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**AN INVESTIGATION INTO THE USE OF CONSTRUCTION  
MANAGEMENT SOFTWARES: A SURVEY OF  
CONSTRUCTION FIRMS IN NAIROBI, KENYA.**

**BY**

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**REG. No: B50/63653/2010**

**A Research Project Submitted In Partial Fulfillment For The Award Of The  
Degree Of Master Of Arts (Construction Management) In The Department  
Of Real Estate And Construction Management At The University Of Nairobi**

**October 2014**

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# DECLARATION

## DECLARATION BY THE CANDIDATE

This research project is my original work and has not been presented for a degree in any other university.

Name: Alex Waiharo Kinuthia

Signature: .....  .....

Date: ..... 27/10/2014 .....

## DECLARATION BY THE SUPERVISOR

This research project has been submitted for examination with my approval as the University supervisor.

Name: Dr Isabella Njeri Wachira - Towey

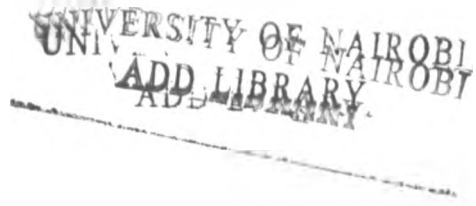
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## **DEDICATION**

To my late grandmother, Joyce Waceke Waiharo who challenged me to invest in my first piece of property and this later inspired me to pursue a career in construction project management.

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## ABSTRACT

Despite unprecedented growth of the construction industry in Kenya, it is still bedeviled by numerous challenges in delivering construction projects efficiently particularly because of poor construction project management. This problem can be addressed *inter alia* by improving the quality of construction project management through the use of modern tools such as construction management software for planning, administrating and executing construction activities within the construction firms.

This study hypothesized that poor project management amongst construction firms in Kenya can be attributed *inter alia* to insignificant usage of construction management software. Accordingly, the objectives of the study were to identify the extent of use of construction management software in the construction firms in Kenya, what they are used for and the benefits of using these softwares. In addition, the study sought to establish the challenges that construction firms experience in using construction management software. The research method used was a survey in which the respondents completed questionnaires and the data obtained was then analyzed using statistical analysis software.

The study findings indicate that majority of the construction firms surveyed had been in business for more than 10 years and were indeed using construction management software to manage their construction projects. MS Project was found to be the most widely used software and this suggests a significant lag between the construction management software technology that is currently available and what is being used in the Kenyan construction industry. The findings also showed that majority of professionals engaged in managing construction projects were quantity surveyors. Most of the respondents in the survey indicated there were benefits of using construction management software thereby demonstrating the importance of these softwares as an effective tool for managing construction activities in their firms. These benefits include ease of planning construction activities, scheduling labour and equipment with ease, ensuring accurate estimates, increase of profit with less risk, simplifying document management and reducing the complexity of HR issues. The findings revealed the various challenges that construction firms face in adopting construction management software including lack of information about these softwares, lack of personnel having adequate working knowledge and familiarity with these softwares, lack of a structured approach in the firms for planning construction activities and cost of the softwares, among others.



The study concluded that though majority of the construction firms were using software tools to manage their construction projects, the uptake of construction industry specific software products is very low. Secondly, the study concluded that the most significant benefits of using construction management software to the construction firms were ease of planning construction activities together with scheduling labour and equipment with ease. Lastly, the most significant challenges that hinder the adoption of construction management software are lack of information about these softwares and lack of personnel having adequate working knowledge and familiarity with these softwares.

The study recommends that professional forums be used to promote adoption and extensive use of modern construction management softwares by local construction firms and that universities and tertiary institutions that train manpower for the construction industry be encouraged to incorporate skills in the usage of construction management software as part of their curriculum. This will lead to improvement in the efficiency of the management of construction projects.

## ABBREVIATIONS AND ACRONYMS

AAK – Architectural Association of Kenya

CAD – Computer Aided Design

CRM – Customer Relationship Management

HR – Human Resource

ICT – Information and Communication Technology

IQSK – Institute of Quantity Surveyors of Kenya

IEK – The Institution of Engineers of Kenya

MOPW – The Ministry Of Public Works of the Government of Kenya.

OSHA - The Occupational Safety And Health Act, 2007

RFI – Request For Information

SPSS – Statistical Package for Social Sciences

V.A.T - Value Added Tax

VPN – Virtual Private Network

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## 1.1 Background of The Study

Information and communication technologies (ICT) have influenced areas of design and construction in the recent years. Much new software and hardware has been developed to aid administrating, planning, designing, and executing of projects and are being implemented by construction firms in different countries over the last two decades (Hurst et al., 2010). Of particular importance worldwide, is the use of software based construction management systems that are intended to enable construction firms achieve greater efficiency in their operations.

Kenyan construction firms also attempt to use construction management software as a tool to aid in the management of construction projects. However, the extent of construction management software usage in managing construction projects in Kenya is largely unknown including whether the construction firms are using the proper tools to improve the quality of their construction project management process. This is despite the fact that the performance of the construction industry is quite crucial to the Kenyan economy. The construction industry accounts for 5% of Kenya's GDP and employs about one million people with an estimated annual wage bill of Sh3.2 billion (Thuita,2011). This shows that any effort made to further increase the productivity of the construction industry will lead to an increased growth of the national economy. According to industry analysts (Ndaiga,2011), the residential construction sector will continue to grow as both the government and private developers try to keep up with the rising demand for housing which is occasioned by the rise in population.

Despite this growth, the construction industry is still bedeviled by numerous challenges that may be addressed inter alia by improving the quality of construction project management through the use of modern tools such as construction management software.

There exists delays among construction projects in Kenya and improving the quality of the construction project management process has been identified as one way to minimize delays and poor planning among clients, contractors and consultants (Kimani, 2004). The use of construction management software by construction firms for planning, administering and executing of projects can therefore greatly assist them to overcome these problems. It is therefore, a matter of great interest for the construction industry to investigate whether the use of

appropriate modern tools that should be used to enhance the quality and effectiveness of construction project management is actually taking place.

## 1.2 Problem Statement

As has been mentioned previously, the construction industry is very important for the Kenyan economy. Yet, previous research has shown that in Kenya, time and cost overruns are very prevalent in construction projects and causes of these overruns have been studied by various researchers such as Mbatha, Wachira and Kivaa (cited in Kimani 2004, p. 2).

Kimani (2004) established that the planning done by the construction industry players was inadequate and is one of the causes of delay. The study recommended that the construction project management process needed serious improvement to help limit the problem of delays. There is therefore need to encourage adoption of appropriate construction project management tools for the construction industry in Kenya, particularly amongst the construction firms so that they can gain competitive advantage in the market and also remain relevant. This is because managing construction time is of great importance to the investor of a construction project and to all the parties involved in the construction activity. In order to do this, it is necessary to understand the importance of modern construction management software to the industry and the benefits that the industry is likely to experience from it.

Previous research showed that most construction projects in Kenya experience delays because there exists a challenge either in making the initial plans or in the control of the plans during execution phase (Kimani 2004, p. 2). Construction management software can be used as an effective tool for planning, implementing and monitoring construction projects in an efficient manner thus improving the performance of such projects by reducing potential problems and hence the chances of unnecessary delays occurring. There are various construction management software systems available for these purposes and it is worthwhile to investigate whether construction firms in Kenya are using them to improve their business processes. The trend worldwide is for construction firms to use such systems as a way of integrating their business processes because they offer numerous benefits such as: effective contract management, control of budgets and clear sight of costs, ability to coordinate the whole business from a single system and effective solution for processing tenders and quotations.

In Kenya, there is not much research done so far to find out whether construction firms are using integrated construction management systems and the challenges in the adoption of these softwares. There is therefore need to fill this gap in knowledge and to avail useful information which can benefit the players in the construction industry.

### **1.3 Objectives of The Study**

Purpose of the Study:

The purpose of this study is to establish whether construction firms in Kenya are using construction management software tools to manage their construction projects.

Specific Objectives:

The specific objectives of the study are:

- i. To establish the extent of use of construction management software amongst the construction firms in Kenya.
- ii. To identify the various construction management softwares used in the construction firms in Kenya, and what they are used for.
- iii. To determine the benefits of using these softwares to the construction firms.
- iv. To investigate the challenges that construction firms experience in using construction management software.

### **1.4 Research Questions**

- i. Do construction firms in Kenya use construction management softwares to manage their projects? If so, which softwares do they use?
- ii. Are the construction management softwares that are being used by construction firms in Kenya an integrated system that incorporates several business processes or are they disparate systems having different stand alone software that have no relationship with each other?
- iii. What are the benefits of using these softwares and which components of the construction project management process do they impact most?
- iv. What challenges do construction firms in Kenya experience in adopting construction management software?

## 1.5 Hypothesis

Previous research has established that there is poor quality of construction project management in the Kenyan construction industry and that there is a link between this and the numerous delays being encountered (Kimani 2004, p. 65). This has led to the conclusion that this is the main cause of the poor performance in completion of these construction projects. With this background in mind, the hypotheses for this study have been formulated as follows:

**The Null Hypothesis:** Poor project management amongst construction firms in Kenya can be attributed *inter alia* to insignificant usage of construction management software.

**The Alternative Hypothesis:** Poor project management amongst construction firms in Kenya cannot be attributed to insignificant usage of construction management software.

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## 1.6 Scope Of The Study

The scope of this study was limited to construction firms that operate within Nairobi City. This is because Nairobi has the largest share of building projects, amounting to over 70% of the national total output (Oketch, 2004) and therefore most construction firms in the country are based there. Nairobi was also a favorable area of study due to resource constraints especially on time and finances. This is because conducting a survey that involves construction firms based in different parts of the country would be too expensive in cases where physical visits to the respondents are required and would also take a long time to complete. The appropriate size of construction firms that are more likely to implement construction management software were deemed to be those in categories A and B in the Ministry of Public Works Register of Contractors because the value of work undertaken by these firms (unlimited for category A and upto Kshs 100 million for category B) is of a reasonably high value such that they can better afford to purchase these softwares compared to much smaller firms. The focus of the study was therefore limited to these firms.

## 1.7 Significance Of The Study

This study seeks to avail information for use by the various construction industry stakeholders in Kenya, particularly construction firms and training institutions. The study identifies the most widely used construction management softwares and the benefits that the users derive from using these softwares. It also identifies the challenges that hinder the successful adoption of construction management software by construction firms in the country. The results of this study

will be useful in identifying ways to encourage the adoption of construction management software as an effective tool for managing construction projects in an efficient manner thus improving the performance of such projects. This is quite critical given that there is urgent need for the construction industry in Kenya to improve the quality and effectiveness of its project management skills. This is especially so because construction projects today have become more complicated and clients have become more demanding in terms of the period of time given for a project to be completed (Thwala, Landu and Aigbavboa 2011, p. 6). Due to this increased complexities in design and demand by clients to have projects completed on time, contractors are forced to work fast and efficiently because of the vast competition available in the market and to save money. Consequently therefore, gaining the competitive advantage in order to obtain new business opportunities requires the use and efficient adoption of construction management software. Rono (cited in Thwala, Landu and Aigbavboa 2011, p. 6) states that construction clients expect their projects to be completed on time, within an anticipated budget and to be of good quality and that during the many phases of the project's life, it is important to have accurate, reliable and timely information for the client.

It is significant to note that the clients of the construction industry in Kenya are increasingly losing confidence in the ability of local construction firms to deliver projects on time. A good example is one of the leading real estate developers in the country, Chigwell Holdings who stated in a leading local daily newspaper (The Standard, August 1, 2013) that they mostly use foreign contractors who are more efficient and deliver projects in time compared to many local contractors who have a problem with time management and complete projects far beyond the scheduled time.

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### **1.8 Study Assumptions**

Time and cost overruns are very prevalent in construction projects and poor planning and control is not the only cause of these overruns. Other possible causes exist such as design changes during execution, bad weather and materials, plant or labour shortages, etc. This study assumes that the main cause of projects not being completed on time can be attributed mainly to poor construction project management (Kimani, 2004), which can be improved upon by the project managers using construction management softwares as a useful tool to assist them perform their work better.

## **1.9 Operational Definitions**

### **Construction management software:**

By definition, construction management software is software that offers features that are useful for management of construction projects and this includes a wide-range of construction industry issues. A partial list includes job costing, estimating, change orders, progress billings, revenue recognition, construction payroll, equipment management, purchasing and subcontract management. This is software that is specific to the construction industry and which is useful in that it can be used to manage information, allowing the various players to focus on running their business (Durst, 2010).

### **Disparate system**

A disparate system has one or more stand alone softwares that have no relationship with each other and offer entirely independent functions. Stand alone systems are simpler and cheaper than integrated systems (Saleemi 2008 p.383).

### **Integrated system**

An integrated system is one that utilizes a total system approach that unifies all the aspects of the organization and is typified by database methodologies. It facilitates information sharing across the entire organization ( Saleemi 2008 p.331).

## **1.10 Outline Of The Study**

The study is organized in five chapters. Chapter one discusses the importance of the construction industry to the Kenyan economy and the challenges that construction firms face in delivering construction projects on time which can be attributed mainly to poor construction project management. The need to find out whether construction firms are using integrated construction management systems and the challenges they encounter in the adoption of these softwares is explained and also the importance of this research study. In addition, the objectives, hypotheses and scope of the study are stated.



Chapter two is the literature review section whereby the importance of construction management software as a modern tool for project management in the construction industry is illustrated. Examples of construction management software products are given and the various features and benefits that they offer to the users. Reference is also made to previous related research made in Kenya and other countries.

Chapter three describes the procedures that have been followed in conducting the study. This includes the research method, population and sample, data collection and method of data analysis.

Chapter four presents the results of the analysis of data and the findings obtained while chapter five contains the conclusions, recommendations and suggested areas of further study.

## Chapter 2: LITERATURE REVIEW

### 2.0 Introduction

Everywhere in the world, the construction industry is notoriously slow for adopting new software technology. According to Durst (2010), this is because construction firms operate in a highly competitive market that is continually short of cash and therefore software providers must do a great job of demonstrating the value a product can bring to a contractor and how that value translates into profits.

According to Durst (2010), sometimes contractors who do not recognize the value of construction management software try to get by with other generic software options. They're more concerned with getting work and at the beginning, recordkeeping looks pretty easy. They then end up tracking construction activities on many different spreadsheets e.g. workers' compensation, change orders, etc. When business expands and they start handling several projects, they then often grow into the need for construction-specific software. The need often becomes apparent when growth is restrained. A generic software package may require a work-around to accomplish certain tasks, which, in turn, diminishes the value of a product to the contractor.

In contrast, construction management software can track millions of details in one system and provide an accurate, real-time analysis of the construction company's performance, with no risk of double-entry. Good construction management software then becomes a necessary productivity tool which allows the contractor to see if the job goes off track as soon as possible and get it back on track (Durst,2010).

Given this background, it is therefore expected that construction firms with lower levels of revenue earnings would be least likely to adopt construction-specific software but that those earning much higher revenues are most likely to demonstrate a high level of software usage. This provides a good basis for limiting the scope of this study to an appropriate size of construction firms that are more likely to implement construction management software.

The question arises as whether a similar trend has been followed in the Kenyan construction firms and it is worth investigating if indeed they adopt more construction-specific software as they grow in business and if they are able to come to the position of realizing that good construction management software then becomes a necessary productivity tool at that level. It is

therefore important to establish the extent of use of construction management software amongst the leading construction firms in Kenya.

## **2.1 Previous Research In Other Countries**

According to Hurst et al. (2010), much research has been carried out in different countries to investigate ICT utilization in the construction industry. Hewage et al. (cited in Hurst et al. 2010, p2) studied IT usage in Alberta's building projects (Canada). They claimed IT can improve the working efficiency in projects by lubricating communication process. They reported that the use of IT to overcome communication issues is limited in the construction industry and construction companies are spending a small proportion of their total budget on IT improvements.

Hewage et al. (cited in Hurst et al.2010, p. 2) made a list of managers' expectations for the future IT developments as: economic feasibility, employee involvement in IT developments, proper training and support, a step-by-step implementation process and an industrywide ICT standard.

Williams et al. (cited in Hurst et al.2010, p 2) by conducting a quantitative study in United States concluded that interest in electronic approval of submittals, exchange of CAD files, web-based document and content management applications is strong. However, there is a lack of familiarity about available ICT tools and a reluctance to invest time and money to adopt them. Williams et al. (cited in Hurst et al.2010, p 2) explained that productivity, work flexibility, faster service and availability of data are benefits of ICT adaptation in U.S construction industry. They also indicated that high cost and little return on investment, needed training, lack of knowledgeable support personnel, risk of system failure and data loss, and unclear benefits for individuals/companies is the main obstacles of ICT adaptation in that country. ✓

Giel and Issa (2013) also conducted a research in the United States of America which showed that the emergence of building information modeling (BIM) and the evolution of virtual design and construction (VDC) in the architecture, engineering, and construction (AEC) industry are fundamentally changing the process by which buildings are designed and constructed. However, the perceived high initial cost of implementing BIM has deterred many industry professionals from adopting this technology. The research confirmed that BIM is a worthwhile investment in the context of the companies that were studied and suggests that savings may be realized regardless of the size of a construction project.

In India, Ahuja et al. (cited in Hurst et al.2010, p 3) confirmed that use of ICT provides the ability to achieve effective communication. However, they explained that effective utilization of

ICT requires its adoption at the industry level. Their study showed that small and medium enterprises (SMEs) with higher turnover have higher adoption of ICT. Based on their analysis, availability of ICT infrastructure onsite, increased requirement of clients for more project information, increased involvement of geographically separated agencies in projects, and education of upcoming construction students towards ICT are enablers of ICT adaptation in the Indian construction industry. Issues that Indian firms encounter, as Ahuja et al. (cited in Hurst et al.2010, p 3) reported are need to periodic upgrade of hardware and software, virus threats, data security, low speed internet connection onsite and low proficiency of site staffs in ICT.

El-Saboni et al. (cited in Hurst et al.2010, p 3) found that the implementation of the projects electronic communication system played a significant role in the transformation of the construction organizations, from a functional structure, into a matrix and project oriented form of organization in United Arab Emirates. They expressed that the benefits of ICT adaptation in UAE are expedited decision making, transparency, availability of information, maintaining relationships, and trust.

This information is important because it gives a good picture of what is happening in various parts of the world and how usage of ICT in general is affecting the way construction firms do business. However, these researches did not address specific issues related to the usage of construction management software by the construction industry in these countries but rather focused on the usage of ICT in general which incorporates not only these softwares, but other components as well.

## **2.2 Previous Research In Kenya**

Mbugua (1996) showed in a research study carried out in June 1996 that amongst the construction professionals in Kenya, Architects were the most computerized (26%), followed by Engineers (21%) and that quantity surveyors were the least computerized (18%). The study also established that there existed many specialized packages in the industry then, but only 4 were widely known i.e. AUTOCAD, ARCHICAD, MASTERBILL and QS ELITE.

In addition, the study established the reasons why consultant firms in the construction industry did not use any specialized application packages as follows; 27% of the firms stated that available software was too expensive, 23% reported lack of enough work to justify the use of such software, 17% hoped that computer use would be adopted soon, 13% of the firms lacked information on buying of appropriate software and 10% lacked personnel knowledgeable in both computing and professional practice, and only 7% complained that there was a lack of proven or

good software (Mbugua,1996). The conclusion of this study was that despite the great achievements in the technological developments of computers internationally, the Kenyan construction industry had not sufficiently arisen to utilize the full potential of computers and their application packages. Notably, this research focused only on the usage of ICT amongst the consultants and did not address the impact of software usage by construction firms.

Eli (1998) conducted a comparative study in August 1998 on the usage of computer software among building contractors. The study concluded that in relation to use of specialized applications, it was evident that there was low familiarity by contractors about the availability of specialized construction software. However, though the level of familiarity was low, it was far much higher than the level of usage, meaning that even those who knew about the existence of the software did not use it much (Eli, 1998). The study also noted that the use of purpose made software (bespoke systems) locally by building contractors was negligible while at the same time, the integration of computer software into a building contractor's work would be beneficial in order to provide new or additional and value added services to their work. However, the study did not conduct an investigation into the challenges that the building contractors face that prevent them from adopting the usage of software tools in their work nor did it seek to determine whether those that used software obtained any benefits from it.

There is therefore a need to investigate which specific construction management software products the construction firms in Kenya are using and the benefits that they are deriving from using them so that this information can be shared across the board. It is also important to establish the challenges that hinder the successful adoption of these software tools so that appropriate ways of overcoming them can be identified.

### **2.3 The Need to Adopt Modern Construction Management Software**

According to Kimani (2004), planning as a management tool can be used to minimize delays and poor planning among clients, contractors and consultants which is common among construction projects in Kenya. In a construction project, if the estimated time required for completion is fairly accurate and a control process implemented to ensure the project remains on schedule, then delay should not occur. Existence of delays in construction projects suggests lack of adequate planning. It is in this regard that planning is considered an important parameter when solving the problem of delays in construction and therefore the use of appropriate tools for planning,

administrating and executing construction activities such as construction management software becomes necessary.

Andeso (2011) stated that Information Technology is now slowly transforming the way the construction industry works. He mentioned that although the industry has been built around brick and mortar, technology is changing almost every aspect of construction and those who are yet to embrace the changes risk being outdated or outdone by tech-savvy competitors.

Construction management software, for example, has greatly transformed how projects are implemented. The software automates the regular project tasks from beginning to the end and it helps the construction project manager to stay on time and within budget. The software helps project managers to be more efficient as they eliminate most of their paperwork, project minutes, change orders requests, job correspondence and many other items (Andeso, 2011).

Every building that is constructed is a prototype. Construction firms may specialize in commercial office buildings or residential buildings, but each project has a different owner, a different team of architects, subcontractors and certainly a different location. That means software companies that develop construction software need to have systems in place that bring consistency to the processes so that contractors can reach their goals on budget. (Durst, 2010).

Durst (2010) states that another incentive for using construction management software is that it enables the management of construction firms to stay on top of the numbers. This is important especially in the case where bonding companies want to know the financials are accurate.

## **2.4 Training Challenges In The Construction Industry**

According to Dindi (2004, p.44), training in construction need not just be on construction related activities only; construction firms need to train their employees on the latest technology in the industry. In a survey conducted by Leslie (cited in Dindi 2010, p 44), it was found that there is a significant lag between technology being available and technology being taught in curriculum, and another lag between what is taught in curriculum and the current knowledge prevailing in the industry. Therefore having better trained personnel is a legitimate need to applying this technology to the betterment of the industry. In view of this information, workers in the construction industry who are involved in managing construction projects are likely not to have been trained in the use and benefits of construction management software.

## **2.5 How Construction Management Software Works**

According to Zoho Corporation (2013), construction management is a complicated process with many steps and tight schedules. Therefore, in order to accomplish all project-related goals in a timely, effective, and efficient manner, the right kind of project management tools are critical. A construction project management software provides a work log that brings the power of automation instead of requiring manual entry of the tasks that were accomplished each day. You can see a project schedule in a calendar view by day, week or month or check the status of tasks in Gantt view.

A site manager can accomplish his work by simply clicking on the work log section and filling in task details, including which sub-contractors showed up on the job site, how long those sub-contractors worked for, and what percentage of each task was completed. If a particular task was not started or needs to have a finish date adjusted, the schedule can be edited from within the tool. In addition, it keeps the construction team up-to-date on the latest invoice and payment status for every change order, track invoice dates, as well as full and partial payment status. (Zoho Corporation 2013)

## **2.6 The Benefits of Construction Management Software**

According to Flynn (2012), operating a construction business can be extremely complex since each project has so many moving parts. The obvious challenges include weather, site conditions, material specification changes, owner preferences and coordination between other on-site contractors. The complexities increase dramatically once you consider other risk and accountability factors.

To be successful, contractors must mitigate construction risks and ensure accountability. By reducing risks (such as missed deadlines, lack of profit, safety and environmental violations and damaged reputations), more time can be spent accomplishing strategic initiatives instead of putting out fires.

Complete construction business management software solutions therefore provide one way to handle the complexities of the entire project lifecycle. This software can help contractors minimize risks and hold all appropriate parties accountable. With more end-to-end control and

seamless workflows, contractors can achieve operational efficiencies and cost reductions to guarantee profitability.

Oketch (2004) stated that a contractor would want to use available information in decision making so as to optimize on resources. Human, capital and financial resources play a key role in entrepreneurship. Carnall (1988) stated that entrepreneurs take risks, handle uncertainties and make initial decisions over objectives, the firm's direction and innovation. Construction firms therefore need to make sure that information that would enable them achieve their objectives is available for each project. The contractor, as a businessman, constantly has to make decisions. Decision making is risk taking and he has to examine the consequences of making the decision in the light of risks involved and expected returns. The more the information available in decision making, the less the risk and therefore by making such information readily available to decision makers, construction management software becomes a valuable tool to them.

Flynn (2012) stated some of the benefits of using construction management software as follows:

### **2.6.1 Ensure Accurate Estimates**

Construction projects begin with the takeoff and estimate. The more accurate the estimate, the greater the potential for profit. Project managers will be held accountable for errors and over-budget projects, which make it essential to begin each job with an accurate estimate.

A construction software solution offers features to perform fast, accurate takeoffs and then automatically pull the data into the project management and accounting processes to prevent errors and eliminate the need for duplicate data entry or recalculations.

Better estimates also result in better negotiating power with subcontractors. General contractors who have confidence in their numbers can challenge subcontractor and vendor quantities on high bids and confirm low-bid quantities—this reduces risks associated with bidding too high or too low.

Estimators can also use assemblies available in software solutions to easily swap materials for revised estimates or value-engineer a project. With these capabilities, estimators not only save time but can use the same assemblies repeatedly to prevent future errors and develop tighter bids.



The efficiency of a complete solution makes it easier to accumulate bid details and produce proposals quickly. Sending out more proposals can result in winning more work. And with more accurate proposals, the probability of winning more jobs and the profit potential on each project increases.

### **2.6.2 Schedule Labor and Equipment with Ease**

Accurate estimates also play a critical role when scheduling labor, materials and equipment for a job. For example, accurately estimating materials will result in less waste and reduced over-orders, under-orders and re-supply delays. With a complete solution, the project manager can automatically create job budget and billing schedules and automate purchasing processes of the estimate details already in the system. This electronic “job folder” that has all project-related data in one location eliminates the risk of data not being passed from the estimator to the project manager.

A more accurate estimate also provides better site management. Project managers will have the necessary labor, materials and equipment at the site, and material deliveries will be more timely leading to less site storage and handling.

More materials and equipment at the jobsite usually results in an increase in damaged and stolen goods. But this risk (often extremely costly to a construction company) can be mitigated with the ability to schedule just-in-time deliveries.

### **2.6.3 Simplify Document Management**

With an all-in-one solution that takes a project from takeoff and estimating through job costing and project management, contractors can also better manage project documents, RFIs, transmittals, submittals, submittal packages, daily field reports, checklists and project plans.

With an online paper trail, contractors can have all documents and related email messages in one place, set alerts to meet deadlines, have an audit trail to hold individuals accountable and have the documentation on hand if they face litigation down the road.

A software solution’s construction document management capabilities can help with managing hazardous jobsite materials as well. These materials must be tracked, tested and appropriately moved to handling sites. Between government agencies and overzealous building inspectors or

even disgruntled neighbors, the contractor must ensure proper procedures have been followed and that there is complete, accurate documentation available to prevent a lawsuit.

End-to-end software solutions also provide safety benefits. OSHA continues to become more stringent about their requirements and pursues litigious actions against companies that do not conform. Completing required jobsite training and maintaining jobsite safety conditions can easily be overlooked. But if something goes wrong or OSHA performs an inspection, noncompliance can become extremely costly.

With workflow and audit trail capabilities in a complete solution, contractors can create assignable action item lists with due dates that backtrack to their critical path schedule. The system then sends reminders throughout the process allowing contractors to stay ahead, prevent delays and avoid potentially devastating situations.

#### **2.6.4 Reduce the Complexity of HR Issues**

Human resources also poses a huge risk to contractors. And certified payroll and prevailing wage projects require significant coordination. If you work on a publicly-funded project and do not properly complete the required forms, payment requisitions can be rejected.

If public funds are withheld, owners can lose money and withhold retainage to the general contractor, who will then withhold retainage from the subcontractors. This creates cash flow issues for all involved. Noncompliance with various regulations and late and inaccurate reporting can result in fines, withheld payments and project delays. If the contractor knowingly reports fraudulent information, this could result in legal action.

A construction management solution can help contractors efficiently manage workforce reporting and construction payroll, including government, union, workers' compensation and benefit tracking. With automated functionalities to meet the ever-changing government and construction regulations, construction business owners can reduce risks to their business.

#### **2.6.5 Increase Profit with Less Risk**

A construction management software solution can help every aspect of a construction business. By reducing the amount of paperwork and streamlining processes, contractors have more time to fix or prevent problems in the field. Instead of spending an extra hour each day putting out fires,

a complete solution will enable contractors to spend that time preventing problems and finding ways to increase operational efficiency and profitability.

## **2.7 Procurement of Construction Management Software**

In procuring construction management software, it is important to request that the software company provide as much relevant information about the software product as possible that will assist the construction firm in the decision making process. The procuring firm should not only consider the cost of the software but also request the vendor to provide references and then ask specific questions of these references related to whether the system is working well, how the implementation process was done, the quality of training and level of support provided, etc. It is also important for the construction firm to carefully evaluate the construction-specific features of a product that are important to their business before making the decision as to whether to purchase the product. This will help the procuring firm to avoid various challenges such as purchasing inappropriate software that is not able to meet their requirements, purchasing complex software such that there is lack of enough work to justify the use of such software, poor support from the software vendors and difficulty in customizing the software. Some of these challenges have been identified in the past as being encountered by other players in the construction industry in Kenya (Mbugua, 1996).

Training on the proper use of the construction software is a major component for a successful implementation in a construction firm. According to research on the leading cause of technology failure in the construction industry (Mathews, 2010), the reasons for technology failure are usually related to people. It is therefore quite important that this aspect be well taken care of when selecting the appropriate product for the construction firm since lack of personnel having adequate working knowledge and familiarity with these softwares can be a major hindrance towards successfully adopting them as suitable tools for the construction project management process.

These are therefore some of the challenges of adopting construction management software and how they can be minimized during the procurement process.

## 2.8 Examples of Construction Management Software

### 2.8.1 Sage Construction Software

A description of this software is provided in this section according to the manufacturers (Sage U.K, 2012). Sage 200 Construction is out-of-the-box financial and operational contract management software based on Sage 200, for monitoring contract costs and budgets while managing cash flow and relationships. It is ideal for medium-sized contractors, subcontractors, house builders and other construction-related companies that need to manage contracts.

This software provides:

- Effective contract management
- Control of budgets and clear sight of costs
- Integrated CRM
- Coordination of the whole business from a single system
- A simplified solution for processing tenders and quotations

Sage 200 Construction provides real-time visibility of contract information, allowing you to manage budgets and costs effectively while measuring performance against targets throughout the project lifecycle, minimizing risk and allowing informed decisions to be made with confidence.

A number of the system's features focus on streamlining operational processes, such as automated subcontractor CIS processing, contract enquiries, production of applications, certificates, payments, invoices, and purchase orders. The software also allows you to easily track subcontractor insurances, applied values, materials delivered, and on/off hire dates.

Sage 200 Construction's integration links control of the financials, purchasing, contract costing, payroll and subcontractors, ensuring key project data is easily shared across the organisation. Stock can be booked out and automatically updated in your accounts system, while payroll integration allows timesheets to be processed efficiently. An integrated CRM function helps you keep track of key stakeholders, with fully synchronized financial, commercial and CRM software providing the relevant employees with a complete picture of your customers, suppliers, subcontractors and other third parties. Role tailored views also bring all key information relevant to each individual's role together on a single screen, improving efficiency.

The system provides a simplified estimating solution that allows the conversion of estimates into contracts by processing tenders and quotations from enquiry register, to tender submission. Flexible libraries for easy quote-building and supplier/subcontractor price comparison are provided by the software, while a report comparing purchase and actual costs on won contracts provides useful feedback for future tendering.

### **Available Features in the Software:**

#### **1. Contracts**

- Sub-Contractor Retention, Discount, Insurance, Trade, and CIS, recording
- Standard or Client specific Response codes with associated response times
- Ability to Import Contracts and Standard Contract templates
- Contract Analysis and Variations recording and default Contract Retention, Discount, and VAT settings
- Multi-level structures and Itemised Cost & Revenue budgets
- Itemised Retention, Discount, and VAT settings
- Contract specific Sub-Contractor Retention, Discount, and Self Billing settings

#### **2. Quotations**

- Standard or Client specific Schedules of Rates and enquiry logging with Won and Lost Analysis.
- Unlimited user definable libraries and multi-level Cost structures
- Search for suitable suppliers or subcontractors by trade and/or region and generate enquiries
- Supplier/Subcontractor quote comparison
- Adjust estimates by individual items, individual supplier/subcontractor, or against the whole tender
- Flexible quotation production and budget costing by plot or unit
- Estimate details transferred into the Contracts module

#### **3. Job costing**

- Subcontractor and Client self-billing - Itemised Applications, Certificates, and Payments
- Contract Invoicing and cumulative and Non Cumulative documents

- Automated Retentions, Discounts and CIS processing
  - Track transactions and tax payments
  - Purchase Order processing including Plant Hire Tracking
  - Integrated labour timesheets, management of stock movements and cost Accrual recording
  - Transactions posted in batches to the relevant ledgers with no need for rekeying
  - Full drill-down on Contract to subcontractor, supplier, and employee transactions
  - Monitor actual costs against estimated/budget costs
  - Aged application reporting showing monies applied for, certified and paid, by client and/or contract
  - Client and Sub-Contractor Retention tracking and a full suite of User Amendable Reports
  - Access to data via Microsoft Excel for Reporting, Trending & modeling
4. Financial management
- Speed batch entry and foreign currency capability
  - Nominal cost centre and departmental analysis
  - Multi-company consolidated financial reporting and group budgeting capabilities
  - Open or closed period accounting and user-defined trading periods
  - Comprehensive customer records with instant links to their sales orders
  - Credit management tools and automated payments based on early settlement discounts
5. Commercials
- Price books for flexible trading
  - Full or rapid order entry mode and back-to-back sales ordering
  - Suggested order list compilation, based on shortfall and existing orders
  - Margin analysis
6. Managing wages and salaries
- Quick links make less common tasks like recording sickness and maternity much easier
  - Simplified screens and automatic calculations make daily tasks and payroll complexities easier and more efficient
  - Totally secure online submission of your year-end reports

- Salary forecast tool predicts the impact of pay increases, bonuses or overtime plans
- Multi-company and multi-user
- Updates financials with payroll payments

## 7. Contact Relationship Management (CRM)

- Sales force automation for managing, forecasting, and reporting on the entire sales cycle
- Marketing automation for targeting the right customer at the right time
- Customer service automation with real-time access to customer information
- Mobile access via BlackBerry smartphones
- Two-way Outlook integration
- Automate predetermined business rules across all channels, departments, and employees with the automated process workflow

### Benefits:

- **Optimise contract performance.** Provides an effective strategy for contract negotiations, helping to reduce the business risks involved in the delivery of construction projects
- **Manage budgets & costs.** Measure performance against targets throughout the project lifecycle, with planning and budget functionality that allows informed decisions to be made
- **Enhance customer relationships.** Integrated CRM helps keep track of key stakeholders by fully synchronising data between the financial, commercial and CRM software.
- **Integrated control of project variables.** Coordinates the whole business from a single system that links financials, purchasing, contract costing, payroll and subcontractors
- **Estimating.** A simplified solution for processing tenders and quotations which also allows the user to convert estimates into contracts easily.

### 2.8.2 EasyBuild Construction Software

The description features and benefits of this software are provided in this section according to the manufacturers (Easybuild U.K, 2012).

#### Description

EasyBuild is an oracle based suite of application software that addresses the operational requirements of the construction industry. This includes compliance regulations, finance and

project management. It enables users to manage and control a construction project by providing them with complete and instant access to its progress such that they can have real time snapshots of how profitable the project is with full analysis of costs, revenues, liabilities and surveyor adjustments.

It is possible to increase the number of system users upto 5000, due to the scalability and reliability of EasyBuild's underlying platform i.e. Oracle which ensures that the application grows with the business.-

### **Available Features**

#### **1. Modular structure**

- The software has various modules to manage and control the business data.

#### **2. Sophisticated cost-value reconciliation**

- Users can take out real time snapshots of how well their projects are doing. It is also possible to establish how profitable projects are by viewing costs, revenues, subcontractor liabilities and surveyor adjustments in a smart dashboard type environment.

#### **3. Drill-down capabilities**

- The system allows users to go from a high level of information to the most detailed aspect within seconds.

#### **4. Central source of information**

- All information which is key to the organization is stored in one central repository, eliminating departmental islands of information.

#### **5. Security**

- The system uses stringent levels of security to keep data safe.

#### **6. Integration**

- EasyBuild easily integrates with a large number of leading third party software packages such as Document management systems, payment systems and data submission packages.
- EasyBuild's architecture easily allows integration with numerous estimating solutions.

#### **7. Remote Access**



- Subject to security permissions, the full EasyBuild capabilities can be accessed via a simple VPN connection from remote building sites or other office locations

## 8. Multi-Currency

- The system allows users to view financial and project transactions values in local and source currencies.

## Benefits

- **Monitoring profitability.** EasyBuild has a sophisticated Cost/Value Reconciliation (CVR) system that enables project managers to very quickly establish profitability.
- **Cash flow management.** EasyBuild has comprehensive cash flow reporting and financial “snapshot” features that highlight project-wide or organization-wide cash flow problems.
- **One point of access to project costs, revenues, sub-contractor liabilities, valuation adjustments and final account forecasts.** EasyBuild has a sophisticated dashboard style environment that manages this data from one single point of access.

### 2.8.3 Crest Software

The description, features and benefits of this software are provided in this section according to the manufacturers (Easybuild U.K, 2012).

#### Description

Crest Software offers a powerful project management solution within reach of all levels of management. It has a combination of a Planning and Professional version which provides an integrated solution with an intuitive user interface for casual and power users alike.

CS Project Planning is an entry-level project planning tool for planning individual projects of any size.

CS Project Professional has advanced technical specifications which makes it the premier project planning tool for corporate workgroups controlling multiple major projects.

#### Available features

CS Project Planning has the following available features:

- Chart Builder bar chart wizard to assist in creating projects
- Copy and paste to and from MS Excel and other Windows software

- Multi-level undo/redo facility Create To-do list and notes per activity
- Show planned vs actual progress
- Unlimited resource assignments per activity
- Highlight over/under allocation of resources
- Text and graphic annotations can be placed anywhere on barchart/histogram
- Filter, sort and group by any field
- Create quick presentation reports including: bar chart, resource histogram, s-curve, cash-flow
- Use custom colours on bars
- Two way compatibility with CS Project Professional
- Interface to estimating software

CS Project Professional has the following available features in addition to all the features of CS Project Planning:

- Schedule up to 200 concurrent projects and create cross-project links
- User-level security for complete control over access to projects
- Additional views include network diagram, assignment bar chart, and crosstab sheet
- Risk Analysis (Monte Carlo) simulation for costs and dates
- Task/resource code libraries (P3 compatible) for large, complex projects
- Any number of activity and resource user-defined variables
- Bulk field change facility
- Store unlimited number of baselines
- Use CARLO to optimise the resource levelling process
- Use the data exchange facility to share data with any external data source
- Escalate resource costs over time
- Assign resources by either time or effort
- Tabular text and matrix reports

## Benefits

- **Creating a project schedule is simplified.** CS Project allows the user to perform the following tasks in a simple but effective manner:

- Listing the tasks that need to be carried out, either by entering them into the activity spreadsheet or simply by drawing bars on the screen
  - Specifying the sequence in which tasks should occur by linking them with the mouse in the bar chart, pert chart or spreadsheet
  - Specifying who or what is required for each task by dragging a resource from the associated resource spreadsheet and dropping it onto one or more tasks
- **Overview of the Project Schedule.** Once the project schedule has been created, you can at a glance see the following:
- Which tasks affect the Critical Path
  - Which resources are over-allocated
  - When more resources are required to complete a project on time
  - When finances will need to be committed
  - When the project will generate positive cash flow
  - Predicted costs based on resource usage at the defined unit cost
  - If new projects can be undertaken with current resource levels
  - The risk of running over time or budget
- **Critical Path Analysis.** The critical path is automatically calculated for your project, instantly highlighting tasks whose late completion will delay completion of the entire project
- **“What-if” Analysis.** This allows the user to test the effect of resource variations on the project duration or cost e.g. a labour shortage or a continuous increase in labour, material or equipment cost

#### 2.8.4 Microsoft Project

The description, features and benefits of this software are provided in this section according to the manufacturers (Microsoft Corporation, 2013).

MS Project is a software application sold by Microsoft that provides project management tools to manage projects. The program, which has many different versions, allows users to:

- Understand and control project schedules and finances.
- Communicate and present project information.

- Organize work and people to make sure that projects are completed on schedule.

## Description

Microsoft Project is a general project management software program, which is developed and sold by Microsoft Corporation. It is designed to assist a project manager in creating project plans, managing resources effectively, keeping track of work progress, managing budgets, and easing communication and collaboration with others working on the project.

## Available features

MS Project enables users to create budgets based on assignment work and resource rates. It also has features that facilitate and propagate best practices for project work with enterprise templates to improve project management process throughout the entire organization. In addition to active projects, the users can see the activities before initiation as proposals and after project completion as activity plans.

Another useful feature of MS Project is that it enables users to assign cost resources across multiple tasks and projects. Cost resources allow the users to more accurately monitor project financials and synchronize the project with data in their accounting. Additionally, Microsoft Project allows different classes of users to be implemented. These different classes of users can be configured to have different access levels to projects, views, and other data.

## Benefits

- **Enables users to stay organized.** MS Project enables users to easily plan and manage their projects. By so doing, it makes it possible for them to know how their tasks come together and identify which tasks are the most critical to their project's success and thus making it easy to quickly share project details with their team, keeping everyone connected and organized.
- **Improves everyday collaboration.** MS Project also enables users to work seamlessly with others to effectively track status and manage changes. This makes it possible to quickly deliver project information to their teams and help them see and amend potential problems before they can impact their schedules.
- **Effectively manage resources.** MS Project enables users to accurately measure resource allocation and manage allocation better to align with the organization's strategy.

## **2.9 Summary**

The construction industry world-wide is notoriously slow for adopting new software technology. The general trend is that there is a linkage between the growth of construction firms and the need for construction-specific project management software. The question is whether a similar trend is followed in the Kenyan construction industry and hence the need to investigate the extent of use of construction management software amongst the leading construction firms arises.

Previous studies in other countries have provided useful information about the usage of ICT in their construction industries, how they have benefited and some of the challenges that have hindered adaptation of ICT. Previous research in Kenya has also provided some useful information about the usage of ICT in the Kenyan construction industry but little is known as to whether software tools are being used to aid the construction project management process and also, what challenges construction firms encounter that hinder the successful adoption of these softwares. There is therefore need to investigate these issues.

There is need to adopt modern construction management software and especially because research has shown improvements in the construction management process can minimize delays and poor planning which is prevalent among construction projects in Kenya. Training challenges in the construction industry also exist and research indicates that there is a significant lag between technology being available and technology being taught in curriculum.

There are numerous benefits offered by modern construction management software tools and examples can be seen of some leading construction management software products that are in use world-wide.

## **Chapter 3: RESEARCH METHODOLOGY**

### **3.1 Introduction**

This study is a survey that aims to establish whether construction firms in Kenya use construction management software to manage their construction projects.

The specific objectives of the study are:

- To establish the extent of use of construction management software amongst the construction firms in Kenya.
- To identify the most widely used construction management software
- To determine the benefits of using these softwares to the construction firms.
- To identify the challenges that construction firms experience in using construction management software.

This chapter describes the procedures that have been followed in conducting the study. It gives details of the research method used and how the techniques of obtaining data were developed.

### **3.2 Research Method**

According to Mugenda and Mugenda (1999), a survey is an attempt to collect data from members of a population in order to determine the current status of that population with respect to one or more variables. Cooper and Schindler (2003) state that surveys (statistical studies) are designed for breadth rather than depth. They attempt to capture a population's characteristics by making inferences from a sample's characteristics. Hypotheses are tested quantitatively and generalizations about findings are presented based on the representativeness of the sample and the validity of the design.

The type of research method preferred for this study was a survey and it was deemed to be a good choice because the investigative questions called for information to be obtained from hard-to-reach respondents since most of the people involved in construction project management work at the construction sites and are quite busy and very mobile. This being a novel area of research also makes this particular research method appropriate because it involves collecting original data from the respondents. It was also a desirable approach because no treatment or control was introduced on the way the construction firms managed their business activities.

Validity refers to the extent to which a test measures what we actually wish to measure (Cooper and Schindler, 2003). The form of validity adopted in this case was content validity. The content validity of a measuring instrument is the extent to which it provides adequate coverage of the investigative questions guiding the study. If the instrument contains a representative sample of the universe of subject matter of interest, then content validity is good. Determination of content validity in this case was determined through a logical process of carefully reviewing the topic of concern, then coming up with the items to be scaled in the measuring instrument i.e. the questionnaire, and the scales to be used.

### **3.3 Population and Sample**

According to Cooper and Schindler (2003), the basic idea of sampling is that by selecting some of the elements in a population, we may draw conclusions about the entire population. A population element is the subject on which the measurement is being taken and is the unit of study. A population is the total collection of elements about which we wish to make some inferences (Cooper & Schindler, 2003). In this case, the population is made up of all registered construction firms in Kenya that deal with construction of buildings.

The target population in the study was further limited to construction firms registered and operating in Nairobi, Kenya. This is because Nairobi has the largest share of building projects, amounting to over 70% of the national total output (Oketch, 2004) and therefore most construction firms in the country are based there. Nairobi is also a favorable area of study due to resource constraints while conducting the survey, especially on time and finances.

The target population data was obtained from construction firms in Nairobi registered in the Ministry of Public Works Register of Contractors under categories A and B. These two categories were chosen because they are of the appropriate size of construction firms that are more likely to utilize construction management softwares since the value and volume of work they undertake is much higher, such that they can better afford to purchase these softwares compared to much smaller firms.

The sampling frame is closely related to the population and is the list of elements from which the sample is actually drawn (Cooper & Schindler, 2003). The sampling frame used was obtained from the list of registered contractors published by the Ministry of Public Works in Categories A and B of Building Works (General Building) as at May 2012. This was because it was the most

currently available data on registered construction firms as at the time of conducting the research survey. It is important to note that the mandate of registering all construction firms in the country was given to the National Construction Authority under the National Construction Authority Act of 2011. However, the exercise of vetting, registering and preparing a new list of contractors by the National Construction Authority was ongoing during the time period that the survey was being conducted, thus the use of the May 2012 list of registered contractors by the Ministry of Public Works was the only option.

In conducting a scientific research, the sample size must be large enough to represent the salient characteristics of the target population. Generally, the sample size depends on factors such as the number of variables in the study, the type of research design, the method of data analysis and the size of the accessible population (Mugenda & Mugenda, 1999). Gay (1981) suggests that for correlational research, 30 cases or more are required; for descriptive studies, ten percent of the accessible population is enough and for experimental studies, at least 30 cases are required per group.

For the purposes of this study, the entire population of 120 construction firms listed in Categories A and B of Building Works (General Building) and which are based in Nairobi, in the Ministry of Public Works register as at May 2012, was sampled because it was deemed to be accessible and the number was manageable.

The number of construction firms that were listed under each category was as shown below in Table 1.

**Table 1: No. of Registered Contractors in Categories A and B**

<b>Class of Registration</b>	<b>Total No. of General Building Contractors</b>	<b>No. of General Building Contractors based in Nairobi</b>
A	68	57
B	82	63

**Source: Ministry of Public Works Register of Contractors as at May 2012**



### **3.4 Data Collection**

According to Mugenda & Mugenda (2003, p.71), questionnaires are commonly used to obtain important information about the population. For the purposes of this study, the use of questionnaires was chosen as the most appropriate instrument with which to collect the necessary information because they are easier to administer and are economical to use in terms of time and money. The data was thus collected from the sampled construction firms using questionnaires which contained structured or closed-ended questions. These are a type of questions which are accompanied by a list of all possible alternatives from which respondents select the answer that best describes their situation (Mugenda & Mugenda 2003, p.72). The questions covered usage of construction management software, benefits derived from these software and challenges that the construction firms encounter in adopting them. The questionnaires were sent by email or hand delivery to the construction firms after identifying suitable respondents who in this case, were the staff members responsible for managing their firms' construction business activities.

The procedure used was as follows:

1. Establishing contact with the construction firms using telephone contacts provided in the register and explaining to them about the research.
2. Identifying suitable respondents.
3. Delivering the questionnaire either by hand delivery or through email.
4. Allowing the respondents about one week to complete the instrument.
5. Collecting the questionnaire or making follow-up via email where necessary.

The questionnaires used are shown in Appendix 1. A letter of introduction from the University of Nairobi was also given to the interviewees as shown in Appendix 2. This letter explained the purpose of the study and also gave an assurance of confidentiality in order to make the respondents aware of the purpose of the study for them to co-operate.

In order to make sure that the instrument used to capture the data was effective for the purpose, a pilot study was done whereby the questionnaire was initially administered to 5 construction firms. The responses from these firms were then evaluated to check whether the information required was captured appropriately. In this case, it was found that the questions were appropriate and easily understood since the respondents did not experience any difficulties in completing the questionnaires and they were able to provide the required information accurately. The purpose of pre-testing the instrument is to ensure that items in the instrument are stated clearly and have the same meaning to all respondents (Mugenda & Mugenda 2003, p.186). This

serves to ensure the reliability of the instrument. Reliability is concerned with estimates of the degree to which a measurement is free of random or unstable error.

### **3.5 Data Analysis**

The data collected was analyzed using statistical analysis software, in this case SPSS version 16.0. Descriptive statistics were then obtained from the data.

The statistical techniques commonly used for data analysis are the use of frequency tables and pie charts. Frequency tables array data from highest to lowest values with counts and percentages. They are most useful for inspecting the range of responses and their repeated occurrence. Pie charts are appropriate for relative comparisons of nominal data. In this case, the use of frequency tables has been adopted because it is more appropriate for the data analysis.

Having detailed the hypotheses in chapter 1 section 1.5, the purpose of hypothesis testing is to determine the accuracy of these hypotheses due to the fact that a sample of data was collected, not a census. The accuracy of hypotheses was evaluated by determining the statistical likelihood that the data reveal true differences, not random sampling error. Following the sampling-theory approach, we accept or reject a hypothesis on the basis of sampling information alone. Since it is expected that any sample will most likely vary to some extent from its population, an assessment is made as to whether these differences are statistically significant or insignificant. A difference has statistical significance if there is good reason to believe the difference does not represent random sampling fluctuations only.

To test a hypothesis, an appropriate statistical test must be chosen. In this case, a two-tailed test or non directional test was selected as it was deemed to be the most appropriate and accurate for the data. A significance test level of 0.01 was chosen and applied in testing the hypothesis using correlation procedure.

## Chapter 4: DATA ANALYSIS AND RESULTS

### 4.1 Introduction

In this chapter, an analysis of the data that was collected from the construction firms is presented. The results of this analysis are then used to explain the findings from the survey. The hypothesis that poor project management amongst construction firms in Kenya can be attributed *inter alia* to insignificant usage of construction management software is also tested.

Out of the 120 construction firms that were listed under Categories A and B in the Ministry of Public Works Register of Contractors as at May 2012 and are based in Nairobi, 46 were effectively contacted for the purposes of conducting the survey. The other respondents were not contacted because of difficulties in obtaining their current contacts (details of their phone numbers, emails or physical locations). In a large number of those cases, the phone numbers that were listed in the register were not functional and there were no alternative sources of this information, not even websites. In other cases, there were no phone numbers listed in the register. The phone numbers were necessary in making the initial contacts because many construction firms do not allow strangers in their premises without prior appointments due to security and safety concerns. In view of this, the number of respondents was significantly reduced but sufficient for the purposes of data analysis.

### 4.2 Response Rate

Out of the 46 construction firms that were contacted, 5 firms indicated that they were no longer involved in building construction activities and 6 firms declined to participate in the survey. The questionnaires were therefore administered to 35 construction firms out of which, 30 firms duly completed and returned the questionnaires.

The response rate from the construction firms that participated in the survey was as shown in the Table 2 below:

**Table 2: Response rate from the survey**

Category of Registration	No. of construction firms contacted	No. of construction firms that responded	% Response
A	23	16	69.6
B	23	14	60.9
<b>Total</b>	<b>46</b>	<b>30</b>	<b>65.2</b>

Source: Own Survey 2013

According to Mugenda & Mugenda (2003, p.83), a response rate of 50% is adequate for analysis and reporting. A response rate of 60% is good and a response rate of 70% and over is very good. Thus, the response rate obtained in this survey is good as can be inferred from Table 2. However, this required a lot of follow-ups, through making several phone calls, sending reminder emails or physical visits to the respondents in their offices or construction sites where some of them were working. The 30 questionnaires that were filled and returned were adequate for the purposes of data analysis as explained previously in section 3.3.

### 4.3 Data Analysis and Findings

The analysis of the various variables, the relationships between them, and the findings are discussed in this section.

**4.3.1 Years in construction business.** When the respondents were asked how many years their construction firms have been in operation, 3.3% of the respondents stated that they had been in operation between 1 – 5 years while 10% had been operating for the last 6 – 10 years and 86.7% for over 10 years as shown in Table 3. The results therefore show that majority of the construction firms that were surveyed i.e. 86.7% have been in business for more than 10 years. This means that the findings reflect what has been happening in mature construction businesses over the past several years and also indicates that the information can be relied upon to make useful conclusions about the construction industry.

**Table 3: Years in Construction Business**

	Frequency	Percent	Cumulative Percent
Valid 1-5	1	3.3	3.3
6-10	3	10.0	13.3
More than 10	26	86.7	100.0
Total	30	100.0	

Source: Own Survey 2013

**4.3.2 Position in the firm.** The majority of the respondents were Quantity Surveyors (31.0%) followed by Directors (24.1%) as shown in table 4 below. This shows that Quantity Surveyors form the largest group of professionals that are involved in construction project management in the various construction firms. This suggests that any efforts that are geared towards raising awareness about the importance of using construction management software to improve the efficiency and effectiveness of managing construction projects in this country should largely be addressed to this group of professionals.

**Table 4: Position in the Firm**

	Frequency	Percent	Valid Percent	Cumulative Percent
Valid Project Engineer	1	3.3	3.4	3.4
Estimator	3	10.0	10.3	13.8
Director	7	23.3	24.1	37.9
Project Manager	5	16.7	17.2	55.2
Construction Foreman	2	6.7	6.9	62.1
Quantity Surveyor	9	30.0	31.0	93.1
Site Agent	1	3.3	3.4	96.6
Project Coordinator	1	3.3	3.4	100.0
Total	29	96.7	100.0	
Missing No answer	1	3.3		
Total	30	100.0		

Source: Own Survey 2013

**4.3.3 Average annual turnover.** Majority (44.4%) of the construction firms that were surveyed and agreed to give the figure for their average annual turnover had an average turnover of between Kshs 100 and 500 million, followed by 22.2% with an average annual turnover of between Kshs 501 and Kshs 999 million as shown in Table 5. This information paints a picture of the amount of revenues earned by majority of the construction firms in Class A and B.

**Table 5: Annual Turnover**

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	< 100 million	2	6.7	7.4	7.4
	100-500 million	12	40.0	44.4	51.9
	501-999 million	6	20.0	22.2	74.1
	1-5 billion	5	16.7	18.5	92.6
	> 5 billion	2	6.7	7.4	100.0
	Total	27	90.0	100.0	
Missing	No answer	3	10.0		
Total		30	100.0		

**Source: Own Survey 2013**

**4.3.4 Usage of Construction Management Software.** 76.7% of the construction firms indicated that they used construction management software to manage their construction projects whereas 23.3% of them did not use any software as shown in table 5 below. This shows a high rate of adoption of construction management software as a useful tool in the management of construction projects by the Kenyan construction firms. It is consistent with the information provided in the literature review which states that the need to adopt construction management software in the construction industry arises because it is a useful tool to manage information (Durst, 2010)

**Table 6: Usage of Construction Management Software**

		Frequency	Percent	Cumulative Percent
Valid	Yes	23	76.7	76.7
	No	7	23.3	100.0
	Total	30	100.0	

Source: Own Survey 2013

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**4.3.5 Most Widely Used Construction Management Software.** MS Project was found to be the most widely used construction management software (95.7% of all cases) as shown in Table 7. All the other softwares had only a single incidence of occurrence. This shows that most of the construction firms either do not recognize the value of these other construction management softwares or they are not aware of them and their benefits. However, this finding is consistent with the claim by Durst (2010) that the construction industry is notoriously slow for adopting new software technology and that software providers must do a great job of demonstrating the value a product can bring to a contractor and how that value translates into profits before they can adopt them.

**Table 7: Softwares Used**

		Responses		
		N	Percent	Percent of Cases
softwares used	Ms Project	22	73.3%	95.7%
	Tetra Reports	1	3.3%	4.3%
	CLJ	1	3.3%	4.3%
	Construction Computer Software (CCS)	1	3.3%	4.3%
	Prima Vera	1	3.3%	4.3%
	Inhouse Developed System for Inventory Mgt	1	3.3%	4.3%
	Inhouse Developed System for Payroll Processing	1	3.3%	4.3%
	Digital Books ERP	1	3.3%	4.3%
	Scala ERP	1	3.3%	4.3%
	Total	30	100.0%	

**Source: Own Survey 2013**

**4.3.6 Integrated System Versus Disparate System.** In the cases where the construction firms were using construction management software, 87% of them had disparate systems and only 13 % had integrated systems in place as shown in Table 8 below. This again demonstrates the reluctance to invest in the more extensive and beneficial integrated systems which can be explained by the same reasons as mentioned in section 4.3.5 above. It shows that usage of integrated construction management systems amongst the leading construction firms in Kenya is quite low. This brings into question the quality of construction project management in the country given that such systems are meant to enable project managers to be more efficient in performing their tasks while at the same time enabling the various workers participating in the construction project to work collaboratively thereby reducing errors and improving productivity.



**Table 8: Types of Software Systems Used**

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Integrated	3	10.0	13.0	13.0
	Disparate	20	66.7	87.0	100.0
	Total	23	76.7	100.0	
Missing	N/A	7	23.3		
Total		30	100.0		

Source: Own Survey 2013

**4.3.7 Benefits Of Using Construction Management Software.** These benefits were illustrated in section 2.6 of the literature review section. 100% of the respondents using construction management software cited ease of planning construction activities as the most significant benefit of using construction management software. This was followed by schedule labour and equipment with ease (78.3%) whereas the other benefits were less important as shown in Table 9 below. This shows that the construction firms view ease of planning construction activities as being the most important benefit of using construction management software.

**Table 9: Software Benefits**

		Responses		
		N	Percent	Percent of Cases
software benefits	Ensure Accurate Estimates	11	13.9%	47.8%
	Schedule Labour and Equipment with Ease	18	22.8%	78.3%
	Simplify Document Management	9	11.4%	39.1%
	Reduce the complexity of HR issues	7	8.9%	30.4%
	Increase of Profit with Less Risk	11	13.9%	47.8%
	Ease of Planning Construction Activities	23	29.1%	100.0%
	Total	79	100.0%	

Source: Own Survey 2013

#### 4.3.8 Components of Construction Project Management Process In Which The Usage Of Construction Management Software Is Most Useful.

21 of the respondents cited project planning as the most useful component for which they find the usage of construction management software to be useful. This represents 91.3% of all cases where these softwares were being used. Procurement came second at 78.3% as shown in Table 10 below. The varying levels of the importance that the respondents gave to the different components could be a reflection of the order of priority given by construction firms to the computerization of their project management process. This suggests that when they adopt construction management software that is stand-alone rather than an integrated system, they will first consider computerizing the project planning then the rest of the components in the order of importance as indicated in the table. This is consistent with the findings in section 4.3.5 whereby MS-Project, a tool largely used for project planning, is the most widely used software.

**Table 10: Components of the Project Management Process**

		Responses		
		N	Percent	Percent of Cases
useful components	Financial Management	5	5.6%	21.7%
	Estimating costs	9	10.0%	39.1%
	Actual job costing	6	6.7%	26.1%
	Managing Change Orders	6	6.7%	26.1%
	Payroll processing	4	4.4%	17.4%
	Equipment management/Resource scheduling	11	12.2%	47.8%
	Procurement	18	20.0%	78.3%
	Sub-contract management	10	11.1%	43.5%
	Project planning	21	23.3%	91.3%
	Total	90	100.0%	

Source: Own Survey 2013

**4.3.9 Challenges Of Adopting Construction Management Software.** 20 of the respondents (66.7% of cases) cited both lack of information about these softwares and lack of personnel having adequate working knowledge and familiarity with these softwares as being the most significant challenges in adopting construction management software. This was followed by cost of the software and lack of a structured approach in their firms for planning construction activities both being cited in 40% of the cases as shown in Table 11 below.

**Table 11: Challenges of Adopting Construction Management Software**

		Responses		
		N	Percent	Percent of Cases
software challenges	Cost of the software	12	14.1%	40.0%
	Lack of enough work to justify the use of such software	4	4.7%	13.3%
	Lack of information about these softwares	20	23.5%	66.7%
	Lack of personnel having adequate working knowledge and familiarity with these softwares.	20	23.5%	66.7%
	Lack of appropriate software in the local market	4	4.7%	13.3%
	Poor support from software vendors	5	5.9%	16.7%
	Difficulty in customizing the software	8	9.4%	26.7%
	Lack of a structured approach in your firm for planning construction activities	12	14.1%	40.0%
	Total	85	100.0%	

**Source: Own Survey 2013**

Some of these challenges are similar to those investigated by Mbugua (1996) as illustrated in section 2.2 of the literature review and relate to challenges that hinder adoption of software applications in general whereas others have been added which are more specific to construction management software in particular.

Thus, the results suggest that very little effort has been made so far towards raising the awareness of local construction firms regarding the existence and benefits of a variety of modern construction management softwares and providing them with adequate information about this.

It also raises concern about the training of personnel for the construction industry and especially the development of skills for people that are engaged in managing construction projects. This coupled with the lack of a structured approach in the construction firms for planning construction activities suggests that more emphasis should be employed to proper training and development of manpower who are involved in construction project management such that they are more exposed and better equipped to use modern software tools in their work. This finding also confirms the study by Dindi (2010) which found that there is a significant lag between technology being available and technology being taught in curriculum.

#### **4.4 Correlations**

The correlation technique is used to analyze the degree of relationship between two variables. Correlational analysis examines how various variables are related. Determining the strength and directions of the association between two variables is important as a basis for selecting variables for further statistical analysis e.g. regression analysis. Although a correlation coefficient indicates the relationship between two variables, it does not imply any causal relationship between the variables (Mugenda & Mugenda, 2003).

The computation of a correlation coefficient yields a statistic that ranges from -1 to +1. This statistic is called a correlation coefficient ( $r$ ). The correlation coefficient provides information about the magnitude of the relationship between the two variables and the direction of the relationship.

In this survey, an attempt was made to further investigate whether there was any meaningful relationship between the level of usage of construction management software in the construction firms and their annual turnover, and also the duration of time that these firms have been in business.

The three relevant variables were correlated and their relationships investigated for any significance. These variables were as follows: years in construction business, annual turnover and usage of construction management software. They were chosen as control variables because they were the most appropriate variables that could be useful in revealing any meaningful information that would help in understanding the study better i.e. they could be used to find a statistically significant relationship. The analyzed correlation data is shown in Table 12.

**Table 12: Correlations**

		Years in Construction business	Annual turnover	Usage of Construction Management Software
Years in Construction business	Pearson Correlation	1.000	.327	.029
	Sig. (2-tailed)		.096	.879
	N	30.000	27	30
Annual turnover	Pearson Correlation	.327	1.000	-.286
	Sig. (2-tailed)	.096		.149
	N	27	27.000	27
Usage of Construction Management Software	Pearson Correlation	.029	-.286	1.000
	Sig. (2-tailed)	.879	.149	
	N	30	27	30.000

**Source: Own Survey 2013**

The two variables years in construction business and annual turnover are correlated with a coefficient of 0.327 and have a positive relationship. This shows that those construction firms that have been in business for longer periods of time tend to have a larger annual turnover which is what would be generally expected to happen.

The variables years in construction business and usage of construction management software are correlated with a coefficient of 0.029 and have a positive relationship. This shows that those construction firms which have been in business for longer periods of time have a higher usage of construction management software. This can be attributed to the fact that they are more likely to have realized the need for such software because they have more experience in managing construction projects. However, this relationship is not very strong as demonstrated by the low correlation coefficient and could probably suggest that some of the younger firms have embraced the use of software tools much faster than expected.

The two variables annual turnover and usage of construction management software have a low negative correlation coefficient (-0.286). This suggests that the adoption of these softwares is probably influenced by other factors rather than turnover e.g. the age of the directors with younger ones being open to ICT tools compared to older ones who tend to be more conservative and dominate many large firms.

## 4.5 Hypothesis Testing

**The Null Hypothesis:** Poor project management amongst construction firms in Kenya can be attributed *inter alia* to insignificant usage of construction management software.

**The Alternative Hypothesis:** Poor project management amongst construction firms in Kenya cannot be attributed to insignificant usage of construction management software.

### 4.4.1 Test of significance of the correlation coefficient

**Table 13: Test of Hypothesis**

**Correlations**

		Number of Construction Firms	Usage of Construction Management Software
Number of Construction Firms	Pearson Correlation	1.000	.487**
	Sig. (2-tailed)		.006
	N	30.000	30
Usage of Construction Management Software	Pearson Correlation	.487**	1.000
	Sig. (2-tailed)	.006	
	N	30	30.000

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

**Source: Own Survey 2013**

The computed correlation coefficient between the number of construction firms and their usage of construction management software is 0.487 as shown in Table 14 above. Using SPSS as the statistical analysis software, it has been established that at a level of significance or confidence level of 0.01, the correlation coefficient is significant hence we reject the null hypothesis and accept the alternative hypothesis which states that poor project management amongst construction firms in Kenya cannot be attributed to insignificant usage of construction management software.

## **Chapter 5: CONCLUSIONS**

### **5.1 Introduction**

In this chapter, conclusions are made from the findings of the survey regarding the prevalence of the use of construction management software in managing building projects amongst construction firms in Kenya. The survey focused on whether the construction firms are using construction management software to manage their construction projects, the identity of the softwares used and benefits that the firms derive from them. It also looked at the challenges that the construction firms experienced in adopting the usage of such software.

### **5.2 Conclusions**

The findings show that majority of the large construction firms were indeed using construction management software to manage their construction projects. It was however, noted that MS Project was the most predominantly used software, compared to the others. Given that MS Project is largely a general project management software which, though useful for managing construction projects, is not specifically designed for the construction industry leads to the conclusion that the uptake of construction industry specific software products is very low amongst the Kenyan construction firms. This conclusion, coupled with the reluctance to invest in the more extensive and beneficial integrated systems as is evident from the findings, is what is preventing the construction firms from getting the full benefits of using construction management software to improve the quality of the entire construction project management process. The result of this is that their ability to delivery completed projects on time is compromised which in turn lowers their competitive advantage in the market as is evident from the claims made by some of their clients.

The second conclusion is that the most significant benefits of using construction management software to the construction firms were ease of planning construction activities and scheduling labour and equipment with ease.

Lastly, the lack of information about construction management softwares coupled with lack of personnel having adequate working knowledge and familiarity with these softwares are the major challenges that hinder the adoption of construction management software amongst the construction firms.



### **5.3 Recommendations**

In order to improve the quality of construction project management within the Kenyan construction industry, there is need to raise awareness of the various players involved in the management of construction projects about the existence and importance of construction industry specific software products that can enable them perform better in their work. This can be done by aggressively promoting the adoption and extensive use of these modern construction management software tools by local construction firms. Awareness of these tools and their benefits can be raised in professional forums attended by those who are involved in managing construction projects and these professionals could then escalate this knowledge to the top management of the firms where they work. These professional forums include those organized by IQSK, AAK, and IEK. In addition, the National Construction Authority could also advocate for construction firms to consider training their staff in this area as part of their continuous professional development programme.

Another recommendation is for universities and tertiary institutions that are involved in the training of manpower for the construction industry and especially those who get involved in the management of construction projects such as architects, quantity surveyors, engineers, construction project managers, etc to incorporate the imparting of skills in the usage of construction management software in their curriculum. This will lead to improvement in the efficiency of the management of construction projects.

### **5.4 Suggested Areas of Further Study**

In chapter 2 of this research, it was noted that everywhere in the world, the construction industry is notoriously slow for adopting new software technology. This is because software providers have to do a great job of demonstrating the value a product can bring to a contractor and how that value translates into profits before they can be persuaded to adopt the new technology.

In the case of the Kenyan construction firms, I would suggest that further research be done on whether usage of the industry specific construction management softwares to manage construction projects does actually lead to increased customer satisfaction and better profitability for the construction firms.

The results of such a study can then be used to better convince local construction firms on the need to invest in such software.

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# APPENDIX I: QUESTIONNAIRE

*TOPIC: AN INVESTIGATION INTO THE USE OF CONSTRUCTION MANAGEMENT SOFTWARES: A SURVEY OF CONSTRUCTION FIRMS IN NAIROBI, KENYA.*

## **DECLARATION:**

ANSWERS TO QUESTIONS CONTAINED IN THIS QUESTIONNAIRE SHALL BE TREATED AS CONFIDENTIAL.

Your assistance in the completion of this questionnaire will be highly appreciated.

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Name of Construction Firm: .....

Category: .....

Date: ...../...../.....

Questionnaire No. : .....

## INSTRUCTIONS:

Please indicate with a tick ( ✓ ) the appropriate answer and give reasons or explanations where necessary.

### PART 1

1	DETAILS OF THE CONSTRUCTION FIRM	Fill in this column
A	How long has your firm been in the construction business? (Please tick as <b>appropriate</b> )	
	1. 1 – 5 years	
	2. 5 – 10 years	
	3. More than 10 years	
B	What is your position in this firm?	
C	What is your firm's average annual turnover?	

### PART 2

2	USAGE OF CONSTRUCTION MANAGEMENT SOFTWARE	Fill in this column
A	Does your firm use any software that is specifically designed for Construction Management in order to manage its projects? (Please tick as <b>appropriate</b> )	
	1. No	
	2. Yes	
B	If the answer to the previous question is No, please proceed to Part 4.	
C	If the answer to the previous question is Yes, which softwares are used?	
	Software No.1:	
	Software No.2:	
	Software No.3:	
	Software No.4:	
	Software No.5:	
D	Are these softwares part of an integrated system or is it a disparate system? (Please tick as appropriate) <i>An integrated system incorporates several business processes together whereas a disparate system has different stand alone software that have no relationship with each other</i>	
	1. Integrated system	
	2. Disparate system	

**PART 3: BENEFITS**

3	<b>BENEFITS OF USING CONSTRUCTION MANAGEMENT SOFTWARE</b>	<b>Fill in this column</b>
A	<b>What are the benefits that your firm experiences in using the softwares identified in section 2B? (Please tick as appropriate)</b>	
	1. <b>Ensure Accurate Estimates</b>	
	2. <b>Schedule Labor and Equipment with Ease</b>	
	3. <b>Simplify Document Management</b>	
	4. <b>Reduce the Complexity of HR Issues</b>	
	5. <b>Increase of Profit with Less Risk</b>	
	6. <b>Ease of Planning Construction activities.</b>	
	7. <b>Any Other Benefits.(Please specify)</b>	
B	<b>In which component of the construction project management process do you find the usage of these softwares most useful? (Please tick as appropriate)</b>	
	1. <b>Financial management (Including billings, revenue recognition,etc)</b>	
	2. <b>Estimating costs</b>	
	3. <b>Actual Job Costing</b>	
	4. <b>Managing Change Orders</b>	
	5. <b>Payroll Processing</b>	
	6. <b>Equipment Management</b>	
	7. <b>Procurement</b>	
	8. <b>Sub-contract management</b>	/
	9. <b>Project planning</b>	
	10. <b>Other (please specify)</b>	

**PART 4: CHALLENGES**

4	CHALLENGES OF ADOPTING CONSTRUCTION MANAGEMENT SOFTWARE.	Fill in this column
A	What are the challenges that your firm experiences in adopting the usage of construction management software? (Please tick as appropriate)	
	1. Cost of the software.	
	2. Lack of enough work to justify the use of such software.	
	3. Lack of information about these softwares.	
	4. Lack of personnel having adequate working knowledge and familiarity with these softwares.	
	5. Lack of appropriate software in the local market.	
	6. Poor support from the software vendors.	
	7. Difficulty in customizing the software	
	8. Lack of a structured approach in your firm for planning construction activities.	
	9. Other challenges. (Please specify)	

# APPENDIX 2: UNIVERSITY LETTER



UNIVERSITY OF NAIROBI  
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19 March 2013

TO WHOM IT MAY CONCERN

Dear Sir/Madam

RE: ALEX WAIHARO KINUTHIA - B50/03653/2010

This is to certify that the above named is a student in the Department of Real Estate and Construction Management pursuing a MA in Construction Management

He is carrying out research project on "The Role of Construction Management Software in Managing Building Projects: A Case Study of Construction Firms in Nairobi Kenya", in partial fulfillment of the requirements of the degree programme

The purpose of this letter is to request you to allow him access to any kind of material he may require to complete his research. The information will be used for research purposes only

Mary Kimani, PhD, MBS  
Chair & Senior Lecturer  
Dept. of Real Estate and Construction Management

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