



## **INFLUENCE OF INFORMATION AND COMMUNICATION TECHNOLOGY APPLICATION ON MANAGEMENT OF ROAD PROJECTS IN KENYA: A CASE OF NATIONAL HIGHWAY AUTHORITY**

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**Abstract:** The number of public road construction projects has been increasing in Kenya from one period to another. However, completion of projects within the cost budget allocated is always a challenge. Due to inadequacy of financial resources that exist in Kenya, cost overrun posts a major challenge in the completion of construction projects in Kenya. The purpose of undertaking this research study was to investigate on the influence of information and communication technology application on management of road projects in Kenya. The specific objectives of the study were to assess how electronic communication, electronic records management, supply chain integration and electronic procurement management application on the management of road projects in Kenya. A descriptive explanatory research design was adopted. The population of study included all staff in the headquarters of KeNHA. There are 114 staff working in the headquarters of KeNHA. The sample size was determined by the Slovin's Formula. Stratified random sampling was adopted in the selection of a sample size of 88 staff. Both primary and secondary data were used. Primary data in this study was obtained by use of interview guides and administering questionnaires; the questionnaire comprised of unstructured and structured questions. Secondary data was obtained from KENHA reports for the last five years. Quantitative data was obtained and analysis was done by use of descriptive and inferential statistics such as correlation and regression analysis. This was achieved by using a statistical package for social sciences (SPSS version 20). Descriptive statistics included percentages, frequency distribution, standard deviation and means. The data obtained was presented by use of graphs tables. The study found that electronic communication has a significant influence on the management of road projects in KeNHA ( $\beta_1=0.676$ ,  $p\text{-value}=0.000$ ). Also, the study established that electronic records management has an insignificant influence on the management of road projects in KENHA ( $\beta_2=0.040$ ,  $p\text{-value}=0.830$ ). Further, the study established that supply chain integration has a significant influence on the management of road projects in KeNHA ( $\beta_3=0.212$ ,  $p\text{-value}=0.000$ ). In addition, the study revealed that electronic procurement has a significant influence on the management of road projects in in KeNHA ( $\beta_4=0.431$ ,  $p\text{-value} 0.000$ ). The study recommends that KeNHA should develop strategies to improve on stability of network which can be done by establishment .of other communication tools. The study also recommends that KeNHA should develop strategies on public procurement record keeping so as improve on electronic records management.

### **Introduction**

Economic growth and development in any country can be measured in terms of physical infrastructural development such as roads, bridges and buildings. Poor construction of road project is related to performance difficulties. There are various factors behind the occurrence of

such problems in construction projects (Ndiang'ui, Ombui & Kagiri, 2015). The problems experienced in the performance of the road construction industry in developing countries can be grouped into three classes namely: problems related to shortages in the infrastructure industry (mainly deals with the supply and demand of resources), problems due to consultants and clients and lastly problems arising as a result of incompetence of the contractor (Gaith, Khalim & Amiruddin, 2012). So as to attain the goals of employment and wealth creation, poverty alleviation and economic growth, there is need of implementation of a well-functioning and good road network (Ndiang'ui, Ombui & Kagiri, 2015). Hence, the Ministry of Roads of Kenya plays a crucial role so as to attain the following goals; attainment of "Millennium Development Goals (MDGs), Kenya vision 2030" goals, Kenya's Economic Recovery Strategy for Employment and wealth Creation Strategy (ERS) through providing the necessary infrastructural equipment needed by the public for rehabilitating, maintaining, managing and developing of road construction industries in the Kenya (KeNHA, 2015).

The construction of road projects is made up of a mixture of very dynamic processes which seldom go in hand with the type of implementation plan adopted. According to Wilkinson (2013), the road construction industry is always complex in its nature since it comprises of a broad number of players including contractors, shareholders, consultants, stakeholders, regulators and clients. In addition, Gaith *et al.* (2012) posit that 30% of road construction is made up of rework, 40% to 60% is made up of labor that is used in potential efficiency and the rest is mainly made of materials that are wasted. A project is said to be implemented successfully if it comes to existence on time scheduled, within the cost budget, attains all the basic goals that it was meant for, its accepted by the user and it meets the purpose for which it was intended for. The significance of information and communication technology in road construction projects cannot be overstated. Information technology usage has become a non-negotiable aspect of construction industry (Xiangjun & Weimei, 2016). Information communication technology provides new opportunities to innovative construction companies so as to enhance the process of communication, collaboration and exchange of information. In addition, IT evolution in project management has led to a shift from implementing projects which depend on analysis approach and intuition to sophisticated integrated project management systems. The main components of information and communication technology in the road construction industry are electronic communication, electronics record management, supply chain integration and electronic procurement management.

There is need for good communication in all the project lifecycle stages so as to ensure the success of the project; it is the main factor that brings together all the factors which affect project implementation. Use of electronic communication in the recent times has become increasingly effective in ensuring there is an efficient and effective project communication (Raulea & Raulea, 2014). Moreover, electronics records management is commonly used to leverage efficiencies, manage projects, shorten delivery cycles, reduce costs, increase productivity, better utilization of resources, capture necessary information to manage projects, comply with regulatory requirements and defend against claims (Duranti, 2011). Though at a slow pace, the road construction industry has been adopting supply chain integration to improve efficiency and supply chain performance. The attributes of an integrated construction supply chain includes; it being coordinated at the center and the relationship among the firms being nurtured for the period that a project has been undertaken (Xiangjun & Weimei, 2016). In addition, E-

Procurement is gaining popularity in business practice and a variety of benefits have encouraged its adoption, such as reducing costs and increasing efficiency.

In Canada, Pellerina et al. (2013) indicate that the performance of the projects is significantly linked to the usage of information technology; the more the use of information and communication technology the better the performance of projects. In New Zealand, Wilkinson (2013) argues that the construction industry in New Zealand has been left behind in the way they use integrated project management software in the management of construction projects effectively. In addition, Bardhan, Krishnan and Lin (2007) found that the adoption of information technology in construction projects led to an improvement in project coordination, improved communication and information exchange, which subsequently led to a reduction in project cost and completion on time. In Nigeria, Gaith, Khalim and Amiruddin (2012) found that the adoption of information technology led to an improvement in project performance. In Kenya, Kinuthia and Were (2015) found that Companies that fully understand and leverage the project management software have a higher propensity of achieving project success. Additionally, the study established that many projects fail due to failure to adopt the necessary project management software in the management of the schedule, labor, project activities and budget. Similarly, Ndiang'ui, Ombui and Kagiri (2015) indicate that project technology, database management, communication and software management influence road construction projects completion in Kenya Urban Roads Authority (KURA).

### **Statement of the problem**

Infrastructural development of road networks in Kenya is a sector that has been put under emphasis by the government due to it being the key incentive to spur economic growth. A large share of the national budget resource allocations goes to it. During the 2013/2014 fiscal year, 7.7% of the National budget allocation was allocated to the Ministry of transport and Infrastructure. Contracting for paved road construction has increased in great measure making construction industry an easily noticeable development (RoK, 2014). This is intended to spur growth by creating efficiency, convenience and cost effectiveness in the transportation of both goods and services in the Kenyan economy.

According to Kenya Roads Board (2014) report, almost 30% of funds that are directed to the ministry of roads annually go to Kenya National Highways Authority. Most of the construction projects end up experiencing cost overruns and hence exceeding the contract amount that was planned for initially. In Kenya, public roads construction projects have been increasing from one period to another. Completion of the project within the stipulated time remains to be a problem. Kenya is faced with a problem of cost overruns as a result of inadequate financial resources within the country. Statistics obtained from the Republic of Kenya report indicates that KeNHA is faced with problems of cost overruns in the implementation of its road projects. For example, during the construction of the Thika Super Highway, there was an increase in cost to 34.45 billion from 26.44 billion. Furthermore, there was a change in the completion deadline to July 2013 from July 2011 of the Thika super highway project (Roads and Civil Engineering Contractors Association, 2013). In addition, the system of sewerage located along Lot1-RD 0530 of the Thika superhighway project also changed after the completion of the superhighway. Data from Republic of Kenya report indicate that due to overruns in cost, there is stagnation in the economic development and also the realization of vision 2030 (republic of Kenya, 2014).

Bardhan, Krishnan and Lin (2007), found out that the adoption of information and communication technology in the construction industry improves effectiveness and efficiency, which in turn lead to an improvement in delivery within time scheduled and the cost of the project. Even though, there is adoption of information and communication technology at KeNHA, road projects are still experiencing cost and time overruns. This study therefore sought to investigate the influence of information and communication technology application on management of road projects in Kenya National Highway Authority.

The study aimed at achieving the following objectives:

- i. To assess how electronic communication influence management of road projects in Kenya.
- ii. To determine the influence of electronic records application on the management of road projects in Kenya.
- iii. To determine the influence of supply chain integration on the management of road projects in Kenya.
- iv. To determine the influence of electronic procurement on the management of road projects in Kenya.

## **Literature Review**

### **Electronic Communication and Management of Road Projects**

Project communication refers to exchange of information which is intended to bring about an understanding among the stakeholders of the project. Stakeholders refers to a group of people who have the ability to be affected with the implementation of the project such as the customers, regulatory agencies, local communities, project sponsor and project team among others. Even though, most scholars have echoed that communication is important in the construction projects, project failures are still as a result of poor communication (Jameson, 2013). Raulea and Raulea (2014) indicate that ineffectiveness in communication is a major contributor to project failures as it contributes to 95% of most project failures. According to Turkulainen, Aaltonen and Lohikoski (2015), effective communication is among the major factors which account for the success of a project. The quality of flows in communication determines the effectiveness that is required in project construction. The quality of flows in communication via the life cycle of project can be termed as the degree to which the required information arrives the intended user of the information within an appropriate time.

According to Turkulainen *et al.* (2015), electronic communication is among the central elements that are required in the integration of project management. A project manager must select appropriate information communication technology equipment which will assist him in the coordination of activities of the team concerned with implementation. Technology adopted must be able to coordinate and monitor all the activities that are ongoing within the project in the team. One such technology that can be used to coordinate communication is the use of the internet. Jameson (2013) emphasized on the same idea. He stated integration of the back office and other systems of the project were of necessity. Also, there was need for every member in the project team to have accessibility to the internet without considering their specific locations. With the availability of the internet, project manager and the implementation team can easily access information about the progress of the project.

## **Electronic Records and Management of Road Projects**

The fast pace and complexity of the contemporary large-scale construction activity affects heavily the process of record management. The records on construction project need to be current and quickly retrievable (Xiangjun & Weimei, 2016). In most cases, there is occurrence of obstacles that are unexpected in the completion and continuation of the construction projects. Management of record affect the cost and the time scheduled for the project. In the recent past, road construction companies have been changing from paper records management system to electronic records management systems (RMS) so as to improve on the speed of record retrieval and also storage of vast quantities with various records formats (Craig & Sommerville, 2007). Despite the benefits of ICT, the road construction industry is still viewed by many as lagging behind in terms of deployment of technology as compared to other industries (Duranti, 2011). The method by which information on construction is recorded, generated and stored in the current period has resulted to various problems on the side of the construction-based personnel.

Craig and Sommerville's (2007) conducted a research in the United Kingdom road construction projects and established that due to inadequate flows of information, poor archiving methods and the retrieval of information led to the poor performance of the projects. Easy accessibility to records is followed by problems such as when the issues occurring on the site. In Botswana, Mampe and Kalusopa (2012) revealed that the practices applied on management of records were not well entrenched hence leading to undermining of service delivery and project performance. Lusuli and Rotich (2014) conducted a study on the problems influencing public procurement records management practice in public entities in the National Treasury and established that there was poor public procurement record keeping systems which led to inefficient of accountability and corrupt practices. The study also found that due to inadequate adoption of the modern technology in records storage, it has led to records loss whenever they are in demand.

## **Supply Chain Integration and Management of Road Projects**

The number of construction organizations in the construction industry has increased lately indicating a realization of the need of Supply Chain Management (SCM) (Njagi & Ogutu, 2014). The construction industry has indicated to be slow in employment of SCM concept as compared to the manufacturing and retail sectors. According to Ofori (2011) use of SCM philosophy can lead to resolving of various problems which are mainly associated with traditional practices that are mainly in the construction industry. The problems that are resolved arise mainly as a result of prevalence of lose and win arrangements; any difficulties that are encountered in the construction processes, insufficient exchange of knowledge and information; increase in price as a result of competition that result from purchases from many suppliers; presence of an environment that is full of dishonest, frustration and fear (Khalfan, Khan & Maqsood, 2015).

Kocoglu et al. (2011) conducted a study on the role of integration of supply chain on sharing of information and performance of supply chain and found that the function of supply chain integration is important in sharing of information process because it reinforces coordination, collaboration and connectedness, among the members in a supply chain. The results also indicated that supply chain integration provides information which is real time to the customers necessary for determination of effectiveness management in management of stock. Moshkdanian, Shahid and Molahosseini (2013) also found the study found that integration of

information influence positively integration of logistic thus improving performance. In Kenya, Njagi and Ogutu (2014) conducted a study on the significance of integration of supply chain on performance supply chain among the Kenyan State Corporations and established that state corporations had attained an average that was above the level of integration in the external integration of suppliers and in the internal integration of operations.

### **Electronic Procurement and Management of Road Projects**

A number of government institutions all over the world have responded by adopting electronic procurement. E-procurement involves the adoption of a social media like intranet in the process of purchase and sale of services and goods (Caniato, Longoni & Moretto, 2012). E-procurement is mainly thought of addressing three major concerns in manual procurement practices: collusion in the bidding process, corruption and inadequate accessibility to bid information. E-procurement increases the number of bidders through reducing the costs of collecting information concerning a tendering process, hence leading to an increase in the number of firms which can bid. Similarly, e-procurement leads to reduction in the collusions among the bidders through provision of information on tenders to various firms that are outside a local cartel, hence allowing the non-cartel firms to take part and dissolving the local bidding cartels. E-procurement potentially reduces corruption through reduction of the degree with which the government officials withhold information selectively and refusal to collect bids from unfavored bidders. Furthermore, through ensuring that there is accessibility by the public to procurement data, it facilitates the possibility of public and oversight transparency (Briggs, 2007).

In the Unites States, Quesada et al. (2010) conducted a study on effect of e-procurement on performance and procurement practices and established that the use of EPT affect the perceptions of managers positively of both procurement performance and the procurement practices. In Kenya, Matunga and Okibo (2013) found out that Kisii Level 5 hospital used e-quotations, e-sourcing and e-tendering as the major e-procurement applications and also that the major challenges faced when e-market provider is used is the problem of inability of the organization to deal with changes in management, inadequate employee training on the way the system is used and inadequate funding. In Elgeyo-Marakwet County, Barngetuny and Kimutai (2015) found that lack of an E-Procurement system in the has made it impossible for the county to achieve the best deal of the supply contract and thus little is done in terms of giving the right information. Payments are delayed when it comes to service delivery and thus the county is slow in delivering as a result of timelessness in supply. Furthermore, the county has failed to pay suppliers effectively as a result of late invoices and delays in approving the supply of services and goods needed by county government.

### **Theoretical framework**

This study was anchored on the Unified Theory of Acceptance and Use of Technology (UTAUT). This theory was advanced by Venkatesh and other researchers in "User acceptance of information technology: In response to the unified view". The the theory focuses on explaining the intentions of the user in the application of subsequent usage behavior and the information system (Venkatesh, et al., 2003). Lin and Anol (2008) and also Wang and Wang (2010) were the ones who proposed the theory. Wang and Wang (2010) extended on the UTAUT theory in the study their study on 343 target population in Taiwan to find out the differences in gender on mobile Internet acceptance. They advanced three constructs perceived value, palm-sized computer self-efficacy and perceived playfulness to UTAUT and decided to choose the

intentional behaviour as the dependent variable. Lin and Anol (2008) posited UTAUT model, involving the effect of online social support and network information technology use. The UTAUT was based on four key determinants on usage and intention, and also four main moderators of core relationships. The UTAUT posited four main constructs which has a key function in determining behavior usage and user acceptance: Facilitating conditions, Performance expectance, Social influence and Effort expectancy. The main moderators of the theory were age, experience, voluntariness and gender. The UTAUT gives a more improved way of how the behavior and intention evolve (Venkatesh, et al., 2003). In addition, it the main relationships that make the model have been moderated.

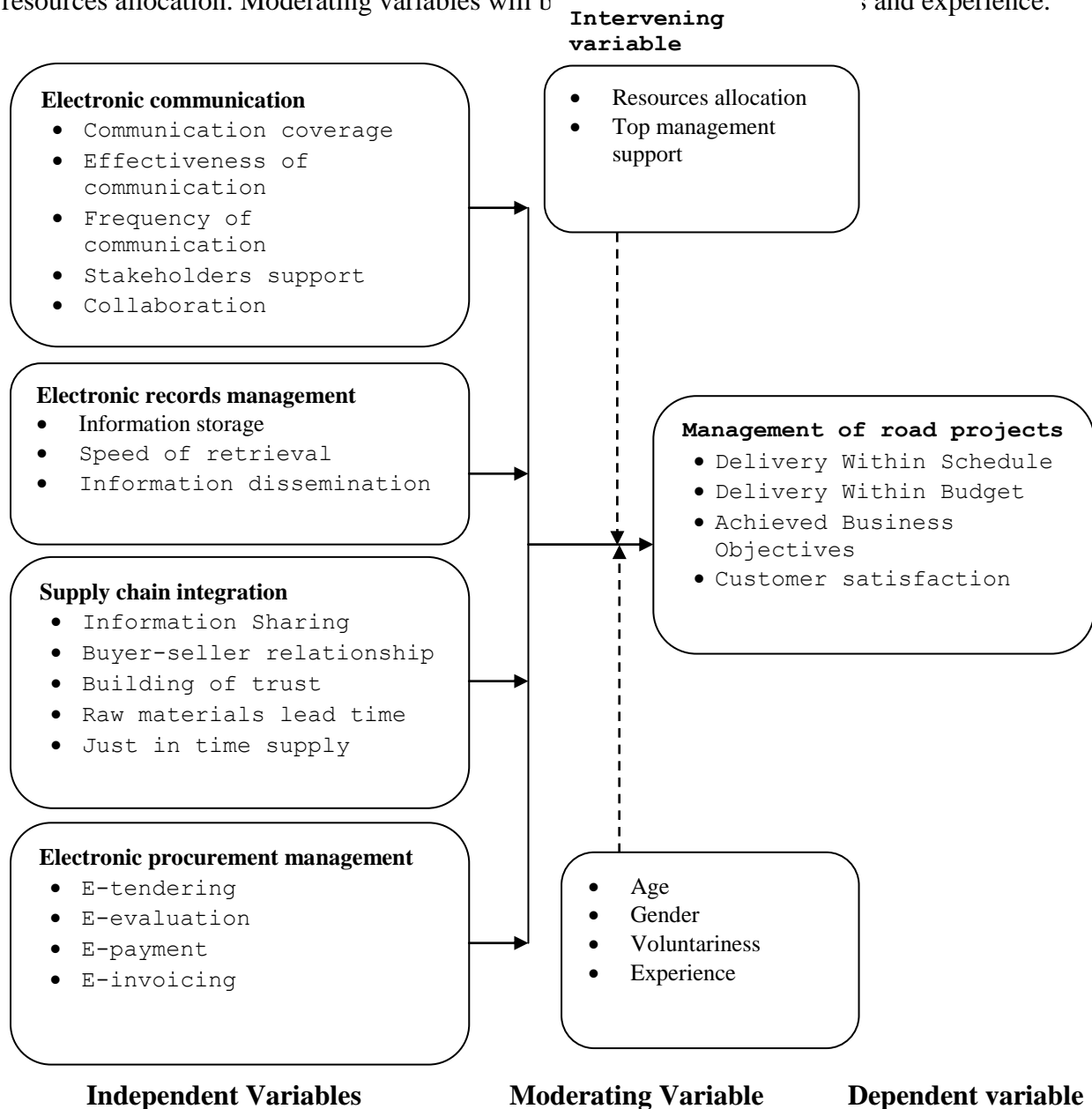
Intentional behaviour involves the intention of a person to work out on a certain action that forecast on the behavior of an individual. Apart from this, behavioral intentions are the subjective probability of conducting behavior and also effect of a particular usage behavior. Hence, intentions indicate factors that are motivational which affect the behavior and are also indicate the willingness of people to try. Performance expectancy refers to the degree to which users gain advantage in the use of a technology while conducting activities (Venkatesh et al. 2012). Effort expectancy is the degree to which a technology is easy to use. Social influence is apperception of an individual that it is good to adopt the technology and is always different from those of other people. The UTAUT2 added four more constructs: hedonic motivation, facilitating conditions, and habit and price value. Facilitating Conditions involves perceiving that technical and organizational infrastructure exist so as to support technology (Venkatesh et al. 2003). Hedonic Motivation refers to the pleasure of adopting technology. Price Value refers to the trade-off between cost paid by adopting a particular technology and benefits received. Habit involves the extent of execution of behaviors automatically by an individual. Venkatesh et al. (2012) posited that habit indirectly and directly affect behaviour of adoption of technology. It was discovered that increase in experience of use result to habitual use of technology.

This theory was adopted in this study to explain the effect of utilization of information technology on the performance of road projects. This is measured in terms of effectiveness of the system, improvement in the work performance of the system, improvement in the work productivity of the system, chances of gaining better control and transferable skills of work. Effort Expectancy refers to an individual's attitude and perception that the use of an IT system will be a free of effort. This is measurable in terms of easy of clarification of data, accessibility to data, smoothness in the interactions with the system, the ability of identifying the relevant data, and overall presentation of the system and outline. Social Influence is an individual's perception of the degree to which important other people approve or disapprove of the target behavior (Lin & Anol, 2008). This is measured by the organizational encouragement; pressure exerted by the organization for change; management of communication and involvement of people in process change; demo experience beforehand; and availability of an "open door" policy which allows for discussion of aspects related to change. Facilitating Conditions includes the availability of information systems, computers and other related equipment. Also, if adopting an information and communication technology will be very costly, and a company cannot afford then this would act as a hindrance to adoption.

### **Conceptual framework**

Conceptual framework refers to a structure of rules, assumptions and principles which holds together ideas concerning a specific concept. The study is conceptualized based on the variables

adopted in the study which are diagrammatically represented to indicate the relationship existing between them through an illustration of the influence of the dependent variables and the independent variables in order to provide coherence. Independent Variables include; electronic communication, electronic records management, supply chain integration and electronic procurement management. The intervening variables will be top management support and resources allocation. Moderating variables will be age, gender, voluntariness, and experience.



**Figure 1: Conceptual Framework  
Research Methodology**

The study adopted a descriptive explanatory research design. Descriptive explanatory studies are designed to test whether one event causes another. Further, correlational analysis was adopted to determine the relationship between the dependent variable and independent variables. The target population was all staff working in the headquarters of KeNHA. According to KeNHA (2015),



there is 114 staff working in the headquarters of KeNHA. Thus, the target population of this study was 114 staff. Slovin's Formula was adopted in this study to determine the sample size. The formula is a random sampling technique that is used in the estimation of the sampling size. This formula was chosen because it considers the size of the population.

$$n = \frac{N}{1 + NE^2}$$

Where by:

n = number of samples

N = target population

E = margin of error (0.05)

$$n = \frac{114}{1 + (114 * 0.05^2)}$$

$$n = 88$$

**Table 1: Sample Size**

Department	Target Population	Sample Size	Percent
Design & Construction	12	9	10.53
Planning & Environment	8	6	7.02
Finance	11	8	9.65
Maintenance	14	11	12.28
Quality Assurance	11	8	9.65
Procurement	11	8	9.65
Legal and Regulatory Affairs	8	6	7.02
Enterprise & Risk Management	12	9	10.53
Human Resource Management & Development	6	5	5.26
Internal Audit	12	9	10.53
ICT	9	7	7.89
<b>Total</b>	<b>114</b>	<b>88</b>	<b>100.00</b>

**Source: KeNHA (2015)**

Stratified random sampling was adopted in selection of 88 staff from the target population. Stratified random sampling gives estimate of the total population parameters involving a higher precision and also ensures that a more representative sample is obtained from a population that has similar attributes. In addition, the study used primary data which was collected by use of semi-structured questionnaires and interview guides. A pilot test was conducted in Kenya Urban Roads Authority (KURA), as it deals with roads the same as KeNHA, to enhance the validity and reliability of the research instrument. The researcher enhanced content validity of the research instrument by obtaining opinions from people with expertise like the supervisor in the field of study. Data reliability which is a measure of internal consistency and average correlation was measured by use of Cronbach's alpha that lies between 0 and 1. A Cronbach's alpha of 0.7 was considered acceptable in this study.

In the analysis of data, the study used quantitative and qualitative data analysis techniques. Qualitative data was analyzed by use of thematic content analysis. Analysis of quantitative data was done by making use of the descriptive statistic and inferential statistics with the help of statistical package for social sciences (SPSS version 22). Descriptive statistics used included

standard deviation, frequency distribution, percentages and means. Thereafter, data presentation was by adoption of graphs and tables. Further, correlation analysis and regression analysis were adopted in finding out whether there is a relationship between the dependent and independent variables. A 95% confidence level was applied. This showed a 0.05 significance level. This indicated that for any independent variable to have a significant effect on the dependent variable, the p-value needs to be less than the significance level (0.05).

### **Research Findings and Discussions**

Out of 88 questionnaires issued, 86 questionnaires were filled and returned, accounting for 97.73% return rate which was deemed adequate for the analysis. A 100% response rate was not achieved as some of the questionnaires had some inconsistent information and some were half way filled and thus could not be used in the study. According to Kothari (2004) a response rate of 50% or more is adequate for analysis, which shows that 97.73% was an acceptable basis for drawing conclusions.

### **Electronic Communication and Management of Road Projects**

The respondents indicated that electronic communication influences the management of road projects in Kenya through liaising with other departments making work easier and effective in road projects. The respondents further reported that electronic communication assists in sharing of information in the management of road projects. Furthermore, good communication that is provided through electronic communication throughout the phases of the lifecycle of the project is a vital factor in the success of the project as it is the prime factor which connects all of the project success factors together. The respondents indicated that the quality of flow in communication via the life cycle of project determined the effectiveness that was required in project construction and that it assisted in the integration and coordination of activities of project management. The key informants reported that electronic communication makes communication easier, faster, effective and efficient. The use of WhatsApp and mail, one does not need to be in the office to work or store the data collected in the field.

From the findings, the respondents indicated that collaboration influences the management of road projects in Kenya to a great extent as shown by a mean of 3.755. The respondents also indicated that stakeholders support and frequency of communication, communication coverage and effectiveness of communication were influencing the management of road projects to a great extent as shown by a mean of 3.651, 3.604 and 3.546, respectively.

**Table 2: Aspects of Electronic Communication and Management of Road Projects**

	<b>Mean</b>	<b>Std. Deviation</b>
Communication coverage	3.604	0.655
Effectiveness of communication	3.546	0.680
Frequency of communication	3.651	0.569
Stakeholders support	3.651	0.479
Collaboration	3.755	0.529

### **Electronic Records Management and Management of Road Projects**

The respondents reported that electronic records influenced the management of road projects through allowing easy accessibility to the records concerning management of road projects. They

also indicated that electronic records are more efficient in the management of road projects because one can access information on road projects from any point and is not necessarily to be in the office. Also the respondents reported that electronic records improved on safety of information on management of road projects and also allow easier retrieval of information on the projects. Moreover, the respondents indicated that the management process of IT records in the construction industry depends on the broad information that is provided, information that is provided in a good environment where there are adequate management practices of records should be appropriate, accurate and clear as decisions made on a daily basis are based on accurate information recorded.

From the findings, the respondents indicated that speed of retrieval, information security, information storage and information dissemination influence the management of road projects in Kenya to a great extent as shown by a mean of 3.860, 3.755, 3.697 and 3.593 respectively.

**Table 3: Aspects of Electronic Records Management and Management of Road Projects**

	Mean	Std. Deviation
Information storage	3.697	0.554
Speed of retrieval	3.860	0.489
Information security	3.755	0.631
Information dissemination	3.593	0.581

### Supply Chain Integration and Management of Road Projects

The respondents reported that through supply chain integration, everyone can access information on tenders concerned with the management of road projects in Kenya. The respondents also indicated that through supply chain integration there is time saved in the management of road projects in Kenya as most of the shareholders can be addressed within a short period of time. The respondents further reported that the usage of the supply chain integration effectively reduces the total costs of construction when there is early involvement of the suppliers and subcontractors in a similar way as the early involvement of contractors in the procurement process. In addition, they indicated that supply chain integration is important in sharing of information process because it reinforces coordination, collaboration and connectedness, among the members in a supply chain and it provided information which is real time to the customers necessary for determination of effectiveness management in management of stock. The senior managers reported that by having the expected qualification on the website supply chain integration helps weed out incompetent suppliers.

According to the findings, the respondents indicated that building of trust, information sharing, buyer-seller relationship, just in time supply and raw materials lead time influence the management of road projects in Kenya to a great extent as indicated by a mean of 3.802, 3.697, 3.651, 3.593 and 3.453 respectively.

**Table 4: Aspects of Supply Chain Integration and Management of Road Projects**

	Mean	Std. Deviation
Information Sharing	3.697	0.461
Buyer-seller relationship	3.651	0.569
Building of trust	3.802	0.590
Raw materials lead time	3.453	0.500
Just in time supply	3.593	0.581

### Electronic procurement on the Management of Road Projects

The respondents indicated that electronic procurement influences the management of road projects in Kenya by building on trust, easement of procurement process and removal of cartels. Also, the respondents indicated that electronic procurement influenced the management of road projects in Kenya by reducing the level of collusion in the bidding process, corruption and inadequate accessibility to bid information hence increasing the number of bidders through reducing the costs of collecting information concerning a tendering process. In addition, they reported that e-procurement leads to lowering of prices that are paid by the government and also established that e-procurement is concerned with improvements in quality. The senior managers reported that that electronic procurement influences the management of road projects in Kenya through having data stored in SAGE it acts as a reference and also aids in accountability.

From the findings, the respondents indicated that e-tendering, e-invoicing and e-payment influence the management of road projects in Kenya to a great extent as shown by a similar mean of 3.697. The respondents also indicated that that e-evaluation influence the management of road projects in Kenya to a great extent as shown by a mean of 3.593.

**Table 5: Aspects of Electronic Procurement and Management of Road Projects**

	Mean	Std. Deviation
E-tendering	3.697	0.461
E-evaluation	3.593	0.494
E-payment	3.697	0.461
E-invoicing	3.697	0.461

### Management of Road Projects

According to the findings, the respondents rated achieved business objectives and customer satisfaction of management of road projects as good as shown by means of 3.848 and 3.802 respectively. In addition, they rated the intended purpose and sustainability of management of road projects as good as indicated by means of 3.755 and 3.639 respectively. Furthermore, the respondents rated finish as per specifications of management of Road Projects as being moderate as shown by a mean of 3.139. In addition they rated finishing as per the scope (m=3.139) and finish in time (M=2.581) of management of road projects as moderate. Lastly they rated finish within budget management of road projects as bad as indicated by a mean of 2.476.

**Table 6: Management of Road Projects**

	Mean	Std. Deviation
Finish in time	2.581	0.659
Finish within budget	2.476	0.663
Finish as per specifications	3.151	0.473
Finish as per the scope	3.139	0.348
Sustainability	3.639	0.572
Intended purpose	3.755	0.432
Achieved Business Objectives	3.848	0.473
Customer satisfaction	3.802	0.504

### Inferential Statistics

The study used correlation analysis and regression analysis to determine the influence of the independent variables (electronic communication, electronic records management, supply chain integration and electronic procurement) on the dependent variable (management of road projects in Kenya).

### Correlation Analysis

From the findings, there is a positive association between electronic communication and management of road projects in Kenya as shown by a correlation coefficient of 0.557. The results also show that there was a negative association between electronic records management and management of road projects in Kenya as shown by a correlation coefficient of 0.119. The results further show that there was a positive association between supply chain integration and management of road projects in Kenya as shown by a correlation coefficient of 0.361. In addition, the results show that there is a positive association between electronic procurement and management of road projects in Kenya as shown by a correlation coefficient of 0.446.

**Table 7: Correlation Coefficients**

		Management of road projects	Electronic communication	Electronic Records management	Supply Chain integration	Electronic Procurement
Management of road projects	Pearson Correlation	1				
	Sig. (2-tailed)					
Electronic communication	Pearson Correlation	.557**	1			
	Sig. (2-tailed)	.000				
Electronic Records management	Pearson Correlation	.119	.774**	1		
	Sig. (2-tailed)	.276	.000			
Supply Chain integration	Pearson Correlation	.361**	-.246*	-.092	1	
	Sig. (2-tailed)	.001	.022	.398		
Electronic Procurement	Pearson Correlation	.446**	.199	-.176	.050	1
	Sig. (2-tailed)	.000	.066	.105	.650	

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

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

### Regression Analysis

A multivariate regression analysis was also carried out to determine the relationship between dependent variable and the four independent variables. The regression equation was;

$$Y = \beta_0 + \beta_1X_1 + \beta_2X_2 + \beta_3X_3 + \beta_4X_4 + \varepsilon$$

Whereby; Y = Management; X<sub>1</sub> = Electronic communication, X<sub>2</sub> = Electronic records management, X<sub>3</sub> = Supply chain integration, X<sub>4</sub> = Electronic procurement,  $\varepsilon$  = Error Term,  $\beta_0$  = Constant Term and  $\beta_1, \beta_2, \beta_3, \beta_4$  = Beta Co-efficient

**Table 8: Model Summary**

Model	R	R Square	Adjusted Square	R Std. Error of the Estimate
1	0.767	0.588	0.528	0.533

The R-Squared is the proportion of variance in the dependent variable which can be explained by the independent variables. From the findings, the R-squared in this study was 0.588, which shows that the four independent variables (electronic communication, electronic records management, supply chain integration and electronic procurement) can explain 58.8% of the variation in the dependent variable. This clearly shows that other factors not considered in this study explain 41.2% of the variation in the dependent variable, management of road projects in Kenya.

**Table 9: Analysis of Variance**

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	50.944	4	12.736	44.676	.000 <sup>b</sup>
	Residual	23.091	81	0.285		
	Total	74.035	85			

From Table 10, the analysis of variance in this study was used to determine whether the model is a good fit for the data. The results indicate that the model was significant since the p-value (0.000) was less than 0.05 thus the model is statistically significant in establishing the influence of electronic communication, electronic records management, supply chain integration and electronic procurement on management of road projects in Kenya. Further, the F-calculated (44.676) was found to be more than the F-critical (2.48) which shows that the models was fit in establishing the influence of the four independent variables on the dependent variable.

**Table 10: Regression Coefficients**

	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
(Constant)	3.838	1.018		3.770	0.000
Electronic communication	0.676	0.12	0.547	5.633	0.000
Electronic Records management	0.040	0.185	0.032	0.216	0.830
Supply Chain integration	0.212	0.073	0.065	2.904	0.000
Electronic Procurement	0.431	0.119	0.088	3.622	0.000

The regression model was;

$$Y = 3.838 + 0.676X_1 + 0.040X_2 + 0.212X_3 + 0.431X_4 + \varepsilon$$

From Table 4.11, the findings show that there is a positive significant relationship between electronic communication and management of road projects in Kenya with a regression coefficient of 0.676. This shows that a unit increase in electronic communication would lead to a 0.676 improvement in the management of road projects in Kenya. The p-value (0.000) was less than the significance level (0.05), hence the relationship was significant. The results also show that there is a negative insignificant relationship between electronic records management and management of road projects in Kenya with a regression coefficient of 0.040. This shows that a unit increase in electronic records management would lead to a 0.040 improvement in the management of road projects in Kenya. The relationship was insignificant as the p-value (0.830) was more than the significance level (0.05).

From the findings, the study found that there is a positive relationship between supply chain integration and the management of road projects in Kenya with a regression coefficient of 0.212. This indicates that a unit increase in supply chain integration would lead to a 0.212 improvement in the management of road projects in Kenya. The relationship was found to be significant as the p-value (0.000) was less than the significance level (0.05). Lastly, the study results show that there is a positive significant relationship between electronic procurement and management of road projects in Kenya as shown by a regression coefficient of 0.431. This indicates that a unit improvement of electronic procurement would lead to a 0.431 improvement in the management of road projects in Kenya. This relationship was significant as the p-value (0.000) was less than the significance level (0.05).

### Discussion of the Findings

The study found that electronic communication influences the management of road projects in Kenya. Raulea and Raulea (2014) indicate that ineffectiveness in communication is a major contributor to project failures as it contributes to 95% of most project failures. The study found

that stakeholders support and frequency of communication influence the management of road projects to a great extent. These findings agree with Jameson (2013) findings that stakeholders support and frequency of communication through emails, professionals can send drawings to their team members on a timely basis and the stakeholders can keep track of the information. In addition, communication coverage and effectiveness of communication influence the management of road project to a great extent. These findings are similar to Aaltonen and Lohikoski (2015) argument that communication coverage and effectiveness is among the major factors which account for the success of a project. The study also established that unstable network was a challenge in the process of implementation of electronic communication. These findings agree with Hart, Vroman and Stulz, (2015) argument that good communication in all project lifecycle stages depends on stability of network so as to ensure the success of the project; it is the main factor which brings together all the factors which affect project implementation.

The study found that electronic records management influences management of road projects in Kenya. The study established that speed of retrieval influence the management of road projects in Kenya to a great extent. These findings agree with Xiangjun and Weimei, (2016) argument that the fast pace and complexity of the contemporary large-scale construction activity affects heavily the process of record management. The study also found out that information storage and information dissemination influence the management of road projects in Kenya to a great extent. These findings agree with Mampe and Kalusopa (2012) argument that the practices applied on management of records were not well entrenched hence leading to undermining of service delivery and project performance. This was evidenced by the practices that were applied on information storage and information dissemination which resulted in missing of some electronic records.

The study found that supply chain integration on the management of road projects in Kenya. The study revealed that building of trust influence the management of road projects in Kenya to a great extent. These findings agree with Ofori (2011) that the ways included ensuring fair payments; trust between parties; educating the construction workforce; early involvement with projects and many others. Also, the established that information sharing influence the management of road projects in Kenya to a great extent. These findings agree with Khalfan, Khan and Maqsood, (2015) argument that the problems that are resolved arise mainly as a result of prevalence of lose and win arrangements; any difficulties that are encountered in the construction processes, insufficient exchange of knowledge and information; increase in price as a result of competition that result from purchases from many suppliers; presence of an environment that is full of dishonest, frustration and fear.

The study found out that electronic procurement influence the management of road projects in Kenya. The study found out that e-tendering, e-invoicing and e-payment influence the management of road projects in Kenya to a great extent. These findings agree with Matunga and Okibo (2013) argument that e-quotations, e-sourcing and e-tendering as the major e-procurement applications and also that the major challenges faced when e-market provider is used is the problem of inability of the organization to deal with changes in management, inadequate employee training on the way the system is used and inadequate funding. In addition, the study found that e-evaluation influence the management of road projects in Kenya to a great extent. These findings agree with Lewis-Faupel *et al.* (2014) argument that e-valuation leads to lowering of prices that are paid by the government and also leads to improvements in quality. The study



found out that organizations were faced with a challenge of lack of skill and knowledge on electronic procurement in the implementation of electronic procurement.

### **Conclusions of the Study**

The study concludes that there is a positive association between electronic communication and management of road projects in Kenya. Electronic communication influences the management of road projects in Kenya through liaising with other departments making work easier and effective in road projects in Kenya. The study also concludes that there was a negative association between electronic records management and management of road projects in Kenya. Electronic records management influences the management of road projects through allowing easy accessibility to the records concerning management of road projects. The study further concludes that there was a positive association between supply chain integration influences the management of road projects in Kenya. The study found out that building of trust influence the management of road projects in Kenya to a great extent. In addition, the study concludes that there is a positive association between electronic procurement and the management of road projects in Kenya. The study found out that that e-tendering, e-invoicing and e-payment influence the management of road projects in Kenya.

### **Recommendations**

Based on the findings of the study and the conclusion made, the study offers the following recommendations:

1. The study found out that KeNHA experienced a challenge of unstable network in the process of implementation of electronic communication. Therefore this study recommends that KeNHA should develop strategies to improve on stability of network which can be done by establishment of other communication tools such as the adoption of video conferencing, use of mobile phones to communicate and emails.
2. The study found out that poor public procurement record keeping systems was a challenge to KeNHA which led to inefficient of accountability and corrupt practices. Therefore, this study recommends that KeNHA should develop strategies on public procurement record keeping so as improve on electronic records management.
3. The study established that KeNHA was faced by a challenge of cost, network coverage, favism among the members in the supply chain integration and inadequate support from information and technology sector in the implementation of supply chain integration. Therefore, this study recommends that KeNHA should establish new policies on adoption of adoption of supply chain integration so as to reduce on cost, network coverage, favism among the members in the supply chain integration.
4. The study found out that KeNHA was faced by a challenge of lack of skill and knowledge on electronic procurement in the implementation of electronic procurement. This study, therefore recommends that should improve on skill and knowledge on electronic procurement. This is done as a way of building on trust, easement of procurement process and removal of cartels.

### Areas for Further Research

1. This research only focused on Kenya National Highways Authority. Therefore, further studies should be conducted on the influence of information and communication technology application on management of road projects in Kenya in other road projects in Kenya.
2. A comparative study of the challenges influencing the adoption of information and communication technology in the management of road projects in Kenya should be conducted.
3. A research should be carried out to establish the influence on information and communication technology application in the Kenyan economy.

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