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Influence of Quality Assurance Infrastructure on In-House Software Quality Assurance in Strategic State Corporations in Kenya

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Abstract: **The purpose of the study was to determine the influence of Quality Assurance (QA) Infrastructure on In-house software quality assurance (SQA) in Strategic state corporations (SSCs) in Kenya.**
Methodology: **The study used quantitative research method and applied Survey research design. The research population and target group comprised 6 large Strategic state corporations which are critical to the Kenyan economy and attainment of Vision 2030. These corporations have a combined ICT work force of approximately 300 personnel. From the research population, a sample of 169 respondents was selected and administered with questionnaires using a drop and pick method. A multiple linear regression model was used to analyze the data using statistical package for the social sciences (SPSS).**
Results: **The study found that 53.9% of the variation in in-house software quality assurance in strategic state corporations was explained by Quality assurance infrastructure. The results of coefficients to the estimates was significant at the 0.05 level of significance. This indicated that quality infrastructure positively and significantly influences in-house software quality assurance in strategic state corporations. Further, government regulation was found to have a partial intervening effect on the relationship between Quality assurance infrastructure and In-house software quality assurance in Strategic state corporations.**
Unique contribution to theory, practice and policy: **The findings of this study are useful to the Government, Strategic state corporations, Policy makers, Scholars, Software developers, IT consultants and other state corporations. There is need to develop policies and software development framework that establishes quality assurance infrastructure to support in-house development of quality software.**

Keywords: **Quality assurance infrastructure, in-house software development, quality assurance, Strategic state corporations.**

1. INTRODUCTION

Strategic state corporations (SSC) operate a diverse range of software systems to support their day to day operations. The quality and performance of this software is expected to be reliable, an attribute that is achieved through a well-defined software development process that adheres to international and industry recognized software development and quality standards (Kimuyu et al., 2017; Kaur & Sengupta, 2011). Despite the progress made in ensuring the development of quality software, software project failure and quality problems continue to be experienced in most organizations (Charette, 2005; Verner & Cerpa, 2005). While such failure may not be a big problem in some organizations, it is suicidal in most SSCs as they control critical facilities and infrastructure such as seaports, international airports, rail network and infrastructure, electricity power generation and distribution, petroleum transportation and distribution among others. These need complex and robust ICT infrastructure and software system whose performance and quality must be top notch (Kimuyu, et al., 2017).

Globally, Scholars continue to agonize with the subject of software quality and much has been written about causes and contributors of software project failure and poor quality. Key among these include: lack of management support and insufficient resources (Nelson, 2007), poorly defined requirements (Nelson, 2007; Charette, 2005) failure to adhere to software development process and standards (Charette, 2005; Reel, 1999), poor project management (Charette, 2005), and problems associated with technology (Reel, 1999). However, areas that has been ignored by researchers and that form the core of this study are in-house software development and the in quality infrastructure available to support it. The study therefore focuses on the influence of Quality Infrastructure on in-house Software Quality Assurance (SQA) in these SSCs.

According to Owoseni and Imhanyehor (2011), In-house software development increases efficiency, meet specific business needs and promote positive user experience as the developers and the users are usually colleagues and work in the same environment. They therefore have a thorough understanding and knowledge of key processes within the organization. Due to their knowledge of the business environment, they are able to produce thorough and well thought systems requirements which lead to production of software that meet and exceed the organizational requirements (Kimuyu et al., 2017). In-house developed software solutions offer high potential to meet organizational and business needs due to the nature of participatory development processes that support gathering and specification of user requirements and in-house usability testing while allowing day to day interaction between the development team, users and the organizations top management.

PROBLEM STATEMENT:

In-house developed software is increasingly becoming an attractive option as a means of software acquisition in SSCs. However, it faces diverse challenges, key among them being an ever-changing technical environment, lack of qualified software developers, poor remuneration, problem of retention of expertise, limited support from the management among others. Despite these challenges, in-house software development remains an attractive option due to the flexibility it offers in addressing unique operational and business environment (Kimuyu et al., 2017). Like all other software, in-house developed must abide to internationally recognized quality standards, organizational and technical specific standards, user requirements and expectation. Scholars have observed that poor software quality is one of the leading sources of software project failure (Nelson, 2007; Murugesan, 1994; Tuteja & Dubey, 2012). The quality of In-house developed software in SSCs has continued to lag behind despite great strides made in improving quality (April & Laporte, 2009; Geethalakshmi, 2009; Owens & Khazanchi, 2009). The escalating cost of software failure is a worrying trend and this situation is worsened when it involves tax payer funds and high mission critical software projects such as the ones in SSCs (Kimuyu et al., 2017).

Despite the importance and sensitivity of the software developed, their development process is still ad-hoc and unpredictable as the process is constantly changed or modified as the work progresses (Kimuyu et al, 2017). It is made worse by incomplete software development teams. All this, causes delays in software project schedule, over expenditure on allocated budget, poor functionality and software product quality that is inconsistent (Kimuyu et al., 2017). To address this problem, this paper therefore seeks to examine the influence of Technical factors on in-house SQA in SSCs in Kenya.

STUDY OBJECTIVES:

a. To assess the influence of QA Infrastructure on In-house SQA in Strategic state corporations in Kenya.

b. To examine the intervening role of Government regulation on the relationship between QA Infrastructure and In-house SQA in Strategic state corporations in Kenya.

2. LITERATURE REVIEW

Theoretical Literature Review:

Total Quality Management (TQM) Theory:

This research applied Total Quality Management (TQM) theory in in-house Software development in SSCs. This is management philosophy that seeks to achieve quality by entrenching it into the organizational culture. It focuses on the Customer as the king, total employee involvement, process-centered, integrated system, strategic and systematic approach, continual improvement, fact-based decision making and communication. Its basic principle is that the cost of prevention is less than the cost of correction and therefore focuses on doing things right from scratch (Seetharaman,

2006). It empowers software users and developers collaboratively to ensure that quality is achieved (Talib et al., 2012). The application and use of TQM in in-house software development in SSCs with a focus on quality assurance infrastructure will improve the software development process, reduce waste and optimize business processes (Talib, 2013).

TQM has wide application and its use in in-house software development provides SSCs with an opportunity to improve its software development process. It can be applied to any development process and therefore, the adoption of TQM in in-house software development will allow quality to be built into the software development process (Li et al., 2000), This will ensure that software bugs are identified and corrected well in advance instead of waiting to correct them when the software product is at very advanced development stage or already in use (Kimuyu et al., 2017).

Empirical Review:

The quality of any product or service will largely be informed by the quality infrastructure that has been put in place to produce and guarantee it. Quality infrastructure in this study include: the organizational quality culture and consciousness, quality managements system's (includes quality policy and objectives), quality standards in use, quality manuals and procedures, document/Records management and hardware and software infrastructure. All these, play a critical irreplaceable role in SQA (Kimuyu et al., 2017; Hribar, 2009). It is the primary responsibility of the top management despite their non-technical background and the development team leaders to ensure that the right quality infrastructure is available to support software development (Javed et al., 2012).

Conceptual framework:

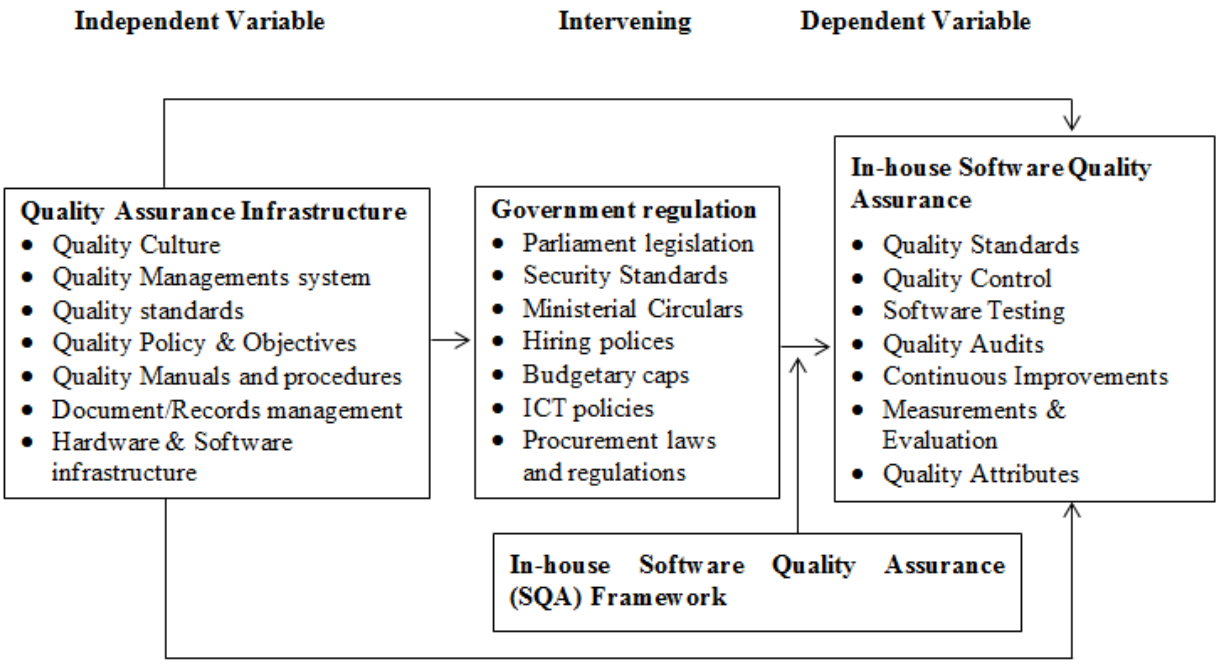

Figure 1: Conceptual framework

3. RESEARCH METHODOLOGY

The study used quantitative research method and applied Survey research design. The research population comprised 6 large SSCs which are critical to the Kenyan economy and attainment of the country's vision 2030. These corporations have an estimated combined ICT work force of 300 personnel. Utilizing Yamane's (1967) scientific calculation of the sample size at 95% confidence level, p = 0.05 and an assumption of 5% allowable error provided a sample of 169 respondents. These were administered with questionnaires using a drop and pick method. A multiple linear regression model was used to analyze the data using Statistical Package for the Social Sciences (SPSS).

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4. RESULTS AND DISCUSSIONS

Quality Assurance Infrastructure and In-House Software Quality Assurance:

Ordinary least squares regression was carried out to determine the relationship between QA Infrastructure and In-house SQA. The regression model $Y= \beta 0 + \beta_1 X$ was thus fitted from the data where X represented QA Infrastructure and Y denoted in-house SQA. From Table 1, the value of R and R^2 were 0.734 and 0.539 respectively. The R value of 0.734 showed that there was a positive linear relationship between QA Infrastructure and In-house SQA. The R^2 value indicated that the explanatory power of the independent variables was 0.539. This means that 53.9% of the variation in In-house SQA was explained by the model $Y= \beta 0 + \beta 1X$.

An ANOVA was carried out and the results showed the F statistic that had a p value of 0.000. Since the p value of the F-statistic was less than 0.05 it showed that the coefficient in the equation fitted was not equal to zero implying a good fit. This implied that considering the simple regression fitted, QA infrastructure had an effect on In-house SQA.

The results of coefficients to the model Y= 1.192 + 0.663 X estimates were both significant at the 0.05 level of significance as shown on Table 1. This was because the significance was 0.000, which were less than 0.05. The constant term implied that at zero QA Infrastructure, In-house SQA is at 1.192 measures, improvement in QA infrastructure by a unit increases the In-house SQA by 0.663 measures.

Table 1: Regression Analysis for QA Infrastructure

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
(Constant)	1.192	0.222		5.364	0.000
Quality Assurance Infrastructure	0.663	0.055	0.734	12.092	**0.000**
R (R2)	0.734	(0.539)			
F(p value)	146.226	(0.000)			
Dependent Variable: In-house SQA					

Hypothesis Testing:

The hypothesis was tested by using simple linear regression. The acceptance/rejection criteria were that, if the p value is greater than 0.05, the Ho is not rejected but if it's less than 0.05, the Ho fails to be accepted. Based on this objective and literature review, the following null hypothesis was formulated for testing.

H0: There is no significant relationship between QA Infrastructure and In-house SQA in SSCs.

Results in Table 1 show that the p-value was 0.000<0.05. This indicated that the null hypothesis was rejected hence there is a significant relationship between QA Infrastructure and In-house SQA in SSCs. This study is consistent with that of Scarpino and Kovacs (2010) that, QA Infrastructure such as organizational wide quality culture and consciousness, development and implementation of a Quality managements system, adoption of quality standards, development of quality manuals and procedures and up to date hardware and software infrastructure will guarantee the development of high quality software.

Mediating effect of Government regulation on the relationship between QA Infrastructure and In-house SQA:

The results in Table 2 show that the influence of QA Infrastructure on In-house SQA ware development is significant (p=0.000). The first mediation condition which states that the independent variable should be significantly related to the dependent variable in the absence of the mediating variable is thus satisfied.

Table 2: Mediating effect of Government regulation on the relationship between QA Infrastructure and In-house SQA (First Step)

	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
(Constant)	1.192	0.222		5.364	0.000
QA Infrastructure	0.663	0.055	0.734	12.092	0.000
Dependent Variable: In-house SQA					

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The second step as presented in Table 3 indicates that the influence of QA Infrastructure on Government regulation is significant (p=0.000) thus satisfying the second condition which states that the independent variable should be significantly related to the mediator variable.

Table 3: Mediating effect of Government regulation on the relationship between QA Infrastructure and In-house SQA (Second Step)

	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
(Constant)	1.090	0.390		2.798	0.006
QA Infrastructure	0.644	0.096	0.514	6.699	**0.000**
Dependent Variable: Government regulation					

The third step was presented in 4. In the third step, the influence of Government regulation on In-house SQA was significant (p=0.000) thus satisfying the third condition which states that the mediator variable should be significantly related to the dependent variable.

Table 4: Mediating effect of Government regulation on the relationship between QA Infrastructure and In-house SQA (Third Step)

	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
(Constant)	1.717	0.144		11.923	0.000
Government Regulation	0.579	0.038	0.804	15.137	**0.000**
Dependent Variable: In-house SQA					

In the fourth step, the influence of the independent variable (QA infrastructure) on the dependent variable (In-house SQA) was significant in the presence of the mediating variable, Government regulation (p=0.000) and thus not satisfying the fourth condition which states that the effect of the independent variable on the dependent variable should be insignificant in the presence of the mediating variable.

Table 5: Mediating effect of Government Regulation on the relationship between QA Infrastructure and In-House SQA (Fourth Step)

	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
(Constant)	0.736	0.156		4.708	0.000
QA Infrastructure	0.393	0.044	0.436	9.021	0.000
Government regulation	0.418	0.035	0.580	12.007	0.000
Dependent Variable: In-house SQA					

The mediation test failed the fourth conditions that should be met for a full mediation relationship to be considered and therefore it can be concluded that Government regulation partially mediate the influence of QA Infrastructure on In-house SQA.

5. DISCUSSION CONCLUSIONS AND RECOMMENDATIONS

Discussion:

The objective of this study was to assess the influence of QA Infrastructure on In-house SQA in SSCs in Kenya. This objective gave rise to hypothesis which predicted that "there is no significant relationship between QA Infrastructure and In-house SQA in SSCs". Ordinary least squares regression was carried out to test this hypothesis. The second test investigated the intervening effect Government regulation had on the relationship between QA Infrastructure and In-house SQA in SSCs.

The R value was found to be 0.734 showing that there was a positive linear relationship between QA Infrastructure and In-house SQA SSCs. The R^2 value indicated that the explanatory power of QA Infrastructure was 0.539. This means that 53.9% of the variation in In-house SQA in SSCs was explained by QA Infrastructure. The results of coefficients to the estimates was significant at the 0.05 level of significance. This was because the significance was 0.000, which was 0.000<0.05. This indicated that the null hypothesis was rejected hence there is a significant relationship between QA Infrastructure and In-house SQA in SSCs.

Further to this, intervening term, Government regulation was introduced in the regression equation along with QA Infrastructure and In-house SQA in SSCs. The Government regulation had a significant influence on QA Infrastructure and In-house SQA in SSCs, it implied that Government regulation had a partial intervening effect on the relationship between QA Infrastructure and In-house SQA in SSCs.

Conclusion:

The results provide sufficient statistically significant evidence to justify the relationship between QA Infrastructure and In-house SQA in SSCs in Kenya. The study concluded that an improvement in QA Infrastructure will lead to an improvement in In-house SQA a situation that will guarantee in-house development of quality software. In light of the above, it is concluded that SSCs must revamp its QA Infrastructure in order to support the development of quality in-house software. This will greatly improve support to critical infrastructure and function, reduce overreliance on software imports and outsourcing and also create jobs for a growing population of young but tech-savvy generation.

Recommendations:

The improvement of QA Infrastructure will greatly boost the software industry and provide an opportunity to the country to create jobs as well as improve its economy. The development of quality software is crucial to this goal and can only be achieved if the support infrastructural mechanisms up on which the SQA function rides on are available. The incorporation of TQM approach in in-house software development will ensure that quality is in-built into the organizational culture. To consolidate all these gains and institutionalize them, an In-house SQA framework is needed to guide policy makers, top management in SSCs, software developers and entire organization in the production of quality in-house software.

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