-0.012	0.097	1.000

From the results in table 6, the cost of IT investment and the ROI had an insignificant inverse weak relationship ($r= -0.249$, $p>0.05$). This meant that an increase in cost corresponded to reduction in the ROI levels. This meant that the cost associated with an IT investments would relate inversely with the ROI. The cost of IT investment and the number on customers served had an insignificant negative weak relationship ($r= -0.012$, $p>0.05$). This indicated that an increase in cost corresponded to reduction in the number of customers served. The cost of IT investment and the level of customer service delivery had an insignificant positive weak correlation ($r= 0.097$, $p>0.05$). This meant that any increase in customer delivery either by efficiency, promptness or convenience corresponded to increased costs.

2. Multivariate Regression Test.

The set of hypotheses for this research were centered on the relationship between the cost of the IT investments, the realized benefits, specifically ROI, number of customers served and the level of delivery service. The corresponding hypotheses were as documented below:

- H_{011}: There was no significant relationship between the cost of IT investment and return on investment (ROI)
- H_{012}: There was no significant relationship between the cost of an IT investment and number of customers served
- H_{013}: There was no significant relationship between the cost an IT investment and level of service delivery

To study the relationship between the independent variable (cost) and the realized benefits of IT investments, the study used a multivariate regression where all the sub-variable indicators for the dependent variables (IT benefits) and the independent variable (cost) were run concurrently. The resulting regression equation relating to the independent variable were as shown:

$ROI = \beta_0 + \beta_{11} cost + \varepsilon$ *Eq.10*
$NC = \beta_0 + \beta_{12} cost + \varepsilon$..... *Eq.11*
$SD = \beta_0 + \beta_{13} cost + \varepsilon$..... *Eq.12*

$Where, ROI = Return\ on\ Investment, NC = Number\ of\ Customers\ \ and\ \ SD = \ Service\ Delivery$

$cost = Actual\ cost\ of\ IT\ project$

β_0=Constant and an Intercept

$\beta 1_1, \beta 1_2, and\ \beta 1_3$ = Beta Regression coefficients

$\varepsilon = error\ term$

The following were the results of the multivariate regression test done for cost and IT benefits realized;

Table 7. Model Summary and F -Statistic (Cost and IT benefits)

Equation	Obs	Parms	RMSE	R-sq	F	P>F
ln_ROI	47	2	3.759787	0.0933	4.632831	0.0368
ln_Customer Served	47	2	1.497591	0.0032	0.146682	0.7035
ln_service delivery	47	2	0.248695	0.1149	5.842691	0.0198

Table 7 detailed the model summary and F-statistics. The value of R squared for Cost and ROI was 0.0933 indicating that cost determined 9.33% of the variation in ROI. The F statistic was given as $F_{1,46}$=4.63, p<0.05) indicating that cost had a significant influence on the ROI of IT projects.

The R square (R^2) value on the model determining the effect of cost and the number of customers served was 0.0032. This implies that cost accounted for 0.32% of the variation on the number of customers served. The F statistic was given as $F_{1,46}$=0.15, p>0.05) implying that the effect of cost on the number of customers served was insignificant.

The third model looked at the effect of the cost on the level of customer delivery. The resulting R square (R^2) was 0.248695. This means that cost accounted for 24.87% of the variation in customer delivery. The F statistic was given as $F_{1,46}$=5.84, p<0.05) implying that the effect of cost on the level of customer delivery was significant.

The multivariate regression coefficient results are given in table 8.

Table 8: Effect of cost on ICT Benefits (ROI, Number of Customers Served and the Level of Service Delivery)

	Coefficient	Std. err.	T	P>t	[95% conf.	interval]
ln_ROI						
ln_cost	-0.49336	0.229212	-2.15	0.037	-0.95501	-0.0317
_cons	13.51537	3.929577	3.44	0.001	5.600798	21.42995
ln_Customer_served						
ln_cost	0.034967	0.091299	0.38	0.704	-0.14892	0.218853
_cons	4.882696	1.565221	3.12	0.003	1.730179	8.035213
ln_service_delivery						
ln_cost	0.036648	0.015161	2.42	0.02	0.006111	0.067184
_cons	0.812201	0.259926	3.12	0.003	0.288684	1.335718

The resulting regression tests results were as shown below

$ROI = 13.5153 - 0.49336\ cost$ *Eq.10*
$NC = 4.882696 + 0.034967 cost$..... *Eq.11*
$SD = 0.812201 + 0.03664 cost$..... *Eq.12*

The results in table 8 showed that a percentage increase in the cost of IT projects by 1 unit had a declining

effect on the ROI of that project by 0.49336 units. The effect was statistically significant ($p<0.05$) and therefore meant that IT project cost reduced the ROI of IT projects in the public sector. The 1st part of the null hypothesis of the study was therefore rejected and the alternative hypothesis adopted that cost of an IT Project had a significant effect on the ROI of the project.

The second model tested the aspect of cost of IT projects and the number of customers served. The results showed that a unit increase in cost of an IT project had insignificant increase in the number of customers by 4.882696 units ($p>0.05$). The null hypothesis was therefore adopted that the cost of an IT project had no significant effect on the number of customers served.

The third model results showed that a 1% percentage increase in the cost of IT projects had a significant increase on the level of customer service delivery of the project ($p<0.05$) of 0.812201. This implied that an increase in the cost of an IT project resulted in an increase in the level of customer service delivery. This could be attributed to the fact that new Technological advancements in IT were relatively costly and that any improvement in service delivery resulting from IT would have increased cost implications. The null hypothesis was thus rejected and the alternative hypothesis adopted that cost of an IT project had a significant effect on the level of customer service delivery

4. Discussions of Results

The first part of the null hypothesis tested in this study stated that, there was no significant relationship between the cost an IT investment and return on investment (ROI). The results from the multivariate regression test however found that a percentage increase in the cost of IT projects by 1 unit had a declining effect on the ROI of that project by 0.49336 units. This effect was statistically significant ($p<0.05$) and therefore meant that IT project cost reduced the ROI of IT projects in the public sector. The 1st part of the null hypothesis of the study was therefore rejected and the alternative hypothesis adopted that cost of an IT Project had a significant effect on the ROI of the project

These results were consistent with findings from previous studies as well as the empirical literature reviewed. For instance, [11] who found that a high number of IT projects in the public sector carried out some element of a cost-benefit analysis with regards to costing and planning except that the scope and quality of the analysis varied from one IT project to another. The cost benefits analysis was done mainly because an increase in cost of an IT project did not necessarily translate to an increase in ROI. A fact that was proved by the findings of the first part of the hypothesis that indeed an increase in cost corresponded to reduction in the ROI levels.

[7] found that IT projects which had accountable, specific, measurable and realistically documented benefits were more successful on realizing those benefits and underscored the need to address the lowest degree of benefits realization for public facing systems through an accountable, realistic and measurable parameters for both tangible and intangible IT benefits.

Prior studies by [10] revealed the existence of a strong positive correlation between digitalization of accounting processes and improved service delivery with associated cost savings in terms of ROI. This finding was consistent with the adopted alternate hypothesis that there existed a positive and significant relationship between costing and ROI of an IT project. This could be attributed to better ways of absorbing the cost and likely reduction in wastage.

Previous research by [22] investigated information modelling and ROI and found that information modelling ROI ranged between -83.3% to 39,900%. Their finding was consistent with the results of both the 1st part of the null hypothesis which found that a percentage increase in the cost of IT projects had a declining effect on the ROI of that project ($p = -0.029$). The finding also concurred with the second part of the hypothesis which adopted the alternate hypothesis that established the existence of a positive and significant relationship between costing and ROI of an IT project.

The second part of the null hypothesis tested in the study stated that there was no significant relationship between the cost of a IT investment and number of customers served. The results from the multivariate regression found that a unit increase in cost of an IT project had insignificant increase in the number of customers by 4.882696 units ($p>0.05$). The study therefore failed to reject the null hypothesis which stated that cost of an IT project had no significant effect on the number of customers served.

These findings were consistent with conclusions drawn from previous related research conclusions. For instance, [23] investigated the effect of IT project performance on consumer satisfaction. The findings also revealed that most IT projects were initiated by senior management decisions rather than organizational

requirements and that most organizations implemented projects without any business need for the project outcomes resulting in zero impact on the number of customers despite the huge costs incurred. The results were also consistent with the findings of [7] who investigated how benefits were realized from costly public sector IT projects and found that internal benefits to the implementing organization had the highest degree of being realized while those with the lowest degree of realization were the external public facing or societal benefits key amongst them, the growth in the number of customers. In general, the results agreed with previous studies that cost and costing of IT investments has no significant relationship with the growth in number of customers [23], [7].

The third part of the null hypothesis tested in this study stated that there was no significant relationship between the cost an IT investment and level of service delivery. This model results showed that a 1% percentage increase in the cost of IT projects had a significant increase on the level of customer service delivery of the project ($p<0.05$) of 0.812201. This implied that an increase in the cost of an IT project resulted in an increase in the level of customer service delivery. This could be attributed to the fact that new Technological advancements in IT were relatively costly and that any improvement in service delivery resulting from IT would have increased cost implications. The null hypothesis was thus rejected and the alternative hypothesis adopted that cost of an IT project had a significant effect on the level of customer service delivery.

These results were consistent with findings by [10] who investigated the role that costly IT enabled digital technologies played in improving accountability and efficiency in public service delivery in Kenya and found the existence of a strong positive correlation between digitalization of accounting processes and improved customer service delivery. The research results also concurred with the findings of [14] who investigated the costings of digitally induced change within the public sector and found that incremental customer service delivery benefits were realized in public organizations that had embraced digital technologies with the resultant cumulative digital transformational benefits felt by the community in its entirety.

Further the results were consistent with previous empirical literature reviewed. For instance, [12] who investigated the public's perception of the capital cost digital technologies which had been implemented by the Ghana administration with respect to their benefits as well as challenges and found that the digital initiatives had enabled increased service delivery and the general public's interaction with online citizen service platforms. In addition, the inferential analysis results were consistent with those of [24] whom examined the impact of costly ICT driven Digital Technologies on the implementation of Sustainable Development Goals (SDGs) in the public sector in Kenya and found the existence of a moderate positive and statistically significant correlation between use of digitally enabled platforms and improved service delivery within the public sector in Kenya

5. Conclusions and Recommendations

The overall objective of this research was to investigate the relationship between cost of IT investment and the benefits realized from IT investments in terms of ROI, number of customers and customer service delivery. The data was collected from senior IT professionals working in the public sector in Kenya. Majority of the respondents were relatively young with 51.5% being of the age bracket 35-44 years. Majority of the respondents had acquired higher education with 48.9% having Bachelor's degree and 40.5% having attained Masters degrees. A further review showed that the most of the respondents (53.7%) had more than 10 years' experience in IT within the public sector and therefore could give expert opinion on matters IT.

The main objective for carrying out the qualitative data analysis was to address the research objective and anchor the research variables on IT enabled benefits realization. These included benefits realization indicators namely; Return on investment, customer service delivery and number of customers as sub-variable indicators for measuring benefits for IT projects within the public sector. The independent variable was the cost of IT investment. The results from the qualitative data analysis and previous research findings anchored and validated the above research variables for modelling IT benefits realization for major IT investments. In addition, the respondents revealed that improved customer service delivery was the leading criterion for IT benefits measurement within public sector entities with 89.62% of the respondents indicating as such. This was followed by ROI at 31.6% and growth in number of customers at 15%.

The study examined the hypothesis using Pearson correlation and multivariate regression tests. The

research found a negative correlation between cost and ROI. This meant that as the cost of IT projects increased the value of ROI declined and vice versa. The correlation between cost and number of customers as well as customer service delivery was negative and insignificant. This meant that cost did not have a significant relationship with the number of customers served or level of customer service delivery.

The multivariate regression test results established the effect of cost on the hypothesized benefits of IT projects. The study found that cost had a significant negative effect on the ROI for IT projects in the public sector. This meant that increasing the cost of IT investments reduced the financial gains made from such an investment. The results on the effect of cost on the number of customers served was 0.035 indicating that a unit increase in cost led to an increase in the number of customers. The causal effect was however insignificant. Meaning that, the established effect could have happened by chance and therefore could not be used to prove the hypothesis. The study found that cost had a significant effect on service delivery. The results showed that a unit increase in the cost led to an increase in the level of service delivery. This implied that improvement in service delivery had some attendant costs. These results were consistent with previous findings from literature reviewed and related previous research work.

Based on the research findings, the following conclusions were drawn; That an increase in the cost of an IT project negatively affected its Return on Investment (ROI) and thus senior management needed to manage IT project costs prudently in order to maximize their return on investments. That an increase in the cost of an IT project had a corresponding improvement on the level of customer service delivery by the public organization. Thus, senior management within the public sector needed to consider additional funding when planning and budgeting for the implementation of major customer facing IT systems. These findings were consistent with those of the ongoing PhD research work.

Acknowledgements

The authors sincerely thank Prof. Daniel Orwa, Prof. Andrew Mwaura and Dr. Evans Miriti from the Department of Computing and Informatics, the University of Nairobi, Kenya for their contributions to this paper

6. References

1. Kim, S. B., & Kim, D. (2020). ICT implementation and its effect on public organizations: The case of digital customs and risk management in Korea. *Sustainability*, *12*(8), 3421.
2. Mwangi, J., (2021) https://www.trade.gov/country-commercial-guides/kenya-information-communications-and-technology-ict
3. Ming-Chang Lee. (2013). IT governance implementation framework in small and medium enterprise. *Int. J. Management and Enterprise Development, Vol. 12, pp. 4-6.*
4. ISACA., (2018). Certified in Governance of Enterprise IT Review Manual, 7th Edition, pp.2-15
5. Venkataraman, R. R., & Pinto, J. K. (2023). *Cost and value management in projects*. John Wiley & Sons.
6. Holgeid, K. K., Jørgensen, M., Volden, G. H., & Berg, H. (2023). Realizing benefits in public IT projects: A multiple case study. *IET Software*, *17*(1), 37-54
7. Fridgeirsson, T. V., Ingason, H. T., Jonasson, H. I., & Gunnarsdottir, H. (2023). A qualitative study on artificial intelligence and its impact on the project schedule, cost and risk management knowledge areas as presented in PMBOK®. *Applied Sciences*, *13*(19), 11081.
8. Narman, P., Sommestad, T., Sandgren, S., & Ekstedt, M. (2009, August). A framework for assessing the cost of IT investments. In *PICMET'09-2009 Portland International Conference on Management of Engineering & Technology* (pp. 3154-3166). IEEE.
9. Rajala, T. and Aaltonen, H., 2021. Reasons for the failure of information technology projects in the public sector. *The Palgrave handbook of the public servant*, pp.1075-1093.
10. Omar, N. J. M., Qasim, N. H., Kawad, R. T., & Kalenychenko, R. (2024). The Role of Digitalization in Improving Accountability and Efficiency in Public Services. *Revista Investigacion Operacional*, *45*(2), 203-24.
11. Berg, H., Holgeid, K., Jørgensen, M., & Volden, G. H. (2023). Successful IT projects–A multiple case study of benefits management practices. *Procedia computer science*, *219*, 1847-1859.

12. Demuyakor, J. (2021). Ghana's digitization initiatives: a survey of citizens perceptions on the benefits and challenges to the utilization of digital governance services. *International Journal of Publication and Social Studies*, *6*(1), 42-55.
13. Levin, G. (2015). Benefits a necessity to deliver business value and a culture change but how do we achieve them? *Paper presented at PMI® Global Congress 2015 North America, Orlando, FL. Newtown Square, PA*: Project Management Institute
14. Haug, N., Dan, S., & Mergel, I. (2024). Digitally-induced change in the public sector: a systematic review and research agenda. *Public Management Review*, *26*(7), 1963-1987
15. Markowitz, H. (1952). Modern portfolio theory. *Journal of Finance*, *7*(11), 77-91.
16. Alzahrani, A. I., Mahmud, I., Ramayah, T., Alfarraj, O., & Alalwan, N. (2019). Modelling digital library success using the DeLone and McLean information system success model. *Journal of Librarianship and Information Science*, *51*(2), 291-306.
17. Eisenhardt, K. M., Graebner, M. E., & Sonenshein, S. (2016). Grand challenges and inductive methods: Rigor without rigor mortis. *Academy of management journal*, *59*(4), 1113-1123.
18. https://www.treasury.go.ke/wp-content/uploads/2021/04/STATE-CORPORATIONS-SAGAs-REVISED-UNAUDITED-CONSOLIDATED-STATEMENT-FOR-FY2017-2018_compressed.pdf 2019
19. Mugenda, O. M., & Mugenda, A. G. (2003). *Research methods: Quantitative & qualitative apporaches* (Vol. 2, No. 2). Nairobi: Acts press.
20. Field, A. P. (2013). *Discovering statistics using SPSS* (4th ed.). London: Sage Publications
21. Martz, E. (2013). Handling multicollinearity in regression analysis. *Manitab Incorporated*.
22. Sompolgrunk, A., Banihashemi, S., & Mohandes, S. R. (2021). Building information modelling (BIM) and the return on investment: a systematic analysis. *Construction Innovation*, *23*(1), 129-154.
23. Syamil, A., Samosir, J. M., & Heriyati, P. (2021). The impact of project performance on customer satisfaction. *Turkish Journal of Computer and Mathematics Education*, *12*(3), 5658-5668.
24. Mburu, D. N., & Munene, R. W. (2024). Influence of digitalization on implementation of sustainable development goals in public administration in Kenya. *International Academic Journal of Human Resource and Business Administration*, *4*(4), 269-290.
25. Daoud, J. I. (2017, December). Multicollinearity and regression analysis. In *journal of physics: Conference series* (Vol. 949, No. 1, p. 012009). IOP Publishing.
26. DeLone, W. H., & McLean, E. R. (2002, January). Information systems success revisited. In *Proceedings of the 35th annual Hawaii international conference on system sciences* (pp. 2966-2976). IEEE.
27. Denzin, N. K., & Lincoln, Y. S. (Eds.). (2011). The SAGE handbook of qualitative research (4th ed.). Thousand Oaks, CA: Sage.
28. Holgeid, K. K. (2022). Benefits from Investments in IT Development.
29. ICTA Kenya., (2019). IT Governance Standard 2nd Edition, pp.7-8
30. IT Governance Institute. (2016). Overview of International IT Guidance. COBIT Mapping 2, pp.8-15, 20-31.
31. Mergel, I., N. Edelmann, and N. Haug. 2019. "Defining Digital Transformation: Results from Expert Interviews." Government Information Quarterly 36 (4): 101385. https://doi.org/10.1016/j.giq.2019. 06.002 .
32. Mwangi, K., (2019). https://pwc-kenya.foleon.com/public-sector-infrastructure-insight/public-sector-infrastructure-insight-2019/value-for-money-vfm-in-the-public-sector/
33. Patanakul, P., & Pinto, J. K. (2017). Program management. In *Cambridge Handbook of Organizational Project Management* (pp. 106-118). Cambridge University Press.
34. Sung, W., & Kim, C. (2021). A study on the effect of change management on organizational Innovation: Focusing on the mediating effect of members' innovative behavior. *Sustainability*, *13*(4), 2079.