*IOSR Journal of Computer Engineering (IOSR-JCE)*
*e-ISSN: 2278-0661,p-ISSN: 2278-8727, Volume 17, Issue 2, Ver. V (Mar – Apr. 2015), PP 79-87*
*www.iosrjournals.org*

# Evaluating Total Cost of Ownership for University Enterprise Resource Planning: Case of Maseno University

Mr. Patrick Oduor Owoche[1], Prof. Wanyembi Gregory[2],
Mr. Kilwake Humphrey Juma[3]
[1]*Department Computer Science, Kisii University, Kenya)*
[2]*School of Information Science and Knowledge Management University of Kabianga, Kenya)*
[3]*Computer Science Department, Kisii University, Kenya)*

***Abstract:*** *Higher learning institutions (HEI) are investing in IT to attain operational excellence. Organizations looking to reduce technology costs typically look for ways to reduce the Total Cost of Ownership (TCO). TCO captures all direct and indirect costs related to deploying a particular system. Understanding life-cycle costs provides opportunity to save scarce resources, improve IT and increase productivity. The study sought to analyze the TCO of university ERP system. The TCO analysis was based on Gartner's TCO model, the Distributed Computing Chart of Account as the theoretical framework. Modified Gartner TCO model was used to determine the total cost of owning Maseno University ERP system. The aim of the study was to create awareness on life-cycle costs of ERP solutions. The results obtained indicate that operations and maintenance account for 51%, end-user usage 23% while technology acquisition costs accounted for 16 %, implementation costs with 7% and the least cost was taken by procurements costs with 3%. Case study was used in gathering both qualitative and quantitative data from Maseno University. Interviews, document analysis, and questionnaires were used to gather the research data. It is hoped that the results of this study will help HEIs improve management of their ERP systems.*

***Keywords:*** *Enterprise Resource Planning, Information System, IT metrics, TCO, Total cost of ownership*

## I. Introduction

Higher Education Institutions (HEI) have a relentless goal of keeping the cost of technology down by combining the best of information technology (IT) and business leadership. This is in their quest to achieve operational excellence, improving decision making and achieving competitive advantage through implementation of information systems (IS) (Laudon & Laudon, 2010[1]). As the computing capabilities continues to double every year or two (Moore, 2006[2]), the potential gains are greater than ever, so are the potential losses. The future belongs to those who are perceptive enough to grasp the significance of IT and resourceful enough to synchronize business management and information technology.

Mwiria, 2006 noted the biggest challenge to full exploitation of the ICT facilities in HEI as inadequate funding (Mwiria, et al., 2006 [3]). As budgets tighten, however, institutions of higher learning are coming under pressure to articulate the costs and benefits of existing and planned technology expenditures. Increasingly, educational decision makers are seeking evidence that their highly visible investments in technology are meeting educational needs and that these information technology (IT) investments are closely monitored and well-managed. According to a World Bank Institute survey (Farrell & Shafika, 2007 [4]), the state of ICT infrastructure in African universities can be summed up as "too little, too expensive, and poorly managed."

As management consultant, Peter Drucker once said; "If you can't measure something, you can't manage it" (Behn, 2005[5]), stands true in IT infrastructure management. Management of investment in IT by HEIs call for appropriate metric tools to measure the cost and value of technology initiatives. The main contribution of this study is in presenting a systematic analysis of TCO of an ERP system in a university setting by identifying its key cost elements. Gartner, a leading IT research firm, came up with the concept of TCO in 1987. TCO is an analysis meant to uncover all the lifetime costs that follow from owning certain kinds of assets. Public sectors have adopted the use of the TCO concept to assist in making decisions about the value for money of ICT deployments. TCO is a comprehensive set of methodologies, models and tools to help organizations better measure and manage their IT investments (Gartner, 2011[6]), (Wouters & Wynstra, 2005[7]). According to Forrester research, TCO requires significant investments in time and rigor, and TCO is without a doubt the most thorough and potentially accurate cost-analysis method available to an IT organization (Reinchman & Staten, 2008[8]).

Many IT metric tools have been developed using a variety of methodologies. Some of these tools include Total Value of Ownership (TVO), Return on Investment (ROI) and Value on Investment (VOI). TVO measures the business value of IT investment decisions based on a set of defined measures that model the

controllable business activities of an organization (Accenture, 2014[9]) (Hurkens & Wynstra, 2006[10]) while ROI is a project-based financial measure of the economic return from an investment (Cresswell, 2004[11]) (Botchkarev & Andru, 2011[12]).

Whereas there is little literature on TCO use in educational institutions in Kenya, studies have been carried out in developed countries. Consortium for School Networking (CoSN) launched its "Taking TCO to the Classroom" project in 1999 in the US to help school leaders understand the long-term costs involved in building and operating a network of computers. Through these, they will be able to budget adequately to cover all the associated costs and build and operate their networks in the most cost-efficient way to achieve their technology goals (Cosn, 2001[13]).

Peterson (2007[14]) asserts that in developing countries that have to deal with constrained resources, financial allocations to ICT must properly take into account the full costs of sustainable ICT systems. However, he further observes that there is a dearth of information about ICT costs that can assist Ministry of Education (MoE) decision makers to apportion their budgets between competing demands. The World Bank notes that there is very little data on the costs of deploying computers in developing country educational contexts (Vital Wave Consulting., 2008[15]).

### 1.1 Statement Of The Problem

For HEI to succeed in their IT investment, they require more operational discipline from their IT groups as well as more IT participation from their business units. Bridging this gap calls for proper analysis of IT efficiency metrics such as TCO and ROI. The use of TCO analysis in the management of IT in education in Africa remains quite low (Farrell & Shafika, 2007). There is very little evidence upon which decision makers can base their decisions to allocate finances to ICT in education (Peterson, 2007). Few good, reliable cost studies of ICT in education implementations exist (Farrell & Shafika, 2007). Those that do exist measure different things, such as cost of acquisition of technology and budgetary allocations to various departments. The MOEST (2005[16]) in session paper No. 2 of 2005 emphasized the importance of TCO in education and uses hypothetical data to illustrate its usage but no empirical research has been conducted to this effect. Such cost analyses are needed if real costs of operation and maintenance of ICTs to benefit education are to be undertaken. Such work is especially relevant in education systems that exhibit great resource scarcity. Complete TCO analysis of ERP in the context of Maseno University setting would be a big contribution to the literature and could help to move towards establishing best practices in area of ICT investment management with the current technological advancement. The specific objectives of the research study were to determine the major cost elements of an ERP system in a university and an analysis of the total cost of ERP ownership in a university.

## II. Literature Review

### 2.1 Total Cost of Ownership

Bill Kirwin, the Father of TCO defined TCO as the holistic view of costs across enterprise boundaries over time (Mieritz & Kirwin, 2005[17]; Pisello, 2001[18]). The TCO approach considers technology, and the IS it supports, placed within its institutional context and related to the business ecosystem from which software, support and services are drawn (Shaikh, 2011[19]). The "total" in TCO is expressed by use of an extended life cycle model which recognizes the various stages through which software goes, from selection through acquisition, implementation, use and finally decommissioning. TCO reveals the balance of the direct qualities of competing software products such as price, functionality, reliability and the relationship of the software to the institution's wider set of technology platforms, deployed systems, culture and skills base, and strategic goals, as well as the ability to access market and community based services and support (Shaikh et al., 2011).

Mieritz and Kirwin (2005) argues that regardless of the objective of the analysis, several mandatory elements listed below must be included for the analysis to qualify as a Gartner TCO:

- Identify the domain or activity for which an annual TCO is required
- Develop a chart of accounts, which is a list of cost elements that refers to TCO.
- Associated indirect cost elements — for example, labor costs associated with the end user's use of an asset or activity, and any subsequent downtime involved
- Ensure that the chart of accounts contains cost elements that satisfy the TCO definition's criteria for "holistic view" and "enterprise boundaries"
- Review the chart of accounts to ensure that all of its elements represent an annualized view of the TCO in question
- Review all chart-of-accounts elements to ensure that critical cost elements have been included and don't overlap, thus avoiding double counting
- Collect and validate information regarding the costs and other data required to populate the chart of accounts
- Amortize all cost elements in the chart of accounts during a specified time period

These elements captures almost all the activities that take place from the time the decision to acquire new system is made to the time the system is decommissioned.

**2.2 Total Cost of Ownership Studies**

There was no formal work at the time of the study available from Kenya on either TCO per se, or on total cost of ERP ownership. There were, however, some recent work on TCO in schools emerging from overseas and particularly the USA, upon which this study did draw. A study done by Unisys, a technology company, illustrates their findings of direct and indirect costs of ICT deployment in an Australian education system conducted in late 1999-2000 (Moyle, 2004[20]). The findings shows that direct costs which are the costs of hardware, software, operations and administration account for 56% of the TCO while indirect costs, that is the costs of downtime and end user operations account for 44% of the TCO. A case study on university ERP conducted at the Albany, State University of New York revealed TCO cost breakdown with employee salary taking the lion's share of TCO with 46%, equipment and software purchase accounted for 11% and 10% respectively. Software maintenance consumed 15%, consulting 9%, equipment maintenance took 3%, training and travel accounted for 4%, while miscellaneous and personal services each accounted for 1% of the TCO (Fryling, 2010[21]).

A Gartner Group study found that only 20% of TCO lies in initial acquisition costs; the rest lies in administration costs (David, 2002[22]). This makes it difficult for organization to gain a competitive advantage by reducing the purchase cost of its hardware and software, but they have significantly greater control of over 80% of IT expenditure they direct toward administering their IT system. In another study it was found that licensed software, licensed software support and professional services are the three top drivers of costs in IS TCO expense analysis (Konschak & Felt, 2010[23]). In reviewing the cross-organizational scope of this analysis, it becomes clear that the TCO is driven by processes, people, technology and tools and comprises all costs expected in a defined timeframe. The timeframe might cover three, five, or ten years for some projects.

Case studies of large, medium, and small school districts, conducted by the CoSN (Kaestner, 2009[24]) indicate that technology, direct labor and indirect labor share of the TCO for each is 23 percent for technology (amortized over useful life), 21 percent for direct labor, and 56 percent for indirect labor. A TCO case study conducted in California school district revealed that Two-thirds (67.7 percent) of the TCO consisted of indirect costs (Stegman, 2003[25]). A research carried out in selected Rwandan HEIs on the major TCO cost drivers showed that institutions often succeed in acquiring computing devices, but they commonly lack the resources needed for the acquisition of relevant hardware and software accessories; train staff to utilize the procured ICT facilities; service and upgrade the facilities acquired and replace them when they become obsolete; and meet recurrent costs of electricity and network subscriptions (Ssempebwa, 2007[26]). This is evidence of under facilitation, which is due to lack of IS TCO awareness.

**2.3 Theoretical Framework**

This study was modeled on the Gartner TCO Model for distributed computing advanced by Gartner Inc. in 1987 and has been the leading advocate for its use in IT, as well as a major developer of TCO methodological tools. The Gartner TCO model utilizes two major categories to organize costs. These are direct (budgeted) costs and indirect (unbudgeted) costs (Gartner, 2001[27]). Direct costs consist of the capital, fees, and labor costs spent by the corporate IS department, and business unit IS groups in delivering IT services and solutions to the organization and users. The direct cost models typical costs and captures actual costs for all direct expenses related to the clients, servers, peripherals, and network in the distributed computing environment and serving the distributed computing users. Also modeled are the indirect (unbudgeted) costs which are hidden in most organizations and are not measured or tracked. Indirect costs include end user time spent in casual learning, problem determination and lost productivity during downtime. Gartner's TCO model is the industry standard framework and methodology for cost management (West, 2004[28]). The model has been used in US schools for case studies of California, Minnesota, Utah, Texas, Wisconsin, Missouri, Pennsylvania and Virginia school Districts (CoSN, 2011[29]). The TCO model postulates that the indirect (unbudgeted) costs measure the efficiency of IS in delivering expected services to end users. If the IS management and solutions are efficient, end users are less likely to be burdened with self and peer support, as well as downtime. If the IS management and solutions are inefficient, end users typically must spend more time supporting themselves and each other (self and peer support), and are impacted by more downtime. This model was preferred over the SAP TCO framework model which the researcher felt was a single vendor TCO model. SAP TCO Framework is a comprehensive approach to a single vendor TCO model that can be applied to answer questions about TCO for customers and prospective users of SAP ERP systems (Greenbaum, 2005[30]).

As applied to this study, the budgeted costs are a direct measure of ERP system spending. Unbudgeted costs can be viewed as a second order effect of the direct spending, and as a result of spending too much or too little in budgeted costs, unbudgeted costs are affected. However, because unbudgeted costs are a second order

effect, a causal relationship, although likely, is not directly measurable or true. There is logical evidence of the correlation of best practice direct expenditures and reduced indirect costs. For example, in a study carried by Intel Corporation in 2009 revealed that delaying PC deployments shifted costs into later periods and failed to optimize cash flow from a discounted cash flow perspective (Mahvi & Zarfaty, 2009[31]).The short-term gain in delaying PC purchases conserves cash in the short run but actually is more expensive in the long run, producing a higher total cost of the life of a PC. Investing in end-user professional development or product training for users lowers the TCO. According to Gartner research, untrained or poorly trained users will cost significantly more to support than well-trained workers (Gartner, 2007[32])

In adopting the Gartner TCO model, the researcher was conscious of the fact that generic model needs to be detailed and focused for specific projects or area of study, as opposed to Garner's TCO model that is not focused on a specific project. For instance, the TCO model for determining the TCO for data centers will not be appropriate model for determination of the TCO of a desktop computer or a TCO model for cloud based ERP system will not be suitable for an on premise based ERP system.

## III. Methodology

This study employed both qualitative and quantitative data collection methods. The research was conducted through case study research design. Compared to other methods, the strength of the case study method is its ability to examine, in-depth, a "case" within its "real-life" context (Yin, 2003[33]) and provides up-to-date information (Al-Shehab, Hughes, & Winstanley, 2009[34]). With the objective of conducting cost analysis of ERP systems in universities, a single case study was conducted in Maseno University. The use of single case study allowed in-depth understanding of ERP costs. The major concern for a single case study is whether the findings can be generalized. (Klein & Myers, 1999[35]) in "principle of Abstraction and Generalization" argue that it is possible to generalize if the reasoning is logically correct. For the use of a single case study in TCO analysis (Fischer & Lugg, 2006[36])argue that there is no generic TCO model and the cost estimation method should be customized to local conditions. In support of Fischer et al., (2006) (Ferrin & Plank, 2002[37])asserts that research has shown that it is in general very difficult to make TCO-calculations, and that there is a need for more case based research to increase knowledge of how cost drivers work in different settings. For studies of single cases, judgment should not be made by the evaluator. Instead, it should be made by those individuals who wish to apply the evaluation finding to their own situations. That is, the evaluator should produce and share the information, but the receiver of the information must determine whether it applies to their own situation (Kennedy, 1979[38]). Therefore, for this study no attempt is made to make generalizations concerning the costs in the TCOs. Instead, it is shown how factors have affected costs in the examined case, and it is up to the reader to determine where these lessons can be applied in projects outside of the sample of this research. Hopefully, some of the insights made in this process can be applied in future projects that are tolerably similar to the ones under study.

### 3.1 Population and Sampling

The target population for the study was 71 consisting of 60 ERP end-users 2 administrative staff, and 9 IT technical staff of Maseno University. The sample population consisted of the university procurement officers, ICT Director, System Administrator, network administrator, and IT technicians as well as the Finance Officer. Asset managers were also interviewed. Slovin's formula (equation 1) was used to calculate the sample size (Ariola, 2006[39]). According to Ariola, 5% is an allowable error for smaller sample.

$$n = \frac{N}{1+Ne^2} \quad \ldots\ldots\ldots\ldots\ldots\ldots 1$$

n = number of samples
N = total population
e = error tolerance
With
n = 53
N = 60
e = 0.05

This study employed purposive sampling technique to select the sample. The researcher consciously decided who to include in the sample. Purposive sampling technique is mainly used to collect focused information (Oso & Onen, 2009[40])

### 3.2 Data Collection

Data was collected from the respondents between the months of January and April the year 2013. The study used semi-structured interviews, document analysis, standard methods (e.g. Request for proposal (RFP)

and bids), questionnaires and observation to collect both quantitative and qualitative data. The selection for these tools was guided by the nature of the data to be collected, the time available as well as the objective of the study. The overall aim of this study was to conduct cost analysis of a university ERP. The study was mainly concerned with the procurement process in IT department, acquisition costs of computing hardware and software and maintenance. Information on downtime both technological and on end-user, end-user training, consultancy services, as well as the salaries of IT support personnel was collected. Data on policy on the disposal of computing devices was also captured.

Supporting documentation was valuable in corroborating the evidence collected in semi-structured interviews. (Kontio, 2004[41]) suggested that interviews provide insightful observations, while documents provide stable, unobtrusive and exact case information. The other data collection method used was structured (online and manual) questionnaire.

### 3.2 Quality Control

To control quality, the researcher endeavored to attain validity and reliability coefficient of at least 0.7. Validity refers to the ability of an instrument to measure what it is designed to measure. Validity is defined as the degree to which the researcher has measured what he has set out to measure (Kumar, 1999[42]), (Creswell, 2008[43]) while reliability is related to the accuracy of the actual measuring methods. The instruments were piloted in the departments that were not included in the study sample and modified to improve their validity and reliability coefficient to at least 0.70. Items with validity and reliability coefficient with at least 0.70 are accepted as valid and reliable in research (Kathuri & Pals, 1993[44]). The survey included a combination of personal interviews, which were conducted first so that any changes that were needed were made to the forms, followed by paper-based and electronic surveys (email).

Voluntary participation, anonymity and confidentiality, purpose and sponsor and analysis and reporting ethical concerns were addressed when conducting research.

## IV. Results

### 4.1 Maseno University Erp System

Maseno University implemented the Microsoft Business Solution- Microsoft Dynamic in 2007-08, which was the latest version of Microsoft Dynamics ERP at that time. Microsoft Dynamics Nav is an ERP solution for small and mid-sized organizations that automates and streamlines business processes (Coretec, 2013[45]). The on premise delivery model was used in which the University bought the ERP software license and installed in the University server within their compound. The university was responsible for buying computer hardware and software for these solutions. They were also responsible for applying any software upgrades, patches or fixes provided by the software vendor. Maseno University employed thin client/server architecture where end users through terminal clients request services from application servers, which in turn get the requested service-related information from the database servers.

Modified Gartner's chart of accounts was used to collect cost elements in procurement, hardware/software acquisition, implementation, operations & maintenance and end-user usage categories. The bulk of direct costs were easily availed from documents analyzed, collaborated by in-depth interviews and market rates at the time of acquisition of the assets. However indirect costs which forms the end-user usage cost were not easy to ascertain and questionnaires and semi-structured interview were used to gather the data. The questionnaire used in collecting end-user usage costs was a modification of the one used in taking TCO to the classroom (Gartner, 2003[46]). The questionnaire used was adopted form had items that asked the end-user to estimate the average duration of time spent on the ERP system per day and the average time they spent on the following activities per month at work:

**Self-support** (activities, such as backups, loading software, and organizing files on hard drives).

**Peer support** - Peer support is the reliance on a knowledgeable resource, typically the unofficial "expert" in providing support answers and in resolving technical issues.. Typical tasks performed by the end users include troubleshooting and repair, support, maintenance, installation, training, and backup management.

**Casual learning** – this is the time taken by end-users in activities such as reading manuals, using on-line help, trial and error, and other self-learning methods to learn programs and resolve issues.

**Time to resolution –** When stuck on a job related task, time spent waiting for problems to be resolved.

Futz factors and application customization information was not sought since they are not easily quantifiable. Futz factor is where an end-user uses corporate technology for his/her own personal use. This cost lies not in the system itself (it is already purchased) but in the time employees spend using the system for non-work-related activities.

Productivity loss due to end-user downtime was calculated using burdened salary figures. Burdened salary includes user compensation, plus the burden of taxes and benefits. The downtime productivity loss was

calculated as the product of number of users affected, the average percentage of time end-users depend on IT system, the average burdened salary per hour and the duration of end-user downtime (Pisello, 2004, Martinez, 2009[47]). Equation 1 was used to calculate the average labor cost of productivity loss:

$$\text{Labor cost} = P \times E \times R \times H \quad \text{---------- Equation 1}$$

Where:
P = number of end-users affected
E = average percentage of time end-users depend on IT system
R = average employee cost per hour
H = number of hours of unproductive end-user activities

Percentage of user dependency is the percentage of time an end-user uses the ERP system in a day and number of hours of productivity loss is the total time spent on non-productive activities. For the system downtime, data collected was for the average number of outage per month experienced in the university and how long the outage lasted. Also collected were the activities performed by the end-users when the system is down. The cost of downtime was computed using equation II.

$$\text{Downtime cost} = T \times D \times B \times N \quad \text{---------- II}$$

Where:
T = number of end-users affected
D = average percentage of end-user dependency on ERP system
B = average hourly rate compensation for end-user
N = average number of hours of outage
The total cost of owning Maseno University ERP system TCO was computed using modified Gartner's TCO model the following first set of TCO figures were collected and the model populated to give the results shown in the Table 1.

**Table 1:** Five Year TCO of Maseno University ERP System (Source: Research data)

| | Nodes Costs (KES) | Elements Costs (KES) |
|---|---|---|
| **Procurement Costs** | | 3,300,000 **(3%)** |
| Feasibility Study | 800,000 | |
| Requirement Specification | 300,000 | |
| Procurement Management | 1,000,000 | |
| Project Management | 1,200,000 | |
| **Hardware/Software** | | 20,175,600 **(16%)** |
| Application Software | 3,249,000 | |
| System Software | 8,476,600 | |
| Hardware | 8,450,000 | |
| **Implementation Costs** | | 9,541,572 **(7%)** |
| Technical Setup | 8,281,572 | |
| Change Management | 200,000 | |
| Personnel Restructuring | 400,000 | |
| Testing | 60,000 | |
| Training | 600,000 | |
| **Operations and Maintenance Costs** | | 66,324,720 **(51%)** |
| Licenses Agreement | 925,000 | |
| Overheads | 4,527,063 | |
| Maintenance | 31,500,000 | |
| Support | 28,672,657 | |
| Monitoring | 300,000 | |
| Upgrade | 400,000 | |
| **End-User Usage** | | 29,735,346 **(23%)** |
| End-user Operations | 5,786,604 | |
| Downtime | 23,948,742 | |
| **Total** | 129,077,238 | |

From Figure 7, it can be seen that the leading cost drivers are operations and maintenance and end-user usage.

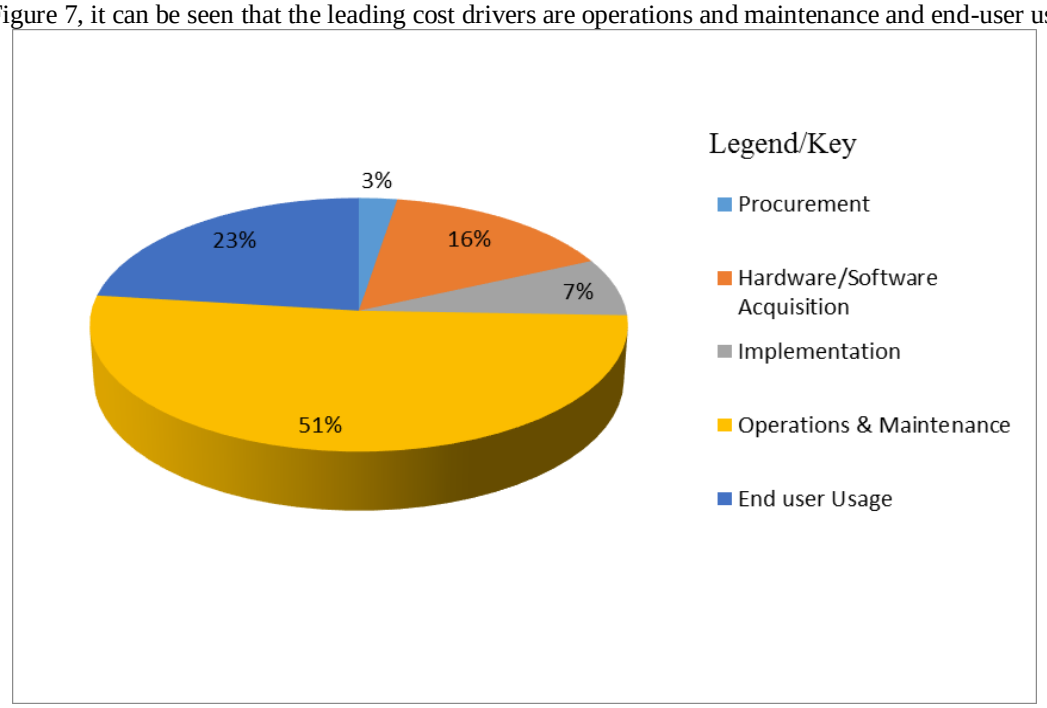


**Fig.1:** Five years TCO of Maseno University ERP System (Source: Research data)

## V. Discussion

This study was carried out to evaluate the total cost of ownership for university enterprise resource planning with Maseno University as a case study. The first objective of the study was to identify the major cost elements of TCO in a university ERP. The study identified operations and maintenance as the highest cost element followed by end-user usage. The third cost element was hardware and software acquisition followed by implementation and procurement in that order.

Procurement costs accounted for 3%, while hardware and software acquisition costs tool 16%, implementation costs took 7% while operations and maintenance took lion's share of 51% and end user usage accounted for 23%. This is in agreement with Gartner's findings discussed in literature review, where Gartner asserts that initial acquisition costs accounts for only 20%. The initial acquisition cost for this study is procurement and hardware and software acquisition costs which account for 19% of the five year TCO. This indicates that the university has significant control of 81% of the TCO since these costs are administrative which can be optimized by employing sound management practices. Operations and maintenance accounts for 51% and is where the highest spending lies which is in agreement with the literature discussed above. End user-usage accounted for 23% of the five years TCO of ERP, which is more than the percentage taken by initial acquisition of hardware and software.

The second objective of the study sought to determine the total cost of owning the Maseno University ERP system. The study revealed that the ERP system will cost the university over a five year period an estimated sum of KES 129,077,238.

The theoretical framework postulated that cutting cost of hardware/software and system support transfers the costs to the end-users. The absence of dedicated system support staff and non-adherence to technology refresh cycle explains why the end-user usage cost is higher than initial hardware/software acquisition costs.

## VI. Conclusion

TCO analysis reveals that the costs over time dwarf the acquisition costs for most IT projects and shows that over 80% of the life cycle costs can be minimized by combining the best of IT and business leadership. Major limitations of TCO analysis are that it does not pay attention to the technological features/functions of the system as it only focusses on costs, it also does not take into account the time value of money and it requires a much better technical understanding of computing than most manager have.

## VII. Recommendations

The researcher has argued in this report that TCO of ERP goes beyond purchase price to comprehensively examine all costs from purchase price to the cost of taking an asset out of service. The study

has also shown that the bulk (84%) of TCO costs lie in operations and maintenance and end-user usage. It is against this background that the recommendations below are made. Despite the limitations, this study should be applied in future projects that are tolerably similar to the one under study. Basing generalization on the findings of this study, the researcher recommends the reduction of TCO through people, processes and technology as discussed next.

i) **People** – Institution should invest in its staff by conducting regular training to end-users and IT staff to make optimal use of cost-management of processes and technologies.
ii) **Processes** – To minimize technology and end-user downtime, the institutions should automate some tasks and streamlining others, such as asset tracking system to software updating.
iii) **Technologies** – Since labor consumed more than half of the TCO of ERP, institutions should pump more resources in deploying information technologies that minimize and in some cases eliminate the widest range of labor-intensive tasks as well as employ best practices in deployment of technology.

## VIII. Suggestions for Further Research

This study focused on a single university that was had implemented ERP system. Study may be appropriate in future to:

i. Determine the factors that cause ERP implementation go beyond the projected time frame.
ii. Develop a model for evaluation of TCO of Cloud based ERP system.
iii. Assess universities the impact of TCO analysis in HEI.
iv. Develop a model to evaluate the Return on Investment of ERP investment in universities

## References

[1]. K. C., Laudon, & J. P. Laudon, (2010). Management Iformation System: Managing the Digital Firm. New York: Prentice Hall.
[2]. G. E. Moore, (2006). Moore's law at 40. In D. C. Brock, Understanding Moore's Law: Four Decades of Innovation (pp. 67-84). Philadelphia: Chemical Heritage Press
[3]. K. Mwiria, N. Ng'ethe, C. Ngome, D. Odero, V. Wawire, & D. Wesonga,. (2006). Public and Private Universities Universities in kenya: New Challenges, Issues & Achievements. Oxford: James Currey.
[4]. G. Farrell, & I. Shafika,. (2007). Survey of ICT and Education in Africa: A Summary Report, Based on 53 Country Surveys. Retrieved from InfoDev: http://www.infodev.org/en/Publication.353.html
[5]. R. D. Behn, (2005). The five most important questions you will ever ask about your organaization. Retrieved from Havard Kennedy School: http://www.ksg.harvard.edu/thebehnreport
[6]. Gartner. (2011, April 14). IT Definitions and Glossary. Retrieved from Gartner: http://www.gartner.com/technology/research/it-glossary/#19_0
[7]. M. A. Wouters, & Wynstra, F. (2005). The adoption of Total Cost of Ownership for sourcing decisions -A Structural Equations Analysis. Elsevier.
[8]. T. Pisello, & B. Quirk,. (2004, January 5). How to quantify downtime. Retrieved may 17, 2013, from Network world: http://www.networkworld.com/careers/2004/0105man.html
[9]. Accenture. (2014). Driving Total Value of Ownership through Strategic Procurement. Atlanta: Accenture.
[10]. K.Hurkens, & F. Wynstra, (2006). The concept 'Total Value of Ownership': A case study approach. Rotterdam: Erasmus Research Institute of Management.
[11]. A. M. Cresswell, (2004). Return on Investment in information technology. Albany: Center for Technology in Government.
[12]. A. Botchkarev, & P. Andru, (2011). A Return on Investment as a Metric for Evaluating Information Systems: Taxonomy and Application. nterdisciplinary Journal of Information, Knowledge, and Management Vol 6, 245-266.
[13]. Cosn. (2001). CoSN. (2001). A School Administrator's Guide To Planning for the Total Cost of New Technology Total of new technology. Washington: Consortium for school networking.
[14]. A. Peterson, (2007). Costs of information and communication technology in developing country school systems: The experience of Botswana, Namibia and Seychelles. International Journal of Education and Development using Information and Communication Technology Vol. 3, Issue 4,, 89-101.
[15]. Vital Wave (2008). Vital Wave Consulting. (2008). Affordable Computing for Schools in Developing Countries: A Total Cost of Ownership (TCO) Model for Education Officials. . California: Vital Wave Consulting.
[16]. MOEST. (2005). ICTs in Education Options Paper. Nairobi: Government Press.
[17]. L. Mieritz, & B. Kirwin, (2005). Defining Gartner Total Cost of Ownership. Stamford: Gartner.
[18]. T. Pisello, (2004, January 5). How to quantify downtime. Retrieved may 17, 2013, from Network world: http://www.networkworld.com/careers/2004/0105man.html
[19]. M. Shaikh, & T. Cornford, (2011). Total cost of ownership of open source software: a report for the UK Cabinet Office supported by OpenForum Europe. London: Queen's Printer and Controller from HMSO.
[20]. K. Moyle, (2004). Total cost of ownership and open source software. Adelaide: : Department of Education and Children's Services South Australia.
[21]. Fryling, M. (2010). Estimating the impact of enterprise resource planning project management decisions on post-implementation maintenance costs: a case study using simulation modelling. Enterprise Information Systems, 4(4), 415–445.
[22]. J. S.David, D. Schuff, & R. S. Louis, (2002, January). Managing your IT TCO. Communication of ACM 45 , 1.
[23]. C. Konschak, & P. Felt, (2010). Understanding the Total Cost of Ownership (TCO) analysis for IS in the healthcare setting. Dallas: Divurgent.
[24]. R. Kaestner, (2009, March 12). Consortium for school networking initiative. . Retrieved December 20, 2012, from Taking TCO to the Class: http://www.cosn.org
[25]. E. Stegman, S. Fitzgerald, & R. Kaestner, (2003). California District Case Study. Washington: K-12 School Districts.
[26]. J. Ssempebwa, A. P. Canene, & Mugabe, M. (2007). ICT Investment in Rwandan Higher Education: Highlighting the Cost of Downtime and End-Users' Operations. Kampala International University Research Digest , 19-29.
[27]. Gartner. (2001). TCO Manager for Distributed Computing Chart of Accounts. Gartner, Inc.

[28]. R. West, & S. L. Daigle, (2004). Astrategic tool for ERP planning and implementation. California: Educause.
[29]. CoSN. (2011, May 5). About TCO. Retrieved June 1, 2011, from Taking TCO to the Classroom: http://www.cosn.org/Initiatives/BudgetingwithTotalCostofOwnership/AboutTCO/tabid/5134/Default.aspx
[30]. J. Greenbaum, (2005). Rethinking TCO: Towards a More Viable and Useful Measure of IT Costs.:. Berkeley: Enterprise Applications Consulting.
[31]. J. Mahvi, & A. Zarfaty, (2009). Using TCO to Determine PC Upgrade Cycles. Corporation, Intel.
[32]. Gartner. (2007). Toolkit Best Practices: Training End Users. Gartner.
[33]. R. K. Yin, (2003). Case Study Methods: Design and Methods, 3rd edition. Thousand Oaks: Sage Publications.
[34]. A. Al-Shehab, R. Hughes, & G. Winstanley, (2009). Modeling risks in IS/IT projects through causal and cognitive mapping. Electronic Journal of Information Systems Evaluation , ., 28-40.
[35]. H. K. Klein, & M. D. Myers, (1999). A Set of Principles for Conducting and Evaluating Interpretive Field Studies in Information Systems. MIS Quarterly, 67-94.
[36]. R.Fischer, & R. Lugg, (2006). The real cost of ILS ownership. . The Bottom Line: . Managing Library Finances, 19 (3), 111-123.
[37]. B. G. Ferrin, & R. E. Plank, (2002). Total Cost of Ownership Models: An Exploratory Study. . The Journal of Supply Chain Management ,, 18-29.
[38]. M. M. Kennedy, (1979). Evaluation Review: Generalizing From Single Case Studies. Sage Journals, 661-678.
[39]. E. A. Ariola, (2006). Principles and Methods of Research. Manila: Rex Bookstore, Inc.,.
[40]. W. Y. Oso & D. Onen, (2009). A general giude to writing research proposal and report. Nairobi: The Jomo Kenyatta Foundation.
[41]. Kontio. (2004). Typical problems in Information Systems – a multiple case study in six Finnish organisations. 11th European Conference on Information Technology Evaluation, . (pp. 211-220). Reading:: Academic Conferences.
[42]. R. Kumar, (1999). Research Methodology. New Delhi: Sage Publications India Pvt Ltd.
[43]. J. W. Creswell, (2008). Research Design: Qualitative, Quantitative, and mixed methods approaches. Thousand Oaks: Sage.
[44]. N. J. Kathuri, & A. D. Pals, (1993). Introduction to educational research. Nakuru: Egerton University Press.
[45]. Coretec. (2013, April 3). Microsoft Dynamics NAV. Retrieved April 21, 2013, from coretec: http://coretec.co.ke/index.php/products/prod1/microsoft-dynamics-nav
[46]. Gartner. (2003). Taking TCO to the classroom. Gartner.