

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

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Abstract

Purpose: The purpose of the study was to determine the influence of organizational factors on in-house software quality assurance in Strategic state corporations in Kenya.

Methodology: The study used quantitative research method and applied Survey research design. The research population and target group comprised 6large Strategic state corporations, three in Transport and Infrastructure sector and three in the Energy sector. These are playing a critical to the Kenyan economy and the 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 scientifically 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 38.5% of the variation in In-house Software Quality Assurance in Strategic state corporations can be explained by Organizational factors. The result of coefficients to the estimates was 0.000 and hence significant at the 0.05 level of significance. This indicated that Organizational factors positively and significantly influence In-house Software Quality Assurance in Strategic state corporations. The results also found that Government regulation had a partial intervening effect on the relationship between Organizational factors 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 frameworkthat will be create a conducive Organizational environment that supports in-house development of quality software.

Keywords: *organizational factors, in-house software development, software quality assurance, Strategic state corporations.*

Introduction

Software is used in Strategic state corporations (SSC) to support them deliver on their crucial mandate in support of government functions and service delivery. One of the critical requirements that influence software's ability to support such operations is quality, which is the extent to which an industry-defined set of desirable features are incorporated into a software product(Fitzpatrick, 1996). Other researchers define software quality in terms of satisfying the needs of the customer, freedom from defects and its ability to produce user's satisfaction (Mnkandla & Dwolatzky, 2006; Weinberg, 1997; Juran & Gryna, 1988).One way to achieve quality software is by having organizational wide Software Quality Assurance (SQA)

mechanisms and measures which entails efforts by managers and software developers to produce software that meets or exceed client's expectation. SQA ensures that there is a planned and systematic pattern of actions undertaken to provide adequate confidence that the developed software conforms to established technical requirements and defined user needs (IEEE, 2014). It is a set of activities designed to ensure that the software development process is able to produce the required product, by doing this, software developers are not only interested with the quality of the end product only, but also the quality of the development process. It is that process that provides adequate assurance that the software product and processes in the product life cycle conform to specific requirements and adhere to agreed and established quality standard(Conklin, 2011; Feldman, 2005).

This paper focusses on the influence of Organizational factors on In-house SQA in SSC. Key among these Organizational factors include: Management commitment, user involvement, user empowerment, financial and budgetary support, human resources management, training and available facilities and infrastructure to support in-house software development. While organizations have the option of buying commercial off-the-shelf software or outsourcing software development to established software development firms, most functions and processes in SSC are unique and require in-house developed software solutions to support them. Owoseni and Imhanyehor (2011), states that the objectives of In-house Software development are to increase efficiency, meet specific business needs and promotion of 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 have a thorough understanding of their colleague's needs and thus able to get the system's requirements right. In-house software development promotes participatory development that allows for day to day interaction between the users, development team and organization's top management.

ICT departments in SSCs face competition from other departments for scarce organizational resources. Therefore, internally produced software must prove their worthy in support of organizational business strategy vis-a-vis the resources committed to produce them. They should ensure that quality is built into the development process. Nair et al. (2011), put it in its right context by stating that quality is a continuous process and not a state, it is dependent on process and people. Indeed, software quality ensures that software products and their development processes not only meet customers' needs but also satisfy these needs (Ratnam et al., 2012; Ortega et al., 2003; Biffi & Halling, 2002). For this to be achieved, there is need to understand that, quality is not only a technical function or responsibility of the ICT department alone, but also an Organizational responsibility that span the areas of management support, establishment of a quality culture, recruitment of software developers, training, motivation and retention, budgetary allocation to support software development among others.

Problem Statement

Strategic state corporations (SSCs) support critical transport, infrastructure and energy systems. They operate a diverse inventory of software which by their nature must be reliable, dependable and robust (Kaur & Sengupta, 2011). Those developed in-house, just like the other software must abide to internationally recognized quality standards, organizational specific standards and user requirements and expectation. Most Scholars have observed that poor software quality is one of the leading sources of software project failure(Nelson, 2007; Murugesan, 1994; Tuteja& Dubey, 2012; Jacob & Constantinescu, 2008). The quality of In-house developed software in SSC 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.

Despite the 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. 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. To address this problem, this paper seeks to examine the influence of Organizational factors on in-house SQA in SSC in Kenya.

Study Objectives

- a. To determine the influence of Organizational factors on In-house SQA in SSCs in Kenya.
- b. To examine the intervening role of Government regulation on the relationship between Organizational factors and In-house SQA in SSCs.

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. TQM is a management philosophy that enhances organizational quality by empowering individual members to participate in ensuring quality is delivered and entrenched as a culture into the organization. It promotes continuous and sustained improvement in quality and performance, and develops an attitude of quality culture (Talib et al., 2012). Its basic principle is that the cost of prevention is less than the cost of correction. TQM address overall organizational performance and recognizes the importance of processes (Seetharaman, 2006). TQM has taken a strong place in all sectors and emerged out as an approach for process improvement, waste reduction, business optimization and quality performance. These are key ingredients that can transform in-house software development in SSC in Kenya as TQM is concerned with the integration of all the efforts in the organization towards quality improvement, quality development and quality maintenance (Talib, 2013).

The use of TQM in this research is well supported in literature. According to Li et al., (2000), the TQM philosophy can be applied to any development process, be it product development or software development. The adoption of TQM will allow quality to be built into the software development process ensuring that faults, defects, bugs and snags 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.

Empirical Review

Organizational factors, key among them, the top management support play a critical irreplaceable role in SQA (Hribar, 2009). It is the primary responsibility of the top management and development team leaders to ensure that the team members are well taken care of, facilitated in all areas and provided with a good working environment (Koru et al., 2009; Javed et al., 2012; Mutunga, 2013). In most cases top management has been accused of allocating fewer resources to IT functions and software development and putting more focus on other so called critical areas (Ichu & Nemani, 2011). The management should ensure that quality is embedded at all levels. It should be noted that software development is a very complex process and the management should not ignore or assume that software developers will comply with SQA requirements without the management involvement.

Verner and Evanco (2005), add weight to this requirement by arguing that when it comes to in-house software development, most organizations continue to make the same mistakes. They further add that most senior management lacks an appreciation of the steps necessary to successfully execute a software development project. Royce (1970), argues that during software development the management should enforce the software development process and compliance on the part of the development team. While, independence of work is encouraged at all organizational levels, there is need for management to provide guidance and support throughout the development process as when it comes to delivery of quality, the buck does not only rest with the development team but also with the management.

While expertise, specialized skills and knowledge in a development team is critical, their mere presence in a software development team is insufficient to produce high quality software. However, most SSC suffer from a shortage of professional staff that is competent to develop software and perform SQA activities (Markauskaite, 2004). Thus available expertise must be managed, coordinated and directed in order to leverage its potential. The development teams on their side must manage their skill and knowledge interdependencies effectively through expertise coordination. This entails knowing where expertise is

located, where expertise is needed and bringing scarce but much needed expertise to bear at the right place and time within the in-house software development cycle (Faraj & Sproull, 2000). In doing so, SSC in Kenya will eliminate manpower problems as well as guarantee in-house developed software quality (Njiru, 2008; Maluti et al., 2011).

Conceptual framework

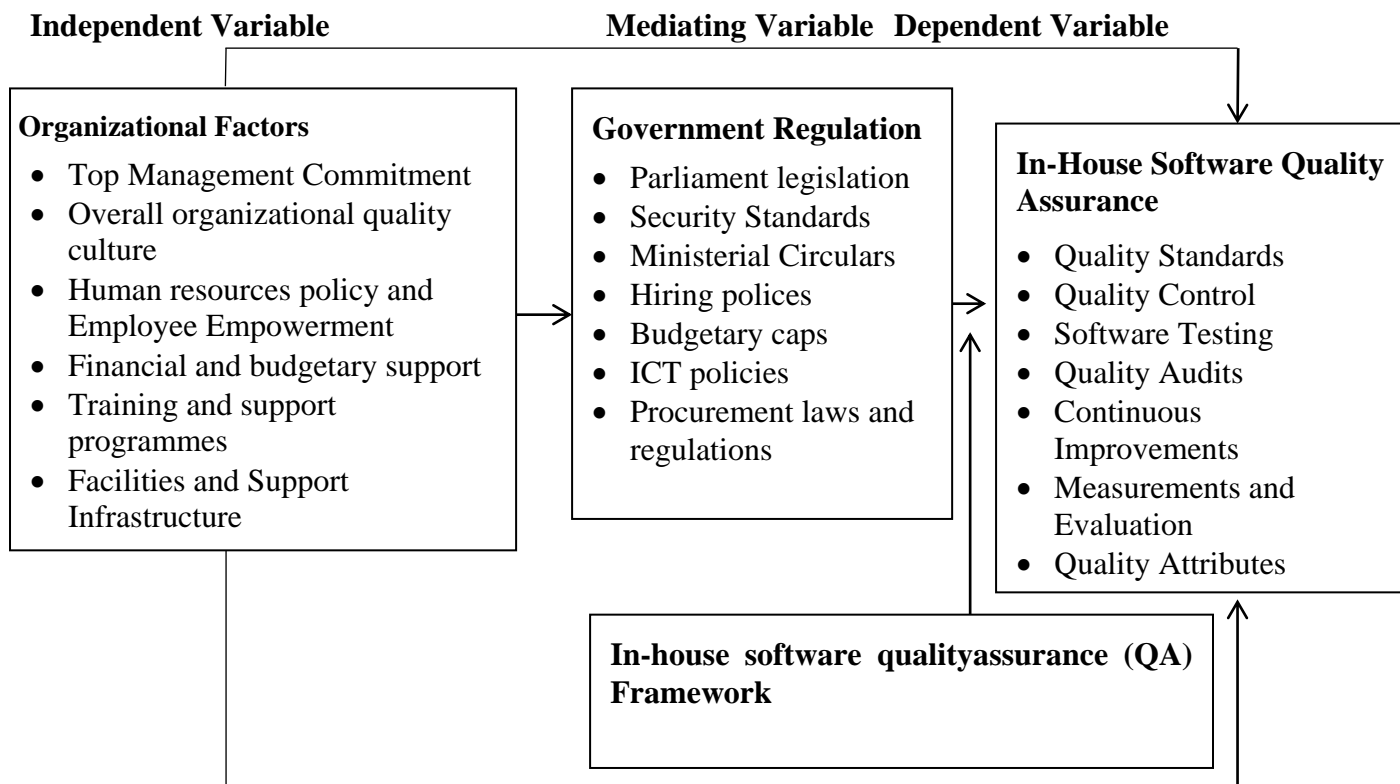


Figure 1: Conceptual framework

Research Methodology

The study used quantitative research method and applied Survey research design. The research population comprised 6 large SSC 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).

Results and Discussions

Organizational Factors and In-house SQA

Ordinary least squares regression was carried out to determine the relationship between Organizational factors and in-house SQA. The regression model $Y = \beta_0 + \beta_1 X$ was thus fitted from the data where X represented Organizational factors and Y denoted In-house SQA.

From Table 1, the value of R and R^2 were 0.621 and 0.385 respectively. The R value of 0.621 showed that there was a positive linear relationship between Organizational factors and In-house SQA. The R^2 value indicated that the explanatory power of the independent variable was 0.385. This means that 38.5% of the variation in In-house SQA was explained by the model $Y = \beta_0 + \beta_1 X$.

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, Organizational factors had an effect on In-house SQA.

The results of coefficients to the model $Y = 1.033 + 0.706X$ 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 Organizational factors, In-house SQA is at 1.033 measures, improvement in Organizational factors by a unit increases the In-house SQA by 0.706 measures.

Table 1: Regression analysis for Organizational factors

Model	Unstandardized Coefficients		Standardized Coefficients Beta	t	Sig.
	B	Std. Error			
(Constant)	1.033	0.320		3.226	0.002
Organizational Factors	0.706	0.080	0.621	8.847	0.000
R (R ²)	0.621	(0.385)			
F(p value)	78.275	(0.000)			

Dependent Variable: In-house SQA

Hypothesis Testing

The hypothesis was tested by using simple linear regression (Table 1). 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.

Ho: There is no significant relationship between Organizational factors and In-house SQA in Strategic state corporations (SSCs).

The 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 Organizational factors and In-house SQA in SSCs. This study is consistent with that of Hribar (2009), that Top Management support, a key element under Organizational factors plays a critical irreplaceable role in SQA. It is the primary responsibility of the top management and development team leaders to ensure that software developers are facilitated in all areas and provided with a good working environment. There is no quality that can be achieved without management commitment and responsibility in ensuring that quality is embedded into the organizational culture. Other studies have shown that, during software development the management should ensure that the development team complies with applicable quality requirements and standards at all development stages (Royce, 1970; Verner & Evanco, 2005).

Mediating effect of Government regulation on the relationship between Organizational factors and In-house SQA

The results in Table 2 show that the influence of Organization factors on In-house SQA 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 Organizational factors and In-house SQA (First Step)

	Unstandardized Coefficients		Standardized Coefficients Beta	t	Sig.
	B	Std. Error			
(Constant)	1.033	0.320		3.226	0.002
Organizational factors	0.706	0.080	0.621	8.847	0.000

Dependent Variable: In-house SQA

The second step as presented in Table 3 indicates that the influence of Organizational factors 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 Organizational factors and In-house SQA (Second Step)

	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
(Constant)	-0.744	0.404		-1.844	0.067
Organizational factors	1.108	0.101	0.702	11.020	0.000

Dependent Variable: Government regulation

The third step was presented in Table 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 Organizational factors 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 Software Quality Assurance

In the fourth step, the influence of the independent variable (Organizational factors) 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 Organizational factors and In-house SQA (Fourth Step)

	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
(Constant)	1.423	0.245		5.815	0.000
Organizational factors	0.125	0.084	0.110	1.484	0.140
Government regulation	0.524	0.053	0.727	9.791	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 Organizational factors on In-house SQA.

Discussion, Conclusions and Recommendations

Discussion

The objective of the study was to determine the influence of Organisational factors on In-house SQA in SSCs in Kenya. Simple linear regression analysis was used to test the hypothesis that “*There is no significant relationship between Organizational factors and In-house SQA in SSCs*”. Organizational factors was separately regressed on In-house SQA before mediation using Government regulation. The

initial regression results revealed a positive relationship with 38.5% variation in In-house SQA being explained by Organizational factors ($R^2=0.385$). The result of the coefficients to the model estimates was significant at the 0.05 level of significance. This was because the significance was 0.000, which is less than 0.05. This indicated that the null hypothesis was rejected hence there is a significant relationship between Organizational factors and In-house SQA in SSCs.

A regression analysis was also done to determine the mediating effect that Government regulation had on the relationship between Organizational factors and In-house SQA in SSCs. All the four steps result of coefficients showed that the relationship between Organizational factors and In-house SQA in SSCs were significant since it had a p-value of less than 0.05. Since the coefficients were significant, it implied that Government regulation had a partial intervening effect on the relationship between Organizational factors and In-house SQA in SSCs.

Conclusions

The study found a relationship between Organization factors and In-house SQA as the results showed that Organizational factors had a positive and statistically significant effect on In-house SQA. On the other hand, the results of the coefficients showed that Government regulation had a partial mediation effect on the relationship between Organizational factors and In-house SQA. From the forgoing, it can be concluded that an improvement in Organizational factors such as management commitment, user involvement, user empowerment, financial and budgetary support, human resources management, training and available facilities and infrastructure to support in-house software development will lead to a positive improvement in In-house SQA.

Recommendations

Software is crucial to support SSCs in Kenya discharge on their crucial mandate to the Government and the people of Kenya. Its quality must therefore be top notch and be approached from an all-inclusive Organizational perspective. The incorporation of TQM approach will ensure ownership by the entire organization with all the employees and resources committed towards the improvement of In-house SQA. An In-house SQA framework is also needed to guide the top management, software developers and entire organization in the production of quality In-house software.

References

1. April, A., & Laporte, C. Y. (2009). An Overview of Software Quality Concepts and Management Issues. In P. Tiako (Ed.), *Software Applications: Concepts, Methodologies, Tools, and Applications* (pp. 222-241). Hershey, PA: Information Science Reference. doi:10.4018/978-1-60566-060-8.ch019.
2. Biffl, S. & Halling, M. (2002). Investigating The Influence of Inspector Capability Factors with Four Inspection Techniques On Inspection Performance. *Software Metrics Proceedings. Eighth IEEE Symposium on 07 August 2002.*
3. Conklin, A (2011). Software Assurance: The Need for Definitions. *Proceedings of 44th a. Hawaii International Conference on System Sciences 2011. IEEE.*
4. Faraj, S., & Sproull, L. (2000). Coordinating Expertise in Software Development Teams. *a. Management Science. 46* (12). 1554 - 1568.
5. Fitzgerald, B. (1996). Formalised Systems Development Methodologies: A critical perspective, *Information Systems Journal*, Vol. 6, No. 1, pp 3–23.
6. Geethalakshmi, S.N (2009). Non-Technical Components of Software Development and their Influence on Success and Failure of Software Development. *Proceedings of CONSEG-09: International Conference on Software Engineering*, December 17-19, Chennai, India.
8. Hribar, L., Burilovic, A., & Huljenic, D. (2009). Implementation of the Software Quality Ranks method in the legacy product development environment. *Telecommunications, ConTEL 2009. 10th International Conference on 8-10 June 2009.*
9. Ichu, E. & Nemani, R. (2011). The Role of Quality Assurance in Software Development Projects: Project Failures and Business Performance. *Int. J. Comp. Tech. Appl.*, 2(4), 716-725.
10. Jacob, A., Weinshenker, B. G., Violich, I., McLinskey, N., Krupp, L., Fox, R. J., ...& De Angelis, T. (2008). Treatment of neuromyelitisoptica with rituximab. *Arch Neurol*, 65(11), 1443-8.

11. Javed, A., Maqsood, M., Khurram, A.Q, & Shah, K.A. (2012). How to improve Software
12. Quality Assurance in Developing Countries.*Advanced Computing: An International Journal (ACIJ)*, 3(2).
13. Juran, J. M., Editor, & Gryna, F. M., Associate Editor. (1998). Juran's Quality Control
 - a. Handbook, 4th ed, McGraw-Hill Book Company, New York.
14. Kaur, R. & Sengupta, J. (2011). Software Process Models and Analysis on Failure of Software Development Projects.*International Journal of Scientific & Engineering Research*.2 (2).ISSN 2229-5518.
15. Koru, A.G., Dongsong, Z., El Emam, K., Hongfang, L. (2009). An Investigation into the Functional Form of the Size-Defect Relationship for Software Modules.*Software Engineering, IEEE Transactions*.
16. Krigsman, M., (2012). Worldwide cost of IT failure (revisited): \$3 trillion. Beyond IT Failure. <http://www.zdnet.com/article/worldwide-cost-of-it-failure-revisited-3-trillion/> (Accessed on 8 April 2015).
17. Li, E. Y., Chen, H., & Cheung, W. (2000). Total Quality Management in Software development Process.*The Journal of Quality assurance Institute*, 14(1), 4 – 6 & 35-41.
18. Maluti, L.V, Warentho, T.O. ,Shiundu, J.O. (2011). Impact of employee commitment on retention in state financial corporations in Kenya.*International Journal of Business and Public Management*. 2(2), 30-38.
19. Markauskaite, L. (2004). Framework for Educational Software Quality Assurance in Lithuania.*Informatics in Education*, 3 (2), 289 – 308.
20. Maruping, L.M., Venkatesh.V.,Agarwal.R. (2009). A Control Theory Perspective on Agile Methodology Use and Changing User Requirements.*Information Systems Research*.20(3), 377–399.
21. Mnkandla, E. & Dwolatzky, B. (2006). Defining Agile Software Quality Assurance.*Proceedings of the International Conference on Software Engineering Advances*, 36-36.
22. Murugesan, S. (1994). Attitude towards testing: A key contributor to software
23. quality. *IEEE's Proceedings of 1st International Conference on Software Testing, Reliability and Quality Assurance*, 111-115.
24. Mutunga, C.K (2013). Indicators Of Quality Management Practices In State Corporations Within The Agriculture Sector In Kenya (Case of Selected ISO Certified Firms in the Agriculture Sector).MBA Thesis.School of business.Kenyatta University.
25. Nelson, R. R. (2007). IT project management: Infamous failures, classic mistakes, and best practices, *MIS Quarterly Executive*, 6(2), June 2007, 67-78.
26. Nair, T.R.G., Suma, V., & Tiwari, P.K. (2011). Analysis of Test Efficiency during Software Development Process.*2nd Annual International Conference on Software Engineering and Applications (SEA 2011)*.
27. Njiru, E. (2008), The role of State Corporations in a developmental state- the Kenya experience. *30th AAPAM Annual Roundtable Conference*, Accra Ghana, October 2008. www.unpal.un.org/introdoc/groups/public.
28. Ortega, M., Perez, M., & Rojas, T. (2003). Construction of a Systemic Quality Model for Evaluating a Software Product, Kluwer Academic Publishers.*Software Quality Journal*, 11, 219–242.
29. Owens, D. M., & Khazanchi, D. (2009). Software quality assurance. In *Handbook of Research on Technology Project Management, Planning, and Operations* (pp. 242-260). IGI Global.
30. Owoseni, A.O & Imhanyehor, G.J. (2011), User Involvement In In-House Developed Software: Case Study of A Nigerian Financial Institution. Msc Thesis School of Computing Blekinge Institute of Technology.
31. Paulk, M.C. (2006), Factors Affecting Personal Software Quality. Carnegie Mellon University. Institute for Software Research. School of Computer Science.
32. Paulk, M.C. (2006), Factors Affecting Personal Software Quality. Carnegie Mellon University. Institute for Software Research. School of Computer Science.
33. Ratnam, S.K., Rajkumar, T.T., & Maheshwari, U. (2012). Quality Management System (QMS) for Corporates.*Excel International Journal of Multidisciplinary Management Studies*. 2(6), ISSN 2249 8834.

34. Royce, W.W., (1970). Managing the Development of Large Software Systems. *Proceedings of IEEE WESCON 26*.1 -9.
35. Seetharaman A. (2006). Critical Success Factors of Total Quality Management. *Quality and Quantity*. 40, 675-695.
36. Talib, F. (2013). An overview of total quality management: understanding the fundamentals in service organization. *Browser Download This Paper*.
37. Talib, F., Rahman, Z., & Qureshi, M. N. (2012). Total quality management in service sector: a literature review. *International Journal of Business Innovation and Research*, 6(3), 259-301.
38. Tan, G., (2012). A Collection of Well-Known Software Failures. Lehigh University. Available at: <http://www.cse.lehigh.edu/~gtan/bug/softwarebug.html>. (Accessed on 8 April 2015).
39. Thakurta, R. & Roy, R. (2012). Determinants of User Involvement in Software Projects. *45th Hawaii International Conference on System Sciences*. 978-0-7695-4525-7/12. IEEE DOI 10.1109/HICSS.2012.203.
40. Tuteja, M., & Dubey, G. (2012). A research study on importance of testing and quality assurance in software development life cycle (SDLC) models. *International Journal of Soft Computing and Engineering (IJSCE)*, 2(3), 251-257.
41. Verner, J. M. & Evancho, W, M. (2005). In-House Software Development: What Project Management Practices Lead to Success?. *IEEE Software*, 22(1). 86-93.
42. Verner, J.M. & Cerpa, N. (2005). Australian Software Development: What Software Project Management Practices Lead to Success?. *Proceedings of the 2005 Australian Software Engineering Conference (ASWEC'05)*.
43. Weinberg, G.M. (1997). *Quality Software Management Anticipating Change*. Dorset House Publication 4, New York.
44. Yamane, T. (1967). *Statistics, an Introductory Analysis*. (2nd ed). New York: Harper and Row.