Effect of E-Procurement on Lead Time in the Public Health Sector in Kenya: A Case of Public Health Facilities in Nairobi County

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Abstract: In Kenya, statistics indicate that more than 50% of procurement processes in health institutions in Kenya are still being carried out manually. Despite all of the efficiencies that can be realized through public e-procurement, most public health facilities have not transitioned to full-fletch operationalization of e-procurement processes for reduction in lead time. Despite well outlined medical supplies policies, there are cases where health facilities run short of drugs and it takes long durations before replenishment is done. The main objective of the study was to determine the effect of e-procurement practices on lead time in public health facilities in Kenya by taking the case of public health facilities in Nairobi County. The specific objectives of the study were: to determine the effect of e-catalogue, ERP integration, e-invoicing and e-sourcing on lead time. This study adopted a descriptive survey research design. The target population was 97 public health facilities in Nairobi County whereas study respondents were 97 administrative staff of these health facilities. The study collected data using structured questionnaires. Descriptive as well as inferential statistics were used to establish the influence of e-procurement on lead time. Data analysis was carried out using statistical package for social sciences (SPSS) version 21. The results of the study were presented in form of tables and charts. The findings of the study revealed that the four e-procurement practices had a positive significant influence on lead time among public health facilities in Nairobi County. The study concluded that an improvement in indicators of e-procurement processes will positively and significantly influence lead time in the public health sector. The study recommends that in order for the public health facilities to improve lead time during procurement, there is need to focus on key electronic catalogue indicators such as online placement of purchase orders, online creation of purchasing requisition, approval of purchasing requisition online, online comparison of products before bidding and using online tender requisitions in procurement process.

Keywords: *E-Catalogue, ERP Integration, E-Invoicing, E-Sourcing, Lead Time*

Introduction

The impact of the internet on the business world has occurred with astonishing speed. The growth of e-business in the late 1990's led to the development of new opportunities related to procurement: e-procurement, spend management, outsourcing and joint product design. The advent of the Internet as a business systems platform has been catalyst for major changes, in the operation and status of organizational procurement (Sheng, Mo & Jiang (2010). E-procurement is a business-to-business or business-to-consumer or Business-to-government purchase and sale of supplies, Work and services through the Internet as well as other information and networking systems, such as Electronic Data Interchange and Planning. Typically, e-procurement Web sites allow qualified and registered users to look for buyers or sellers of goods and services. Depending on the approach, buyers or sellers may specify costs or invite bids. Mose, Njihia, and Magutu, (2013) argue that e-procurement refers to the use of Internet-based (integrated) information and communication technologies (ICTs) to carry out individual or all stages of the procurement process including search, sourcing, negotiation, ordering, receipt, and post-purchase review. E-procurement may make it possible to automate some buying and selling. Companies participating expect to be able to control parts inventories more effectively, reduce purchasing agent overhead, and improve manufacturing cycles. E-procurement is expected to be integrated into the wider Purchase-to-pay (P2P) value chain with the trend toward computerized supply chain management (Odongo, 2010).

While there are various forms of e-Procurement that concentrate on one or many stages of the procurement process such as e-Tendering, e-Marketplace, e-Auction/Reverse Auction, and e-Catalogue/Purchasing, e-Procurement can be viewed more broadly as an end-to-end solution that integrates and streamlines many procurement processes throughout the organization (Sheng, Mo & Jiang (2010).In the public sector, despite all of the efficiencies that can be realized through public e-procurement, the implementation of any e-government project is complicated because of the size and bureaucratic nature of government. Besides, procurement process—which includes selecting bidders, evaluating tenders, and selecting contracts—is expected to be transparent to the public (Devadoss, 2013). Public sector organizations worldwide have identified e-procurement as a priority and have implemented or are in the process of implementing e-procurement. Previtali (2012) finds that the public procurement of goods and services are strategically important for at least three reasons: first, the economic impact is between 15-20% of the GDP of European countries, second it is relevant for potential improvements in public services and third affects both the competitiveness of nations and the welfare of citizens. The use of Electronic procurement in Kenya introduces a new era to public procurement by ending the manual procurement challenges the country has experienced in the past. IFMIS system is now well established having been rolled out to MDAs and Counties. IFMIS is at the centre of government financial management in areas of planning, budgeting, expenditure management and procurement among others (Muhia & Afande, 2015).

Statement of the Problem

Drugs and laboratory supplies are central to quality healthcare provision and cut across all aspects of effective and efficient health care practices (GNDP, 2004). Unfortunately, particularly in developing countries like Kenya, it is not unusual to spot and fail to address shortages of drugs and laboratory supplies and this is a major concern of most healthcare providers (Rosser, Hamisi, Njoroge, & Huchko, 2015). The healthcare system in Kenya faces a number of challenges that make it difficult for its supply chain to operate efficiently and effectively. There are several challenges associated with public health procurement processes that must urgently be addressed (Rosser *et al.,* 2015). Patients in public healthcare facilities have been forced to pay bribes to access health services, receive improved quality services, reduce waiting times and to obtain drugs and meals (KACC. 2016). The survey report also found out that public health care facilities don't have sufficient medical supplies with 38.6% of patients being asked to buy their own drugs and equipment to access healthcare. This has been partly attributed to inefficient procurement processes among public health facilities.

E-procurement makes it possible to automate some buying and selling procedure, ensure effective control of inventory, reduce purchasing agents overhead, and improve manufacturing cycles. E-procurement is expected to be integrated into the wider Purchase-to-pay (P2P) value chain with the trend toward computerized supply chain management (Odongo, 2010). In the health sector, e-procurement can facilitate enhanced relationships with suppliers; reduced order cycle times; reductions in the cost of placing orders; the stream-lining of the supply-chain, and greater compliance with standards leading to improvement in lead time during procurement (Odongo, 2010). A number of studies have been conducted on the effects of lead time on effective delivery of quality healthcare delivery but very few have attempted to establish the influence of e-procurement on lead time particular among public health facilities. For example Chopra *et al.* (2004) established that firms that have cycle service levels of 50% or above, reorder point and safety stock can be reduced drastically when firms are able to reduce the variability of their lead time. On the same note, Decarolis, Giuffrida, Iossa, Mollisi and Spagnolo (2016) in their study found that when firms are able to identify and are able to get rid of inefficiencies in their procurement systems, it becomes much easier to concentrate on activities that will make the management of the procurement lead time efficient and by so doing reducing costs and stock out.

Nachtmann and Pohl (2009) also conducted a study on the state of healthcare logistics. The study established that most healthcare supply chains are immature and are at their infancy. The authors suggested that firms especially those directly responsible for supply and procurement should pay more attention improving all area of the procurement function in order to reduce lead time variability. These studies failed to focus on the need or otherwise to adopt e-procurement to improve on lead time thereby improving lead time during procurement. With these long lead times, it's a signal that the supply chain process is underperforming. Drugs are essential, and supply as well as procurement lead-times needs to be manageable. Faced with this problem of dismal procurement performance; the need for e-procurement adoption among public health facilities in Kenya and particularly in Nairobi County is inevitable. It was thus, critical to establish the role of e-procurement practices on lead time in the public health sector in Kenya.

Research Objectives

   i.   To examine the effect of electronic catalogue on lead time in public health facilities in Nairobi county

  ii.   To examine the effect of ERP integration on lead time in public health facilities in Nairobi county

 iii.   To determine the effect of electronic invoicing on lead time in public health facilities in Nairobi county

 iv.   To establish the effect of electronic sourcing on lead time in public health facilities in Nairobi county

Theoretical Review

Disruptive Innovation Theory

This theory was proposed in 1997 by Christensen. According to the disruptive innovation theory, e-procurement is a modernization approach that calls for ongoing enhancement. Such developments upset traditional procurement processes and activities. The theory of disruptive innovation defined by little and expensive customer-base and insufficient appeal at the early stages of execution, a little degree of approval as system execution progresses, new competition while modernization progresses, and ongoing quality enhancement to suit the system to the requirements of its users and all stakeholders. Disruptive innovations must be supported by important values, procedures, and resources. Important resources are such as those that that back usual business processes, for example, humans, technology, marketing functions, design of products, branding, engagement between customer and supplier, and relationship management for clients and vendors. Vital processes encompass decision-making modalities, and the coordination patterns that give life to existing enterprise functions. Other important elements are cultural practices, belief system, and suppositions within an organization (Barahona & Elizondo, 2012). An innovation is considered disruptive if it's capable of establishing new markets and value network, which results in the disturbance of the current market value and network, eventually rendering obsolete conventional market leaders in terms of companies, brands, and alliances. Commencing 1995, Clayton M. Christensen defined and analyzed the concept.

The concept of disruptive innovation acknowledges the truth regarding the lack of versatility in public organizations and systems flexible. As such, the embracing of electronic procurement calls for a tactical and proactive formula for the setting up of the system within the current structural environment as opposed to the creation of entirely new infrastructure. This requires 100% readiness in areas such as acquisition of the appropriate technology, leadership to enhance the shifting of processes, personnel education, and awareness programs directed towards all system users. Nonetheless, it makes sense to realize that disruptive may have short-lived efficacy in certain cases. This theory is relevant to the study since it provided an understanding on the perceived influences resulting from the adoption of electronic procurement practices.

Technology Acceptance Theory

The proponent of the technology acceptance concept was Davis in 1986. The theory holds that technological advancements will not enhance the effectiveness and performance within an organization if their users have not embraced change (Davis, 1986). This concept is among the most common in the understanding the acceptance of computer technologies. The acceptance of any innovation particularly that which is based on information technology, calls for the acquisition of computer-based instruments that may facilitate the making of decisions as well as planning communication. Nonetheless, there are risks with such systems. As such, it is extremely important that the new systems meet specifications derived from organizational preference and reasoning. It also makes sense to recognize that individuals may not be open to technological shifting. There should be an attempt to explain why individuals object to change and the viable methods for overcoming their concerns. The correct organizational culture ought to be instilled, with the intended shift being implemented gradually and supported by communication.

According to Kamel (2014), all participants in the change process must be educated on their roles and given support to play their respective part well. Two hypotheses form the basis of the concept of technology acceptance: The supposed efficacy of the system, for example, enhanced performance and productivity as well as more effective and efficient performance, and the perceptible simplicity of application of the new system in terms of the simplicity of learning, and how easy it is to control and remember. The model introduces the understanding that the willingness to accept and apply emerging technology is dependent on the feelings of the user regarding the system in relation to its supposed benefits. Therefore this theory is relevant to the study since it provided more insight on the need and the influence with regard to the use of e-procurement practices on supply chain performance.

Innovation Diffusion Theory

Rogers (1962) came up with the theory of innovation diffusion. According to the theory, innovation is a process that targets to enhance economic progress. As per the theory, any concept that people consider new is innovation. OECD (1997) referenced by Andreanne and Swaminathan (2007) described innovation to be "all the scientific, technological, organizational, financial, and commercial activities necessary to create, implement, and 14 market new or improved products or processes." The innovation concept encompasses four critical components. The first component is innovation that focuses on the capacity to create efficient and better methods for performing tasks. According to the theory, there are five classifications for those who adopt innovation: the innovators, the few who adopt innovation early, early majority, the majority that adopts later on, and those who lag behind in embracing innovation. Innovators are the group that's eager to be the first one to sample new innovation, while early adopters constitute opinion influencers. Early majority are the people that are initially skeptical about the innovation until they see it working, while late majority are those embrace innovation only after others have successfully tried it.
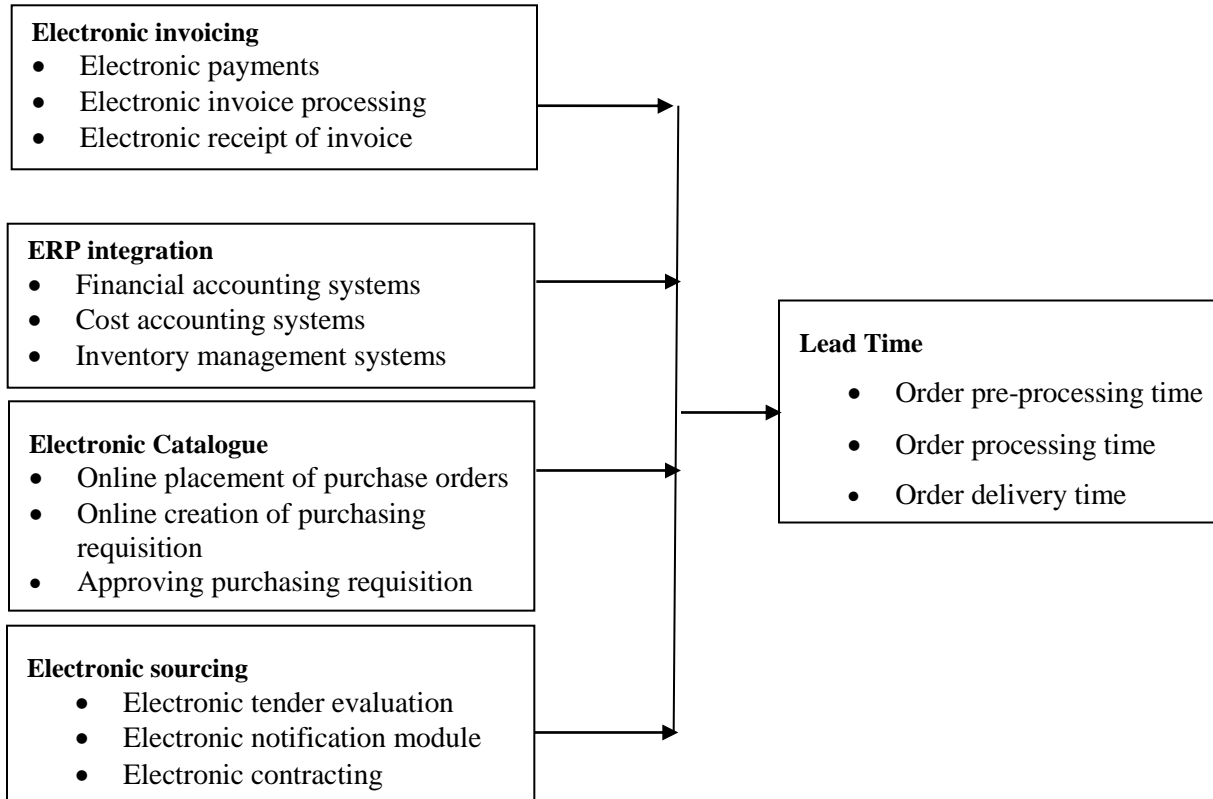
On the other hand, laggards are the extremely pessimistic group that is most difficult to bring on board in the innovation process. The innovation theory dictates that the rate of acceptance of innovative methods may be viewed in terms of comparative benefits that an organization is offered**,** compatibility, sophistication levels, the ability to try and test the new methods, and the ease with which stakeholders in social environment can observe

these. The second element is communication which conveys information, and the creation as well as sharing of information that pertains to innovative ideas within the entity. The third perspective is time which takes into account how long the innovation decision process will take. The fourth dimension is the social environment within which new system exists (Rogers, 1997). Methods of diffusion innovation necessitate the development as well as reinvention of brands and individuals with a view to enabling improved performance (Les Robinson, 2009). The ideas in this theory were pertinent to this research. They helped with the development of the study and facilitated a better understanding of the adoption of e-procurement practices and the linkages between the variables such as e-catalogue, e-resourcing, e-invoicing and ERP inegration.

Institutional Theory

The proponent of this theory was DiMaggio and Powell in 1991. This theory appreciates that within the framework of formal and informal rules, institutional actors should be present in an environment. The proponents of this theory allude that the actions of an organization are driven and justified by it. Through norms and social procedures, there should be a rational account for an entity's actions by the very actors who undertake them in order to make the (Dacin, Oliver *et al.,* 2007). Subsequently, entities are built upon three bases; regulative, normative and cultural-cognitive elements. It is stated in Wei, *et al* (2008) that going by this theory, so as to fully understand how to implement e-procurement, a number of forces driving institutions may influence the adoption of Information Technology based systems. These forces include normative, mimetic and coercive. Pressures coming from copying what competitors do are what are called mimetic, as firms tend to adopt the successes of other similar one (Cox, 2010). This reduces a number of costs that an entity is likely to incur when faced with (Barua, *et al*, 2009. Therefore this theory provided an understanding on the need for the adoption for e-procurement practices.

Conceptual Framework

Electronic invoicing
- Electronic payments
- Electronic invoice processing
- Electronic receipt of invoice

ERP integration
- Financial accounting systems
- Cost accounting systems
- Inventory management systems

Electronic Catalogue
- Online placement of purchase orders
- Online creation of purchasing requisition
- Approving purchasing requisition

Electronic sourcing
- Electronic tender evaluation
- Electronic notification module
- Electronic contracting

Lead Time
- Order pre-processing time
- Order processing time
- Order delivery time

Independent Variable   **Dependent Variable**

Figure 1 Conceptual Framework

Research Methodology

This study adopted a descriptive survey research design. A similar research design has been adopted by studies such as Garane and Mwangi (2018); Bashir and Ondigo (2018). The target population for this study comprised of all the 97 public health facilities in Nairobi County. Nairobi County has a total of 905 health facilities of which 97 are public, and the rest are either non-governmental, religion based or private. The unit of observation was 97 administrative staff owing to their information about strategic management practices since they coordinate most strategies in the health facilities (KNBS 2016). The sampling frame for the study consisted of a list of all the 97 administrative staff of the public health facilities in Nairobi County that were part of the survey. The study adopted a census survey since the population of the study was small. This study used both primary and secondary data for analysis purposes. Primary data was collected by the use of structured questionnaires to collect quantitative data while secondary data on the dependent variable (lead time) was obtained using data collection sheet.

Primary data was gathered by use of structured questionnaires and the information was captured through a 5-point Likert scale type. Drop and pick was also suitable because the respondents had busy schedules and hence were given enough time to respond to the questionnaires. This study pre-tested the questionnaire on 6 respondents to ascertain the relevance, clarity and whether they are understandable. Descriptive statistics such as frequencies, means and standard deviation were used to summarize the data. Inferential statistics that is correlation analysis and regression analysis were used for analysis. Analyzed data was presented in form of graphs, pie charts and tables for easy interpretation and clear presentation of the results. A multiple linear regression model was used to establish the influence of the independent variable on the dependent variable. The multivariate model was stated as follows:

$Y = \beta_0 + \beta_1X_1 + \beta_2X_2 + \beta_3X_3 + \beta_4X_4 + \varepsilon$ Where; Y =Lead Time, X_1 = Electronic catalogue, X_2 = ERP integration, X_3 = Electronic invoicing, X_4 = Electronic sourcing and ε =Error term. β_{1-4}= Regression coefficients.

Results

A total of 97 questionnaires were administered to administrative staff of the public health facilities who were the study respondents. The total number of questionnaires that were filled and returned was 79, this representing an overall response rate of 81.44%. The response rate is in accordance with the suggestions of Fincham (2008) that a response rate of above 70% which adequate for a descriptive study.

Demographic Characteristics

The study sought to examine the demographic characteristics of the study respondents in terms of their age, level of education as well as duration they had worked in the health facility.

Table 1 Demographic Characteristics

Demographic Characteristics	Category	Percentage
Respondent's Age	Less than 29 years	7.6%
	Between 30-39 years	12.7%
	Between 40-49 years	40.5%
	Between 50-59 years	30.4%
	Between 60-69 years	8.9%
Respondent Level of Education	PhD	6.3%
	Masters	34.2%
	Graduate	39.2%

Demographic Characteristics	Category	Percentage
	Diploma	20.3%
Duration of work in the Health Facility	Less than 3 years	29.1%
	Between 4-10 years	44.7%
	Above 10 years	15.2%

Electronic Catalogue

The study sought to examine the effect of electronic catalogue on lead time in public health facilities in Nairobi County. Descriptive results on electronic catalogue showed that majority of the study respondents revealed as indicated by 39.2% strongly agreed that the health facilities used online placement of purchase orders with a further 36.7% of the study respondents also agreeing to the statement and 19% of the study respondents were neutral regarding the claim that the health facilities used online placement of purchase orders. The results of the study however indicated that 5.1% of the study respondents disagreed that the health facilities used online placement of purchase orders but none of the respondents strongly refuted this statement. The standard deviation value of 0.89 indicated low variation in responses on this statement. The descriptive results on electronic catalogue further showed that majority of the study respondents, 74.7%, strongly agreed that the public health facilities within Nairobi County performed online creation of purchasing requisition and a further 13.9% of the study respondents also agreed to this statement while 11.4% of the respondents were neutral regarding the claim that public health facilities within Nairobi County performed online creation of purchasing requisition. Importantly, none of the study respondents refuted the statement that public health facilities within Nairobi County performed online creation of purchasing requisition with the standard deviation value of 0.68 indicating low variation in responses on this statement. The descriptive results on electronic catalogue further showed that majority of the study respondents as indicated by 70.9% strongly agreed that the public health facilities within Nairobi County approved purchasing requisition online followed by 26.6% of the respondents who also agreed to the statement while 2.5% of the respondents were neutral regarding the claim that public health facilities within Nairobi County approved purchasing requisition online.

None of the respondents refuted this statement while the standard deviation value of 0.52 also implied low variation in responses provided on this statement. On the same note, majority of the respondents, 41.8% and mean value 3.84 strongly agreed that public health facilities within Nairobi County compared prices of medical equipment and other goods online before bidding, 22.8% agreed to this statement whereas an equal percentage of the study respondents were neutral. However, the findings also indicated that 10.1% of the respondents strongly disagreed that the public health facilities within Nairobi County compared prices of medical equipment and other goods online before bidding reinforced by a further 2.5% of the respondents who also disagreed to this statement. The standard deviation value of 1.29 implied a high variation in responses presented on this statement. The descriptive results finally showed that majority of the study respondents, 31.6% and mean value 3.03 agreed that the public health facilities within Nairobi County used online tender requisitions in

procurement process with the standard deviation value of 1.24 also depicting a high variation in the study responses regarding this statement.

On average therefore, the descriptive results on electronic catalogue showed that majority of the study respondents, mean value 4.06%, agreed that electronic catalogue influenced lead time of the public health facilities within Nairobi County. Accordingly, the results are consistent with the argument by Teviu *et al* (2012) that the use of online directories had enhanced the acquisition of numerous medical folders per patient and minimized misfiling.

Table 2 Electronic Catalogue

Statement	Strongly disagree	Disagree	Neutral	Agree	Strongly agree	Mean	Std Dev
The health facility uses online placement of purchase orders	0.0%	5.1%	19.0%	36.7%	39.2%	4.10	0.89
The health facility performs online creation of purchasing requisition	0.0%	0.0%	11.4%	13.9%	74.7%	4.63	0.68
The health facility approves purchasing requisition online	0.0%	0.0%	2.5%	26.6%	70.9%	4.68	0.52
The organization compares prices of goods online before bidding	10.1%	2.5%	22.8%	22.8%	41.8%	3.84	1.29
The health facility uses online tender requisitions in procurement process	15.2%	19.0%	24.1%	31.6%	10.10%	3.03	1.24
Average						**4.06**	**0.92**

Enterprise Resource Planning Integration

The study sought to examine the effect of Enterprise resource planning integration on lead time in public health facilities in Nairobi County. The findings showed that majority of the study respondents, 77.2%, strongly agreed that there was the use of financial accounting systems when financing supplies while 21.5% of the respondents were neutral regarding availability of financial accounting systems when financing supplies and only 1.3% of the respondents strongly refuted this statement. None of the respondents disagreed or agreed with the statement and the standard deviation value of 0.92 implied a relatively low variation in response provided on this statement. The descriptive results on Enterprise resource planning integration further showed that majority of the respondents as indicated by92.4% strongly agreed that there is the use of cost accounting systems when costing supplies among public health facilities in Nairobi county reinforced by 5.1% of the respondents who also agreed to the statement and 2.5% who were neutral regarding use of cost accounting systems when costing

supplies. None of the study respondents strongly disagreed that there is use of cost accounting systems when costing supplies and the standard deviation of 0.38 implied low variation in responses on this statement.

On the same note, the results also indicated that majority of the study respondents, 58.2%, strongly agreed that electronic systems are used when planning distribution of supplies reinforced by 12.7% of the study respondents who also agreed to this statement and a further 11.4% who were neutral. However, 8.9% of the respondents strongly refuted that electronic systems are used when planning distribution of supplies reinforced by an equal percentage of respondents who also disagreed. The standard deviation value of 1.37 implied relatively high variation in responses on this statement. Moreover, the descriptive results on ERP integration showed that majority of the respondents as indicated by 40.5% strongly agreed that there is the use of materials management systems when managing inventories among public health facilities in Nairobi County reinforced by 11.4% of the study respondents who also agreed. However, 16.5% of the respondents strongly disagreed that there is the use of materials management systems when managing inventories among public health facilities in Nairobi County reinforced by 6.3% of the respondents who disagreed. On average therefore, the descriptive results on ERP integration showed that majority of the respondents, mean value 4.17, agreed that ERP integration influenced lead time among public health facilities in Nairobi County. The results are consistent with the argument by Martinez (2008) that Enterprise Resource Planning Systems enhances security of data management that may enhance procurement performance in both the private and public sector.

Table 3 Enterprise Resource Planning Integration

Statement	Strongly disagree	Disagree	Neutral	Agree	Strongly agree	Mean	Std Dev
There is the use of financial accounting systems when financing supplies	1.3%	0.0%	21.5%	0.0%	77.2%	4.52	0.92
There is the use of cost accounting systems when costing supplies	0.0%	0.0%	2.5%	5.1%	92.4%	4.90	0.38
Electronic systems are used when planning distribution of supplies to sub counties	8.9%	8.9%	11.4%	12.7%	58.2%	4.03	1.37
There is the use of materials management systems when managing inventories	16.5%	6.3%	25.3%	11.4%	40.5%	3.53	1.48
The institution uses electronic systems to source the suppliers information	3.8%	1.3%	13.9%	65.8%	15.2%	3.87	0.82
Average						**4.17**	**0.99**

Electronic Invoicing

The study sought to determine the effect of electronic invoicing on lead time in public health facilities in Nairobi County. The results revealed that majority of the study respondents, 36.7%, strongly agreed that the health facilities used electronic payments when making purchases and 27.8% of the respondents also agreed with the statement while 13.9% of the study respondents were neutral.

However, 13.9% of the respondents strongly disagreed that health facilities used electronic payments when making purchases reinforced by another 7.6% of the respondents who also disagreed to the statement. The standard deviation value of 1.40 implied a relatively high variation in responses on this statement. The results further showed that majority of the study respondents, 48.1% and mean value 4.05, strongly agreed that the health facilities use electronic invoice processing to carry out transactions, reinforced by 24.1% of the respondents who also agreed while 17.7% of the respondents were neutral regarding this statement. However, 5.1% of the study respondents strongly refuted the statement that the health facilities use electronic invoice processing to carry out transactions while the standard deviation value of 1.15 implied low variation in responses on this statement. Moreover, the descriptive results on electronic invoicing showed that majority of the respondents as indicated by 53.2% strongly agreed to the statement that the health facilities have seen a reduction in pay time due to electronic invoicing reinforced by a further 31.6% of the respondents who agreed to this statement while 8.9% of the respondents were neutral. On the other hand, 3.8% of the respondents strongly refuted the statement with 2.5% of them also disagreeing that the health facilities have seen a reduction in pay time due to electronic invoicing. The standard deviation value of 1 indicates low variation in responses on this statement. On the same note, the results revealed that majority of the respondents as shown by 53.2% and mean value 3.99 agreed that the health facilities had online invoice preparation systems for purchases while 30.4% of the respondents strongly agreed with this statement and 6.3% were neutral.

On the other hand, 5.1% of the respondents strongly disagreed that the health facilities had an online invoice preparation systems for purchases whereby the standard deviation value of 1.02 implied low variation in responses provided on this statement. The findings equally confirmed that majority of the respondents, 34.2% and mean 3.58, strongly agreed that electronic invoice receipts were used in making payments for the purchases. On average therefore, the descriptive results on electronic invoicing showed that majority of the respondents, mean value 3.91, agreed that electronic invoicing influenced lead time among public health facilities in Nairobi County. The results are consistent with the argument by Groznik and Manfreda (2015) that the adoption electronic invoicing in both government and business enterprises leads to cost cutting due to less operating expenses as a result of lack of paperwork or postal services through realization of higher returns as a result of the incorporation of e-invoicing in ordering of commodities.

Table 4 Electronic Invoicing

Statement	Strongly disagree	Disagree	Neutral	Agree	Strongly agree	Mean	Std Dev
The health facility uses electronic payments when purchasing goods	13.90%	7.60%	13.90%	27.80%	36.70%	3.66	1.40
The health facility uses electronic invoice processing to carry its transactions	5.10%	5.10%	17.70%	24.10%	48.10%	4.05	1.15
The health facility has seen a reduction in pay time	3.80%	2.50%	8.90%	31.60%	53.20%	4.28	1.00
The health facility has an online invoice preparation systems for purchases	5.10%	5.10%	6.30%	53.20%	30.40%	3.99	1.02
The health facility uses electronic invoice receipts during purchase of commodities	7.60%	21.50%	10.10%	26.60%	34.20%	3.58	1.36
Average						**3.91**	**1.19**

Electronic Sourcing

The study sought to determine the effect of electronic sourcing on lead time in public health facilities in Nairobi County. The findings revealed that majority of the study respondents, 44.3%, strongly agreed that electronic tender evaluation system was used to evaluate tenders reinforced by 30.4% of the respondent who also agreed to this effect while 24.1% were neutral. On the other hand, 1.3% of the respondents disagreed that electronic tender evaluation system was used to evaluate tenders but none of the respondents strongly refuted this statement. On the same note, the findings also revealed that majority of the respondents, 64.4% and mean value 4.58, strongly agreed that suppliers were easily identified online, supported by 29.1% of the respondents who also agreed to this statement while 6.3% of them were neutral. None of the respondents disagreed to the claim that suppliers were easily identified online with the standard deviation value of 0.61 implying low variation in responses provided on this statement.

The descriptive results on electronic sourcing also revealed that 72.2% of the respondents who were the majority in this case strongly agreed that electronic notification module was used during procurement process and 25.3% of them also agreed while 2.5% of the respondents were neutral regarding use of electronic notification module during procurement. None of the study respondents disagreed to this statement and the

standard deviation value of 0.52 implied low variations in responses regarding use of electronic notification module during procurement process. On the same note, the results indicated that majority of the respondents, 62% and mean value 4.46 strongly agreed that electronic contracting was adopted to contact suppliers supported by 29.1% of the respondents who also agreed that electronic contracting was adopted to contact suppliers while 5.1% of the respondents were neutral.

On the other hand, 3.8% of the respondents strongly disagreed that electronic contracting was adopted to contact suppliers and the standard deviation value of 0.9 implied low variation in responses regarding the use of electronic contracting to contact suppliers. The descriptive results on electronic sourcing finally revealed that majority of the study respondents as given by 49.4% and mean value 3.99 strongly agreed that the requirements for the suppliers to meet were recorded online with a further 29.1% of the respondents also agreeing to this statement. On average therefore, the descriptive results on electronic sourcing revealed that majority of the study respondents as shown by a mean value of 4.38 strongly agreed that electronic sourcing influenced lead time among public health facilities within Nairobi County. The results are consistent with the argument by Chipiro (2010) that the electronic resourcing positively impacted the organizations' uptake of E-procurement to complement its strategic processes.

Table 5 Electronic Sourcing

Statement	Strongly disagree	Dis agree	Neutral	Agree	Strongly agree	Mean	Std Dev
The health facility uses electronic tender evaluation system to evaluate its tenders	0.00%	1.30%	24.10%	30.40%	44.30%	4.18	0.84
The health facility identifies its suppliers easily online	0.00%	0.00%	6.30%	29.10%	64.60%	4.58	0.61
The health facility uses electronic notification module during its procurement process	0.00%	0.00%	2.50%	25.30%	72.20%	4.70	0.52
The health facility uses electronic contracting to contact its suppliers	3.80%	0.00%	5.10%	29.10%	62.00%	4.46	0.90
The institution lists the requirements for the supplies to meet online	3.80%	1.30%	16.50%	49.40%	29.10%	3.99	0.93
Average						**4.38**	**0.76**

Lead Time

The study asked the respondents to indicate whether they agree or disagree with the statements on lead time. The results on lead time showed that majority of the respondents, 51.9% agreed that order delivery time was well managed in among public health facilities in Nairobi County reinforced by 48.1% of the respondents who strongly agreed that order delivery time was well managed in among public health facilities. None of the study respondents refuted this claim whereas the standard deviation value of 0.5 implied low variation in responses on

this statement. On the same note, the results also showed that majority of the respondents as given by 70.9% strongly agreed that demand variability did not affect lead time among public health facilities in Nairobi County reinforced by 25.3% of the respondents who also agreed that demand variability did not affect lead time while 3.8% of the respondents were neutral.

The descriptive results on lead time finally showed that majority of the respondents, 40.5% and mean value 3.51 strongly agreed that there is regular reviews and audits of logistic procedures thus managing lead time among public health facilities in Nairobi County with the standard deviation value of 1.5 implying high variation in responses on this statement. On average, the descriptive results on lead time showed that majority of the respondents, mean value 4.18, agreed that lead time had improved among public health facilities in Nairobi County.

Table 6 Lead Time in the Public Health Facilities in Nairobi County

Statement	Strongly disagree	Disagree	Neutral	Agree	Strongly agree	Mean	Std Dev
There is coordinated order shipping hence preprocessing lead time is well managed	0.00%	0.00%	31.60%	31.60%	36.70%	4.05	0.83
Order delivery time is well managed in the organization	0.00%	0.00%	0.00%	51.90%	48.10%	4.48	0.50
Demand variability does not affect lead time in the organization	0.00%	0.00%	3.80%	25.30%	70.90%	4.67	0.55
There is regular reviews and audits of logistic procedures thus managing lead time	19.00%	1.30%	30.40%	8.90%	40.50%	3.51	1.50
Average						**4.18**	**0.85**

Secondary descriptive findings on lead time

The study sought to establish the percentage change in indicators of lead time cycle for the last one year after adoption of e-procurement. The findings depicted that majority of the study respondents as indicated by 51% revealed that order preprocessing time had decreased by less than 50%, followed by 26% of the study respondents who revealed that order preprocessing time had increased by less than 50% and 15% of the respondents who revealed that order preprocessing time had decreased by over 50%. Only 8% of the study respondents revealed that order preprocessing time had increased by over 50%. The findings therefore imply that majority of the study respondents indicated that order preprocessing time had decreased. The results further showed that majority of the study respondents, 48%, revealed that order processing time had decreased by over 50% followed by 32% who revealed that order processing time had increased by less than 50% and 11% of the respondents who indicated that order processing time had decreased by over 50%. Only 9% of the study

respondents indicated that order processing time had increased by over 50% implying that majority of the respondents revealed that order processing time had decreased as a result of e-procurement.

The results finally depicted that majority of the study respondents, 57%, revealed that order delivery time had decreased by less than 50% reinforced by 26% of the respondents who revealed that order delivery time had decreased by over 50% while 11% of the respondents revealed that order delivery time had increased by less than 50% and only 6% of the respondents revealed that order delivery time had increased by over 50%.

Table 7 Percentage change in Lead time

Indicator/ Year	Increased by over 50%	Increased by less than 50%	Decreased by less than 50%	Decreased by over 50%
Order Preprocessing time	8%	26%	51%	15%
Order Processing time	9%	32%	48%	11%
Order delivery time	6%	11%	57%	26%

The study also sought to establish the percentage approximate time in days taken at various stages of procurement among public health facilities within Nairobi County after adoption of e-procurement. The results depicted that majority of the study respondents, 52%, revealed that it took between 20-30 days during order preprocessing with e-procurement followed by 21% of the respondents who revealed that order preprocessing took between 30 to 40 days and a further 18% who indicated that this stage of procurement took less than 20 days. Only 9% 0f the study respondents indicated that with e-procurement, it took above 40 days during order preprocessing. On the same note, the findings also showed that majority of the study respondents, 41%, revealed that it took between 30 to 40 days to process orders during procurement among public health facilities in Nairobi County while majority of the study respondents, 49%, revealed that it shorter (between 20-30 days) to deliver orders during procurement among public health facilities in Nairobi County. Only 11% of the study respondents revealed that it took relatively longer (more than 40 days) to deliver orders during procurement among public health facilities in Nairobi County. The findings therefore implied significant reduction in the number of days taken to perform various operations during procurement as a result of adopting e-procurement.

Table 8 Lead-Time Period

Indicator/ Time in Days	Below 20	20-30	30-40	Above 40
Order preprocessing	18%	52%	21%	9%
Order Processing	13%	39%	41%	7%
Order Delivery time	15%	49%	25%	11%

Correlation Analysis

The study used Pearson correlation coefficient to determine the connection among the study variables and the threshold for significance was set at 5%. The study findings revealed a positive and significant relationship between electronic catalogue and lead time in the public health facilities in Nairobi County(R =457, Sig <0.05).

This therefore implies that an improvement in various indicators of electronic catalogue such as online placement of purchase orders, online creation of purchasing requisition, approval of purchasing requisition online, online comparison of products before bidding and using online tender requisitions in procurement process will result to a significant improvement in lead time among public health facilities in Nairobi County. This finding is consistent with the study findings of Kingori (2013) that confirmed existence of a strong association between e-Procurement, the levels of ICT expertise and the levels of e-Procurement application.

The study also indicated that the use of online storage of data increased accessibility of information as well as the security of information. Correlation results further indicated existence of a positive and significant relationship between ERP integration and lead time in the public health facilities in Nairobi County (R=476, Sig <0.05). This therefore implies that an improvement in various indicators of ERP integration such as use of financial accounting systems when financing supplies, adopting cost accounting systems when costing supplies, adopting electronic systems when planning distribution of supplies, using materials management systems when managing inventories, using electronic systems to source suppliers information will result to a significant improvement in lead time among public health facilities in Nairobi County. This finding is consistent with the argument by Mabert *et al.*, (2010) that process automation of procurement function helps in reduction of cost to firms in various industries. Moreover, the correlation results further showed that electronic invoicing and lead time in the public health facilities in Nairobi County were positively and significantly associated (R = 321, Sig <0.05) implying that an improvement in various indicators of electronic invoicing such as using electronic payments when purchasing, using electronic invoice processing to carry out transactions, having an online invoice preparation systems for purchases and using electronic invoice receipts during purchase of commodities will result to a significant improvement in lead time among public health facilities in Nairobi County. This finding is consistent with the argument by Doherty *et al* (2013) that the adoption of e-procurement technologies such as electronic invoicing to make payments and issuance of receipts has improved lead time in supply chain.

The study results finally indicated that electronic sourcing and lead time in the public health facilities in Nairobi County were positively and significantly associated (R =519, Sig <0.05) implying that an improvement in various indicators of electronic sourcing such as using electronic tender evaluation system to evaluate tenders, online identification of suppliers, using electronic notification module during procurement process, adopting electronic contracting to contract suppliers and online listing of the requirements for the suppliers to meet will result to a significant improvement in lead time among public health facilities in Nairobi County. This finding is consistent with the argument by Göbl (2014) that E-sourcing platforms provide a proper way for suppliers to market their companies and products in different ways.

Table 9 Correlation Analysis

Correlations		Electronic catalogue	ERP integration	Electronic Invoicing	Electronic Sourcing	Lead time
Electronic catalogue	Pearson Correlation	1				
ERP integration	Pearson Correlation	0.16	1			
Electronic Invoicing	Pearson Correlation	0.118	0.042	1		
Electronic Sourcing	Pearson Correlation	.284	0.182	0.125	1	
Lead time	Pearson Correlation	.457**	.476**	.321**	.519**	1
	Sig. (2-tailed)	0.000	0.000	0.004	0.000	
	N	79	79	79	79	79

* Correlation is significant at the 0.05 level (2-tailed).

** Correlation is significant at the 0.01 level (2-tailed).

Regression analysis

This study used the following regression model to establish the effect of e-procurement on lead time in the public health sector in Kenya taking a case of public health facilities in Nairobi County. The model summary results revealed that the four independent variables have a strong positive influence on lead time among public health facilities in Nairobi County as shown by a joint Pearson correlation of 0.742. This implies that an overall improvement in all the four independent variables of Electronic catalogue, electronic resource planning integration, electronic invoicing and electronic sourcing would result to a strong positive improvement in lead time among public health facilities in Nairobi County. The coefficient of determination (R-square) was 0.551 implying that the four variables (Electronic catalogue, electronic resource planning integration, electronic invoicing and electronic sourcing) jointly account for up to 55.1% of the variation in lead time among public health facilities in Nairobi County implying that the remaining 44.9% of the variation in lead time among public health facilities in Nairobi County was accounted for by other factors not covered in the model presented in this study.

Table 10 Model Summary

R	R Square	Adjusted R Square	Std. Error of the Estimate
.742	0.551	0.526	0.2579
a Predictors: (Constant), Electronic Sourcing, Electronic Invoicing, ERP integration, Electronic catalogue			

The F statistic indicating the overall significance of the model is significant at 5% (Sig < 0.000) showing that the model was significant. The F calculated statistic of 22.666> F (4, 74) critical value of 2.4953 confirming that the model was significant.

The model significance results therefore imply that the four independent variables (Electronic catalogue, electronic resource planning integration, electronic invoicing and electronic sourcing) adopted in the study are suitable factors in predicting variation in lead time among public health facilities in Nairobi County.

Table 11 ANOVA (Model Significance)

	Sum of Squares	df	Mean Square	F	Sig.
Regression	6.029	4	1.507	22.666	.000
Residual	4.921	74	0.066		
Total	10.949	78			

a Dependent Variable: Lead time
b Predictors: (Constant), Electronic Sourcing, Electronic Invoicing, ERP integration, Electronic catalogue

The regression results in Table 4.12 revealed that electronic catalogue positively and significantly influenced lead time among public health facilities in Nairobi County(Beta = 0.241, Sig< 0.05). This implies that a unit increase in various indicators of electronic catalogue including online placement of purchase orders, online creation of purchasing requisition, approval of purchasing requisition online, online comparison of products before bidding and using online tender requisitions in procurement process will result to 0.241 unit significant improvement in lead time among public health facilities. Accordingly, the regressions results are consistent with the study findings of Kingori (2013) that confirmed existence of a strong association between e-Procurement, the levels of ICT expertise and the levels of e-Procurement application. The study also indicated that the use of online storage of data increased accessibility of information as well as the security of information. The regression results further revealed existence of positive and significant association between ERP integration and lead time among public health facilities in Nairobi County (Beta = 0.215, Sig< 0.05) implying that a unit increase in various indicators of ERP integration such as use of financial accounting systems when financing supplies, adopting cost accounting systems when costing supplies, adopting electronic systems when planning distribution of supplies, using materials management systems when managing inventories, using electronic systems to source suppliers information leads to 0.215 unit significant improvement in lead time among public health facilities. Accordingly, the regressions results are consistent with the argument by Martinez (2008) that Enterprise Resource Planning Systems enhances security of data management that may enhance procurement performance in both the private and public sector.

Moreover, the regression results revealed that electronic invoicing positively and significantly influenced lead time among public health facilities in Nairobi County (Beta = 0.14, Sig< 0.05). This implies that a unit increase in various indicators of electronic invoicing including using electronic payments when purchasing, using electronic invoice processing to carry out transactions, having an online invoice preparation systems for purchases and using electronic invoice receipts during purchase of commodities will result to 0.14 unit significant improvements in lead time among public health facilities. Accordingly, the regressions results are

consistent with the argument by Doherty *et al* (2013) that the adoption of e-procurement technologies such as electronic invoicing to make payments and issuance of receipts has improved lead time in supply chain.

The regression results finally indicated existence of positive and significant association between electronic sourcing and lead time among public health facilities in Nairobi County (Beta = 0.403, Sig< 0.05) implying that a unit increase in various indicators of electronic sourcing such as using electronic tender evaluation system to evaluate tenders, online identification of suppliers, using electronic notification module during procurement process, adopting electronic contracting to contract suppliers and online listing of the requirements for the suppliers to meet leads to 0.403 unit significant improvement in lead time among public health facilities. The regressions results are consistent with the argument by Göbl (2014) that E-sourcing platforms provide a proper way for suppliers to market their companies and products in different ways. The regression coefficients are presented in Table 4.12

Table 12 Regression Coefficients

Coefficients	Unstandardized Coefficients		Standardized Coefficients		
	B	Std. Error	Beta	t	Sig.
(Constant)	0.01	0.462		0.021	0.983
Electronic catalogue	0.241	0.072	0.274	3.332	0.001
ERP integration	0.215	0.048	0.359	4.503	0.000
Electronic Invoicing	0.14	0.048	0.23	2.923	0.005
Electronic Sourcing	0.403	0.096	0.348	4.213	0.000
a Dependent Variable: Lead time					

The optimal regression model is as shown below; the coefficients are ranked in order of magnitude

Lead time = 0.01 + 0.403 Electronic sourcing + 0.241 Electronic catalogue + 0.215ERP Integration+ 0.14Electronic invoicing

Conclusions

The study concluded that an improvement in various indicators of electronic catalogue such as online placement of purchase orders, online creation of purchasing requisition, approval of purchasing requisition online, online comparison of products before bidding and using online tender requisitions in procurement process will result to significant improvement in lead time in public health facilities. The study also concluded that Electronic Resource planning integration and lead time in public health facilities in Nairobi County were positively and significantly associated. Improvement in key indicators of Electronic Resource planning integration such as use of financial accounting systems when financing supplies, adopting cost accounting systems when costing supplies, adopting electronic systems when planning distribution of supplies, using materials management systems when managing inventories, using electronic systems to source suppliers information would therefore result to positive significant change in lead time in public health facilities. The study conclude that an

improvement in electronic invoicing indicators such as using electronic payments when purchasing, using electronic invoice processing to carry out transactions, having an online invoice preparation systems for purchases and using electronic invoice receipts during purchase of commodities leading to significant improvement in lead time in public health facilities.

Finally the study concluded that an improvement in electronic sourcing indicators which includes using electronic tender evaluation system to evaluate tenders, online identification of suppliers, using electronic notification module during procurement process, adopting electronic contracting to contract suppliers and online listing of the requirements for the suppliers to meet will lead to positive and significant change in lead time in public health facilities.

Recommendations of the Study

The study recommends public health facilities in Kenya to focus on key electronic catalogue indicators such as online placement of purchase orders, online creation of purchasing requisition, approval of purchasing requisition online so as improve their procurement lead time. The study recommends public health institutions to use financial accounting systems when financing supplies, adopt cost accounting systems when costing supplies, adopting electronic systems when planning distribution of supplies so as to improve lead time. Moreover, the study recommends public health facilities not just in Nairobi County but across all the other counties in the country to use electronic payments when purchasing, electronic invoice processing to carry out transactions so as to improve the lead time during procurement The study finally concludes that in order for the public health facilities to improve lead time during procurement, there is need to encourage positive change in electronic sourcing indicators such as using electronic tender evaluation system to evaluate tenders, online identification of suppliers, using electronic notification module during procurement process, adopting electronic contracting to contract suppliers and online listing of the requirements for the suppliers to meet.

Conflict of Interest

No potential conflict of interest was reported by the authors.

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