FACTORS AFFECTING THE ADOPTION OF ICT IN BUILDING AND CONSTRUCTION PROJECTS IN NAIROBI COUNTY

BY

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DECLARATION

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

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DEDICATION
This research project is dedicated to my parents Mr. and Mrs. Njue, siblings Frank and Felix, and son Shalom for the love, inspiration, support and prayers throughout my M.B.A program. God bless you.
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<tr>
<td>ICT</td>
<td>Information Communication Technology</td>
</tr>
<tr>
<td>ICPM</td>
<td>Internet based construction project management</td>
</tr>
<tr>
<td>IT</td>
<td>Information Technology</td>
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<tr>
<td>IS</td>
<td>Information System</td>
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<td>SME</td>
<td>Small Medium Enterprise</td>
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ABSTRACT

The construction industry has to cope with a highly complex, fragmented and unique combination of business relationships and processes. This is because most construction projects involve many phases such as feasibility, design, construction and maintenance. There has been constant complains by various shareholders of inefficient workmanship in the building and construction industry, many collapsed buildings, unfinished construction building due to defect and poor management of projects. This calls for incorporation of appropriate ICT tools so as to change the disturbing trend of project outcome. The researcher aimed at looking at factors affecting adoption of ICT in construction and building projects by looking at factors such as training of employees, cost / benefits, management commitment and project size. The benefits of ICT adoption are primarily perception based and not quantifiable and these perceived benefits define the extent of ICT adoption in building and construction industry. The study took into account the views of other researchers who studied the topic in other countries such as Malaysia, Sweden, European Union and Nigeria as well as their conclusions. This study employed descriptive research design with a target population of 140 registered contractors who fell under category A of registered contractors in Nairobi County. The researcher employed simple random technique by taking 30% of the entire population and used Random sampling to come up with the companies that were involved in the research. Data was collected by use of a close ended questionnaire which was self administered as well as sent electronically. Collected data was analyzed using descriptive and inferential statistics and then presented using statistical and graphical techniques. Based on the findings, it can be concluded that the registered contractors in the building and construction projects have adopted ICT. However, not all project participants have fully adopted ICT with project managers using it more frequently as compared to the project supervisors undertaking the same projects. The factors highlighted by the researcher as affecting the adoption of ICT play a key role in its adoption. The study will help the top management of various projects to realize the importance of ICT adoption in the efficiency of management in the building and construction projects by putting into consideration and improving on the factors discussed in this research work among other factors that may affect the adoption of ICT in the building and construction projects. Future researchers in the same field may also use this study for references to facilitate their study.
CHAPTER ONE

INTRODUCTION

This chapter outlined the background of the study, industry composition, benefits of ICT in building and construction industry and challenges faced by the industry. The statement of the problem was also stated in this chapter as well as the general and specific objectives and research questions. The researcher also highlighted the significance of the study, anticipated limitations and the scope of the study.

1.1 Background information

The construction industry has to cope with a highly complex, fragmented and unique combination of business relationships and processes. This is because most construction projects involve many phases such as feasibility, design, construction and maintenance. Each phase requires effective communication of underlying knowledge and coordination between many project participants such as the owner, contractor, designer, consultant, subcontractors, and suppliers. This may lead to timing and technical content communication-transfer problems – each project is unique in its construction type, location and project participants. Traditional construction management approaches have been criticized as not improving construction productivity within this turbulent environment (Latham, 1994).

1.1.1 Industry Composition:

Construction projects require effective collaboration and coordination among the diverse project participants. It can be achieved by effective communication between all the project participants. Such co-ordination and effective communication is crucial in order to achieve quality standards and to reduce the cost of production effectively (Villagarcia and Cardoso, 1999).

Construction projects are managed by designated project managers, architects, or contractors on behalf of the client or by the clients themselves depending upon the contract and the project type. Effective communication is important to monitor and control projects' activities
according to the project plans and for achieving project goals. Thus, the effectiveness of the project manager to communicate, evaluate, and feedback to the rest of the project team during each stage of the project life-cycle determines how efficiently a project's goals will be achieved (Alshawi and Ingirige, 2002).

### 1.1.2 Benefits of ICT in Building Construction Project

To maximize the use of ICT in construction contracts it needs to become common practice throughout the industry. The use of ICT can impact on the traditional processes of organization in construction and result in change in organizational processes, working methods and culture (Ruikar et al., 2005). In this regard, some benefits of ICT critical to the performance of the construction industry are to reduce the time for data processing and communicating information, as well as to improve communications for effective decision-making and coordination among construction participants (Peansupap & Walker, 2005) to enhance construction productivity (Liston et al., 2000). This is possible because the Internet-based tools of ICT allow communication between even remote users and enables them to share files, comment on changes and post requests for information (De Lapp et al., 2004).

Communication or data handling often takes about 75-90 percent of project managers' time in the construction industry (Fisher and Li Yin, 1992; Alshawi and Ingirige, 2002). Information communication technology (ICT) is required not only to free up project managers for more decision-making tasks but also to deliver the required levels of “consistency and reliability” of information in the construction supply chains because use of incorrect or incomplete data can compromise the scheduled completion of a project and lead to wastage of resources (Sturges and Bates, 2001). Multi-enterprise scenario of construction projects requires collaborative use of ICT by all the project team organizations, i.e. extent of ICT adoption for managing a project is to be planned before the start of the project, leading to uniform ICT adoption by all the project team organizations.
1.1.3 Challenges faced by Building Construction Projects in ICT adoption

In Kenya, experts have once again floated theories to explain what could have been the cause of buildings that collapsed in Kisii, Nairobi, Mombasa and Kisumu killing people but nothing will be evident than one factor, corruption and shoddy architectural work by the architects that designed and oversaw the construction of the collapsed buildings. According to the experts, this can be solved by adopting a system that guarantees efficiency for developers and builders. Also, the Architectural Association of Kenya (AAK) should help public sector organizations develop systems that will better recognize and identify opportunities for corruption and assist them to act effectively when corruption occurs. This was according to a report on ‘Deal with graft to curb collapsed buildings by Awino – an IT expert attached to an architectural Firm.

1.2 Statement of the problem.

The unique and highly fragmented nature of the industry requires numerous design firms, consultants, contractors and suppliers be involved in almost any project. Debatably, a significant challenge currently facing the construction projects is that of inaccurate and untimely communications amongst project team members, inevitably resulting in costly delays to the progress of any construction projects. Currently, information is often lost in the sense that vital information is not retained for easy re-use and must be re-entered, or bulky manuals and drawing folios must be carried, to ensure the employees working out of the office have rapid access to the information needed to perform some of the tasks (Love et al 2001).

Australia, Sohal et al. (1998) studied 530 Australian companies, and found IT use to be positively related to the organizations’ performance. According to findings of a study done by Liberatore and Pollack-Johnson (2003) on companies from several industries across Europe, the strongest self-reported factors influencing Project Management Software usage, both positively and negatively, was the size and complexity of projects. Larger and more complex projects pushing Project Management professionals to use the software more. Bresnen (2006) states that it can be realized that the management of an ICT mediated change process in the organizational form of a project with set boundaries, will imply a number of challenges for the permanent organization. According to the findings of another study conducted by Sarosa and Underwood (2004) on Small to Medium Enterprises (SMEs) in
Indonesia, adoption of Information communication Technology (ICT) was dependant on lack of technical know-how, skills and training hindered adaptation of IT amongst its respondents. Another reason is that construction companies often find it difficult to justify ICT investments in an industry that suffers from low profit margin (Alshawi et al 2003) and that many managers often view ICT investments as a process of consumption rather than capital expenditure and do not realize the importance of evaluating the IT investment (Willcocks et al 1997).

In Kenya there has been constant complains by various shareholders on inefficient workmanship in the building and construction industry, many buildings are reported to have collapsed claiming a number of lives, unfinished construction building due to defects and poor management of building construction projects. Due to the high cases of reported project failure across all industries, it is of paramount importance that project managers begin to take stock of past performance and incorporate appropriate ICT tools so as to change the disturbing trend of project outcomes. Despite the capability that ICT tools have to remedy the causes of project failure; it is possible that not many organizations have made the paradigm shift and fully adopted ICT tools. One would therefore ask what factors affect the adoption of ICT in building and construction industry. (Project Management Institute (2009).

1.3 Research Objectives.

1.3.1 General Objectives

This research aimed at finding out the factors affecting the adoption of ICT in building and construction projects in Nairobi County.

1.3.2 Specific Objectives.

i. To determine if training of employees affected the adoption of ICT in building and construction projects in Nairobi County.

ii. To investigate the extent to which cost / benefits affected the adoption of ICT in building and construction projects in Nairobi County.
iii. To examine the role of management commitment in the adoption of ICT in building and construction projects in Nairobi County.

iv. To assess if project size affected the adoption of ICT in building and construction projects in Nairobi County.

1.4 Research Questions.

i. How did training and involvement of employees affect the adoption of ICT in building and construction projects in Nairobi County?

ii. What was the role of management commitment in the adoption of ICT in building and construction projects in Nairobi County?

iii. How did cost / benefits affect the adoption of ICT in building and construction projects in Nairobi County?

iv. How did project size affect the adoption of ICT in building and construction projects in Nairobi County?

1.5 Significance of the Study

The Top Management of Building and Construction Industry

The study may help the top management of the various projects to realize the importance of adoption of ICT in the efficiency management of the building and construction industry in Nairobi County.

The Future Researchers

The study may also be of great help to other researchers in the same field which will act as a resource material to facilitate their study. They could use it as a point of reference during their study as well as fill the gaps that have been left out.
Donors, Financers and Well Wishers

Findings of the study may be used by these stakeholders to identify areas they need to increase funding of the building and construction projects and can acquire needed ict software’s and thus enhance the success of their projects.

1.6 Anticipated Limitations

Financial Expenses

Financial expenses were a limitation because of traveling from one place to another to gather information and materials. To offset the financial deficit the researcher negotiated with the various sponsors and convinced them on the benefits resulting from the study and also the researcher avoided research assistants to cut on cost.

Data Sourcing

Sourcing data from the busy organizations whose staff were ever busy and reluctant to provide information regarding the study. To ensure thorough collection of information the researcher assured all the companies staff and management that the information would be purely for research purposes and would be treated with utmost confidentiality.

Biasness

Biasness where companies only gave information that greatly favored their welfare. To avoid biasness the researcher explained how the study would be of benefit to the individual companies and projects.

1.7 Scope Of the Study

The study was conducted in Nairobi County targeting a population of 140 who fell under category A of registered contractors according to the records in the Ministry of public works as at January 2011. Out of the 140 target population, the researcher took a sample size of 30%. The study was conducted among project managers and supervisors.
CHAPTER TWO

LITERATURE REVIEW

2.1 INTRODUCTION

This chapter discussed the various views of other researchers who have carried out the study in other parts of the world. It discussed the diffusion of new innovation theory as well as the behavioral theory of ICT adoption in the theoretical review. The literature review was discussed in two major classification of dependent and independent variables.

2.2 THEORITICAL REVIEW

2.2.1 DIFFUSION OF NEW INNOVATION THEORY

Diffusion is the communication process by which a new idea is accepted by the market. According to Rogers (1962), diffusion process in a social system follows an S-curve in which adoption of a technology begins with slow change, then rapid change and ends in slow change as new technology emerge. People adopt new technological innovation at different times and rate thus the following adopters’ category. Firstly, we have the innovators who are the first individuals to adopt an innovation. They are willing to take risks, youngest in age, have the highest social class, have great financial lucidity, very social and have closest contact to scientific sources and interaction with other innovators. Risk tolerance has them adopting technologies which may ultimately fail. Financial resources help absorb these failures.

Secondly, there exist the early adopters who have the highest degree of opinion leadership among the other adopter categories. They are typically younger in age, have a higher social status, have more financial lucidity, advanced education, and are more socially forward than late adopters. More discrete in adoption choices than innovators. Realize judicious choice of adoption will help them maintain central communication position.

Thirdly there is the early majority who adopt an innovation after a varying degree of time which is usually longer than the innovators and early adopters. They tend to be slower in the adoption process, have above average social status, contact with early adopters, and seldom hold positions of opinion leadership in a system.
Fourthly, there is the late majority who will adopt an innovation after the average member of the society. These individuals approach an innovation with a high degree of skepticism and after the majority of society has adopted the innovation. They are typically skeptical about an innovation, have below average social status, very little financial lucidity, in contact with others in late majority and early majority, very little opinion leadership.

Lastly we have the laggards who are the last to adopt an innovation and have an aversion to change-agents and tend to be advanced in age. They tend to be focused on “traditions”, likely to have lowest social status, lowest financial fluidity, be oldest of all other adopters, in contact with only family and close friends, very little to no opinion leadership.

2.2.2 BEHAVIOURAL THEORIES OF ICT ADOPTION

This theory discusses the impact of individual characteristics in their acceptance of technology driven by ICT. It observes that difference among individual influence their adoption and use of technology. In relation to this, three models have been widely applied to explain general ICT adoption.

To start with, there is the Technology Acceptance Model (TAM) which focuses on the attitudinal explanations of intention to use a specific technology. The model shows good fit and reasonable explanatory power when explaining intention to use, but has to be re-specified to explain an acceptable percentage of the variance in attitude towards use. Kwon and Chidambaram (2000) applied the TAM model to explain the general adoption of mobile phones. They suggested the TAM model should be extended, and included social pressure as an additional variable. Somewhat surprising, the authors did not find support for the social pressure variable, and contrary to many other studies applying TAM, they found that ease of use was perceived to be more influential in explaining intentions to use than usefulness.

Then The Theory of Reasoned Action (TRA) model which includes four general concepts – behavioral attitude, subjective norm, intention to use and actual use. Lastly there is The
Theory of Planned Behaviour (TPB) which was proposed as an extension of TRA to account for conditions where individuals do not have complete control over their behavior. It includes perceived behavior control which reflects the internal and external constraints on behavior and is directly related to behavioral intention to use and actual use.

2.3 ADOPTION OF ICT IN CONSTRUCTION PROJECTS

Information and Communication Technology (ICT) has been widely applied across many sectors in order to increase competitiveness and reduce costs (Marsh et al. 2000), and is today seen as a vehicle to gain a competitive advantage (Ives et al. 1991, Earl 1993). The average annual growth rate of ICT investment in the construction industry is increasing every year and constitutes now a significant part of the total project cost. However, some studies indicate that the ICT utilization ratio is still relatively low in the construction industry. For example, a comprehensive study within the EU project InPro (Open Information Environment for knowledge-based Collaborative Processes throughout the Lifecycle of a Building), which ICT tools in the European construction industry (InPro internal report D2, 2007), revealed a lack of use of ICT tools in construction projects, especially in the early stages, despite several good alternatives available.

In Hong Kong, Burn (1990) studied the strategic use of IT in small and medium-sized organizations. She surveyed three medium-sized organizations and found that their IT strategy could be described by the Porter and Miller (1983) model of competitive advantage. In Australia, Sohal et al. (1998) studied 530 Australian companies, and found IT use to be positively related to the organizations’ performance.

Today large building and construction companies use ICT to the same extent as companies in other industries in order to co-ordinate and manage their internal information flows (Molnár et al., 2007). However, in construction projects the use of ICT for intra and inter organizational coordination and information exchange in the planning, design and production processes has been limited even if it is claimed to be a recognized potential (Wikforss and Lofgren, 2007).
Among the explanations for the limited adoption and use of ICT are: fragmentation of the industry and lack of integration between design and production process (Dainty et al, 2006).

A focus on solving technical problems, at the same time as the organizational context is overlooked, as well as problems of existing ICT solutions to incorporate interests of varying professional groups (Wikforss and Löfgren, 2007); which in turn is grounded in a varying set of principals, rules, knowledge domains, etc in professional groups leading to difficulties in co-operating (Söderholm, 2006). Moreover, in the literature on construction related ICT there has been a focus on construction companies, and no distinction between ICT use in construction “parent” organization, the permanent organization, and the temporary coalition of actors forming project teams (Rowlingson, 2007). Accordingly the central issue analyzed and discussed in this paper is how an enhanced understanding of the adoption and use of ICT in building and construction projects can be gained.

2.4 EMPLOYEE TRAINING

According to Armstrong (1998) employees need to be trained to perform their job, changes in technology, patterns of production and increased competition means that people and organizations are faced with situations requiring continuous learning. The scope of training and development depends on the policies and strategies of the organization, for instance an organization whose policy is to recruit from outside will carry out minimum of staff training and development because they prefer getting already trained and professionally qualified personnel. While organization recruiting from within must carry out comprehensive training on the concerned persons such a policy is geared on motivating employees’ commitment.

Today most of the organizations have realized the importance of investing on their human resources in form of training and development. Human resource is the most dynamic of all the organization. The employees need a lot of attention from the management if they are to pull potential in their work. Training and development should be viewed as an investment in people particularly with the increasing pace of technological structural and sociological change (Kotler 2003).
According to the findings of another study conducted by Sarosa and Underwood (2004) on Small to Medium Enterprises (SMEs) in Indonesia, adoption of Information communication Technology (ICT) was dependant on lack of technical know-how, skills and training hindered adaptation of IT amongst its respondents.

A study carried out by Sarosa and Underwood (2004) on the adoption of ICT within Indonesian Small and Medium Enterprises (SMEs). The aim of this research was to compare the actual factors influencing Indonesian ICT adoption decisions with those factors suggested in the literature, which is drawn mainly from research in developed countries. From the comparison between results of the field study and literature, it was found that there were some significant differences. The apparent differences were two fold; social and economic. A social factor highlighted was in the attitudes and awareness of ICT by locals in Indonesia compared to those of developed countries. This was because of the different exposure levels. Indonesian staff was noted to be apprehensive and exhibit low acceptance of ICT solutions.

2.5 COST/BENEFITS

Some of the main causes for this were suggested to be deficient understanding and lack of knowledge about the possibilities of ICT, unsuccessful implementation into project organizations and limitations of software functionality. Another reason is most likely that construction companies often find it difficult to justify ICT investments in an industry that suffers from low profit margin (Alshawi et al 2003) and that many managers often view ICT investments as a process of consumption rather than capital expenditure and do not realize the importance of evaluating the IT investment (Willcocks et al 1997). Moreover, the traditional approaches to evaluate investments have been shown inadequate (Peacock et al 2005, Andresen 1999, Irani et al 1999, Shank et al 1992). DeLone et al (1992) argues that commonly used benefit and cost analyses are often found lacking due to difficulty of quantifying intangible benefits. The lack of effective evaluation models does not only have an influence on individual projects but also, in the long run, the motivation to innovate and introduce new ICT tools in the construction industry.

ICT is being adopted for construction project management. But to date, a methodology has not been developed for the construction industry to examine the potential contributions of
information management strategies in efforts to reduce overall project schedule and cost (Back and Moreau, 2000). This inability to quantify process improvements and uncertainty of benefits from process and cultural changes is one of the primary barriers for effective implementation of ICT for construction project management. As a result, the benefits of ICT adoption are primarily perception based and not quantifiable and these perceived benefits define the extent of ICT adoption by the construction industry.

Carefully evaluated and considered ICT investments with established objectives can boost an organization forward with the increased likelihood to achieve successful implementation and improved project performance while reducing costs. Equally, poor investments, those that are inadequately justified or whose costs, risks, and benefits are poorly managed can hinder and even restrict an organization's performance (Love et al 2001)

As many ICT investment also involves changes in the process, the traditional construction processes has to be changed to take advantage of the benefits that the ICT tools can offer. This is as an integral part of the concurrent engineering approach. Still, the shift in focus from individual stakeholders to benefits for the project gives a momentum to optimize the benefits in the use of a new ICT tools in construction. This will surely affect the processes and the contractual environment in the project, since it has to support sharing of information and achieved benefits and the costs of investment in the project.

In Malaysia, during the two-day Infrastructure & Construction Asia’s Building Information Modelling & Sustainable Architecture 2009 conference (August 2009), Public Works Department director-general Datuk Seri Prof Judin Abdul Karim urged the construction companies to adopt information and communications technology (ICT) to enhance their capability. He said the awareness of using ICT was there but the cost of investment prohibited companies from adopting the technology and upgrading the system especially for the small companies. It was not a problem of knowledge and information on the usage of the ICT. He also emphasized on the importance to have a integrated software system as a lot of professionals like architects and engineers within the same companies were using different kinds of software.
2.6 MANAGEMENT COMMITMENT

The importance of taking the organization and its context into consideration when ICT adoption and use is studied has in IS-research been recognized by Lucas (1975). He stated that one reason for failures of ICT implementations was a focus on the technology, whereas it was neglected that a new ICT should be integrated in an organization where people would be affected by the new technology. This view was further developed in the seminal articles by Kling (1980) and Markus and Robey (1988) who challenged the views on change, tending to overemphasize the rationality of managers directing change and the capability of ICT to create predictable changes of organizational processes. Instead they suggested that research should analyze the processual and emergent nature of ICT-mediated change.

The heterogeneity of ICT can be seen as a result of patterns of action, or programs of actions, inscribed in technological artifacts, which originate from technology designers' assumptions about the potential user and the context for use. These inscribed programs of action delegate roles and competencies to the components of a socio-technical network, including human and non-human entities of the system (Akrish 1992, Latour 1992). When a program of action is inscribed into a piece of technology the technology could become an actor imposing its inscribed programs of action on its user (Monteiro 2000:77). However, the concept of inscriptions should not be viewed from a technology determinist perspective. Instead, inscriptions in technological artifacts can govern programs of action in strong or weak modes (Hanseth & Monteiro, 1997), and inscriptions are strengthened in a process of translation where different actor groups, indispensable for the change, need to be enrolled into a network carrying out the change (Latour, 1991).

The process of ICT adoption and use can be described as social process involving a wide array of actors (Robey and Bourdreau, 1999). This social process is linked to intra organizational and broader contexts, so called multi-layered contexts, emerging from a series of historical, organizational and economic circumstances (Walsham, 1993). The context can be understood as broader socio-political structure in which the adoption and use unfolds, including industry characteristics, political agendas and power relations. Further the context is also understood as
an organization’s cultural characteristics including particular formal and informal rules of behavior enacted by organizational members

When changes triggered by the adoption and use of a new ICT it is very likely that programs of action inscribed in the ICT challenge existing cultures, structures and power relations in the organization (Orlikowski, 1992; 2000). The contextual elements can also be seen as entities reinforcing actors’ frames of reference. By drawing on stocks of knowledge, norms, formal and informal rules constituted by the contextual elements, humans interpret and give meanings to events and behaviors to achieve meaningful interaction (Giddens, 1984). In this view a new ICT is interpreted and given a meaning, but the interpretation and sense making of ICT should not be viewed as static. Even if the technology may appear to have objective forms and functions at one point in time, these can and do vary over times due to there being different contexts and different users assigning varying meanings to technology (Pinch and Bijker, 1987; Orlikowski, 1992; Linderoth and Pellegrino, 2005). Thus, actors’ frames of reference are continuously constructed and refined in practice through inferences of past experience, as well as the obtainment of new knowledge emerging from for example added features to a technology, or a redefined use of a technology.

When studying adoption and use of ICT in organizational contexts, it is of crucial importance to include the ICT in the analysis of outcomes of the interaction between the technology and the organizational context (Monteiro and Hanseth, 1996; Orlikowski and Iacono, 2001). However, in the analysis of interactions between ICT, social settings, and their contexts, ICT often tend to fade away, be taken for granted, or assumed to be unproblematic when it once has been designed and installed (Orlikowski and Iacono, 2001). However, in contemporary research there is a well known slippage between designers and managers intentions, and users actual deployment of technology labeled as drifting, meaning that original goals and aims with a new ICT-system often drifts away from its assigners, regardless of who defines them (Ciborra 1996; Hanseth & Braa 1998). The drifting can be seen as a process where interactions between a not totally ‘disambiguated’ technology (Ciborra 2000) and multilayered contexts (Walsham 1993) trigger knowledge development and learning concerning the further deployment of a technology (Rosenberg 1982; Andersson and Linderoth, 2008).
Depending on roles and relationships delegated to the socio-technical entities in the network carrying out the change, different challenges arise for the permanent organization when outcomes from ICT-mediated change processes would be managed and transferred (Linderoth, 2007). By taking the technology into consideration when ICT-mediated change processes are analyzed, it can be concluded that the process is ambiguous, fluid and long term consequences are hard to predict (Ciborra, 1996; 2000; Orlikowski, 1996; Orlikowski and Hofman, 1997). Taking these conditions into consideration, it can be realized that the management of an ICT mediated change process in the organizational form of a project with set boundaries, will imply a number of challenges for the permanent organization (Bresnen, 2006).

2.7 PROJECT SIZE

There are factors however that influence the adaptation of ICT software within organizations. For example, according to findings of a study done by Liberatore and Pollack-Johnson (2003) on companies from several industries across Europe, the strongest self-reported factors influencing Project Management Software usage, both positively and negatively, was the size and complexity of projects larger and more complex projects pushing Project Management professionals to use the software more.

The building and construction industry used to be mentioned as one of the industries with the longest tradition of organizing the activities by projects. With regard to the often individual and unique character of the outcomes of the production processes, the project has been the most appropriate form for organizing activities. But on the other hand, the project as organizational form for organizing activities can be claimed to be a factor constraining the adoption and use of ICT in building and construction projects. (Peansupap and Walker 2006)

It can be argued that the focus on time and costs in projects are direct counterproductive for the adoption and use of ICT, if it is taken into consideration that positive outcomes from ICT implementations emerge through processes of knowledge development and learning these require a time span that often goes far beyond the termination of a project. I.e. the indefinite duration of ICT mediated change processes (Orlikowski, 1996), stands in sharp contrast to the well defined duration of a construction project. Furthermore Bresnen (2006) points at a
number of inherent conflicts, or key differences, between the underlying logics of project management on one side, and on the other side the underlying logics of organizational change and learning. Thus, unless immediate benefits from an ICT implementation can be showed with regard to the central dimensions of time and cost, it will be hard to convince project actors to adopt a technology. If the realizing of benefits from an ICT-implementation requires changes of work structures and a process requiring knowledge development and learning, which most often is the case in ICT implementations, project stakeholders incentives for adopting a new technology would probably be rather low.

In contemporary research a number of factors have been identified as explanations for the adoption and use of ICT in the building and construction industry. These factors are competitive advantages, external and internal forces, management support, user’s individual characteristics. According to Mitropolous and Tatum, 2000; Rowlingson, 2007 these factors can explain the adoption and use of ICT, analyses can be brought further by highlighting one of the most distinguishable industry characteristic, namely the way building and construction activities are organized: by projects.

In accordance with Molnár et al. (2007) this study confirms that large building and construction companies use ICT to a large extent in order to co-ordinate and manage their internal information flows. In the company studied there are 60 different systems with a range of users from one to four thousand. The large majority of systems are used in accordance with the common idea reinforcing IS implementation initiatives: To integrate all information into a system in order to reduce fragmentation and increase efficiency (Monteiro, 2003). One crucial dimension of this, in the building and construction industry, can be claimed to be monitoring and control of projects. Since this, according to a head of a region, is one of the core control issues in building and construction companies. Accordingly, the large majority of ICT can be seen as means for the permanent organization to control, monitor, and to some degree provide the temporary organization, the project teams, with ICT facilitating monitoring and control of activities in the project context. However, what role contextual elements and actors’ structure of reference plays in the interactions with ICT and the potential adoption and use of ICT in construction projects is still needed to be elaborated upon.
2.8 Research Gap

Literature review had major gaps existing in ICT adoption by construction projects since some studies indicated that ICT utilization ratio was still relatively low in the construction industry. Studies had also revealed a lack of use of ICT tools in construction projects, especially in the early stages, despite several good alternatives available. The reason being that construction companies often found it difficult to justify ICT investments in an industry that suffered from low profit margin and that many managers often viewed ICT investments as a process of consumption rather than capital expenditure and did not realize the benefits of IT investment. Commonly used benefit and cost analyses were often found lacking due to difficulty of quantifying intangible benefits. Delone et al (1992). In the literature review most of the studies concentrated on developed countries thus this study focused on Kenya as a developing country particularly Nairobi county to assess the adoption of ICT in construction industry as well.

2.9 Conceptual Framework

The researcher drew the conceptual framework from the literature review.

Figure 1.1 Conceptual Framework

<table>
<thead>
<tr>
<th>Independent Variables</th>
<th>Dependent Variable</th>
</tr>
</thead>
<tbody>
<tr>
<td>Employee Training &amp; involvement</td>
<td>Adoption of ICT in building and construction projects</td>
</tr>
<tr>
<td>Cost/Benefit</td>
<td></td>
</tr>
<tr>
<td>Management commitment</td>
<td></td>
</tr>
<tr>
<td>Project size</td>
<td></td>
</tr>
</tbody>
</table>

Source: Researcher (2011)
2.9.1 Definition of Variables

In adoption, in construction projects the use of ICT for intra and inter organizational coordination and information exchange in the planning, design and production processes has been limited even if it is claimed to be a recognized potential (Wikforss and Löfgren, 2007).

In terms of employee training and involvement, the enhancement of the skills, knowledge, and experience of employees with the purpose of improving performance. Thus implementation of employee training leads to reduced customer complains and efficient quality services (Kotler, 2003).

Cost/ benefit effects associated with an ICT investment are uncertain and difficult to measure (Ekström et al 2003) and the benefits and value of IT investments are being questioned by researchers and practitioners (Dadayan 2006).

In terms of management commitment when studying adoption and use of ICT in organizational contexts, it is of crucial importance to include the ICT in the analysis of outcomes of the interaction between the technology and the organizational context (Monteiro and Hanseth, 1996; Orlikowski and Iacono, 2001).

In regards to project size, according to Liberatore and Pollack-Johnson (2003), the strongest self-reported factors influencing Project Management Software usage, both positively and negatively, was the size and complexity of projects larger and more complex projects pushing Project Management professionals to use the software more.
CHAPTER THREE
RESEARCH METHODOLOGY

3.1 Introduction

This chapter outlined the methodology that the researcher used in the study. It gave the
description of the design, the target population, sampling design, and the development of
research, instruments and how they were administered, methods of data, presentation and data
analysis.

3.2 Study Design

This study employed the descriptive research design. The reason for employing this type of
research design was because in the construction projects, there already existed information
about the use of I.C.T Kasomo (2007) has explained that descriptive research design aims at
collecting data on current conditions or procedures or to establish relationship among factors
or conditions or determine needs, trends or changes.

3.3 Target Population

The target population was 140 registered contractors who fell under Category A of registered
contractors in Nairobi according to the records in the Ministry of public works in January
2011. The study targeted the 140 registered contractors in category A because they had the
capacity in terms of capital investment and capacity to handle multiple and complex projects
as compared to the other categories. The study targeted the project managers and the
supervisors of the projects. The table below shows the various categories of contractors
classified according to their capital investment and work capacity.
Table 1

<table>
<thead>
<tr>
<th>Category</th>
<th>Capacity</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>1 Billion and above</td>
</tr>
<tr>
<td>B</td>
<td>500 Million – 1 Billion</td>
</tr>
<tr>
<td>C</td>
<td>250 Million – 500 Million</td>
</tr>
<tr>
<td>D</td>
<td>100 Million – 250 Million</td>
</tr>
<tr>
<td>E</td>
<td>50 Million – 100 Million</td>
</tr>
<tr>
<td>F</td>
<td>25 Million – 50 Million</td>
</tr>
<tr>
<td>G</td>
<td>1 Million – 25 Million</td>
</tr>
<tr>
<td>H</td>
<td>Less than a Million</td>
</tr>
</tbody>
</table>

**Source:** Researcher (2011)

3.4 Sampling Design

The researcher employed simple random technique by taking 30% of the target population as supported by Kasomo (2007). The researcher therefore took a sample size of 42 out of the target population of 140 and used the Random Sampling to come up with the companies involved in the research. The researcher then had 21 project managers and 21 supervisors of various projects as shown in the table below.

Table 2

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Project Manager</td>
<td>21</td>
</tr>
<tr>
<td>Project Supervisor</td>
<td>21</td>
</tr>
<tr>
<td>Total</td>
<td>42</td>
</tr>
</tbody>
</table>

**Source:** Researcher (2011)
3.5 Data Collection

Data was collected by use of a questionnaire which constituted closed ended questions gathering information from the respondents in the registered contractors companies in Nairobi. The questionnaires were self administered where the instrument were dropped and picked later on. The researcher acquired the necessary introduction and permission letters from relevant authorities.

3.6 Pre-Testing the Instrument

A pilot test was conducted prior the data collection to test the validity and reliability of the questionnaire by use of test- retest technique where the researcher administered the instrument twice to 10% of the sample size. According to mugenda and mugenda (1999) normally the pretest sample is between 1% and 10% depending on the sample size. The firms used in pretesting were excluded from the main research.

3.7 Data Analysis

The researcher employed descriptive and inferential statistics. Quantitative data was analyzed using mean, mode and median. This was done by first placing some order on the data collected to reduce down to one or two descriptive summaries like the mean and standard deviation. The table below shows the various variables, their indicators and how they were measured.

<table>
<thead>
<tr>
<th>Variables</th>
<th>Indicators</th>
<th>Measurement</th>
</tr>
</thead>
<tbody>
<tr>
<td>ICT adoption in building and construction projects</td>
<td>Number of ICT software used</td>
<td>0 or 1 ICT software = 0</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2 or more ICT software = 1</td>
</tr>
<tr>
<td>Project size</td>
<td>Enhanced coordination</td>
<td>Likert scale 1 – 5</td>
</tr>
<tr>
<td></td>
<td>streamlined process</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Improved communication</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Error identification and/ or</td>
<td></td>
</tr>
</tbody>
</table>
| Management commitment | The level and frequency of technical support provided  
|                       | Enable immediate reporting and receiving feedback  
|                       | Establish and support the project team  
|                       | Enhanced the organization’s image in the industry  
|                       | Empowered participation to make decisions  
|                       | Likert scale 1-5 |
| Employee training and involvement | Enabling a culture/ change among project members  
|                               | The Level and frequency of training provided  
|                               | Improved computer/ ICT literacy  
|                               | Time saving (processing, responding)  
|                               | Facilitate document transfer and handling  
|                               | Likert scale |
| Cost / benefit | Cost saving  
|                | Reduction of cost of production  
|                | Decreased number of design errors  
|                | Accuracy and quality of the system output  
|                | Improved document quality  
|                | Likert scale |

**Source:** Author (2011)
CHAPTER FOUR
RESULTS AND DISCUSSION

4.1 Introduction

This chapter presents the results of the study together with a discussion of the findings. The main objective of the study is to find out factors affecting the adoption of ICT in building and construction projects. The chapter first presents the demographic characteristics of the respondents, after which data on each of the four research objectives is presented.

4.2 Demographic Data of the Respondents

The study targeted 140 registered contractors in category A according to the records of ministry of public works as per January 2011 from which 42 contractors were selected for the study. The study participants comprised of 17 (81%) project managers and 15 (71.4%) project supervisors as shown in Table 4.1.

Table 4.1: Position held in the organization

<table>
<thead>
<tr>
<th>Position held</th>
<th>No. of respondents</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Project Manager</td>
<td>17</td>
<td>40.5</td>
</tr>
<tr>
<td>Project supervisors</td>
<td>15</td>
<td>35.7</td>
</tr>
<tr>
<td>Total</td>
<td>32</td>
<td>76.2</td>
</tr>
</tbody>
</table>

Source: Survey data (2011)

Table 4.1 shows that there were a total of 32 respondents out of the expected 42 respondents. It was expected that there were to be 21 project managers respondents but only 17 of them return the questionnaires while out of the 21 expected project supervisors respondents only 15 of them returned the questionnaires. That brought about a 40.5% response from the project managers and 35.7% from the project supervisors totaling to 76.2% response. The response was good and from it the researcher achieved her objectives.
Table 4.2 shows that the respondents use computers in their work.

**Table 4.2: usage of computers**

<table>
<thead>
<tr>
<th>Frequency</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Valid YES</td>
<td>32</td>
</tr>
</tbody>
</table>

**Source:** Survey data (2011)

Table 4.2 shows that all the 32 respondents who returned their questionnaires out of the expected 42 respondents use computers in one way or the other in their work.

Table 4.3 shows how much of the project work done requires a computer.

**Table 4.3: work requiring a computer**

<table>
<thead>
<tr>
<th>Frequency</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Valid 1-20%</td>
<td>6</td>
</tr>
<tr>
<td>21-40%</td>
<td>3</td>
</tr>
<tr>
<td>41-60%</td>
<td>4</td>
</tr>
<tr>
<td>61-80%</td>
<td>5</td>
</tr>
<tr>
<td>81-100%</td>
<td>14</td>
</tr>
<tr>
<td>Total</td>
<td>32</td>
</tr>
</tbody>
</table>

**Source:** Survey data (2011)

As shown in Table 4.3, 18.8% of the respondents’ work requires a computer 1-20% times, 9.4% of their work required a computer 21-40% times, 12.5% of their required a computer 41-60% times, 15.6% of their required a computer 61-80% times and 43.8% of their work required a computer 81-100% times. All these were as at the time the data was collected.

From the research, 1-60% whose work required a computer represented the project supervisors while 61-100% represented the project managers. The project managers used computers more frequently as compared to project supervisors who were mostly at the ground.
Figure 4.3 shows the distribution of the project work that requires a computer

**Figure 4.3: How much of project work requires a computer**

![Bar chart showing the distribution of project work requiring a computer.](image)

Figure 4.3 is a graphical representation of table 4.3 discussed previously with 18.8% of the respondents’ work required a computer 1-20% times, 9.4% of their work required a computer 21-40% times, 12.5% of their work required a computer 41-60% times, 15.6% required a computer 61-80% times and 43.8% required a computer 81-100% times. However, it varied depending on different contractors. The project managers used computers more frequently as compared to project supervisors who most of the times are on the construction site.

Table 4.4 shows the participants’ perception about computers improving their work capabilities.

**Table 4.4: Do you believe computers can improve your work capabilities**

<table>
<thead>
<tr>
<th></th>
<th>Frequency</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Valid YES</td>
<td>32</td>
<td>100.0</td>
</tr>
</tbody>
</table>

**Source:** Survey data (2011)

Table 4.4 shows that all the 32 respondents out of the expected 42 who returned their questionnaires believed that computers can improve their work capabilities.
Table 4.5 shows whether any information received electronically is used electronically.

**Table 4.5: For any information received electronically, do you use it electronically**

<table>
<thead>
<tr>
<th></th>
<th>Frequency</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Valid</td>
<td>YES</td>
<td>23</td>
</tr>
<tr>
<td></td>
<td>NO</td>
<td>9</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>32</td>
</tr>
</tbody>
</table>

**Source:** Survey data (2011)

Table 4.5 shows that 71.9% use information received electronically, electronically while 28.1% do not use information received electronically, electronically.

Figure 4.5 whether information received electronically is used electronically

**FIGURE 4.5**

![Pie chart showing the use of electronically received information: 71.9% use it, 28.1% do not.](image)

**Source:** Survey data (2011)

Figure 4.5 shows that a large portion uses information received electronically, electronically.
Table 4.6 shows whether information received electronically is responded to electronically.

**Table 4.6: For any information received electronically, do you respond electronically**

<table>
<thead>
<tr>
<th></th>
<th>Frequency</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Valid</td>
<td>YES</td>
<td>23</td>
</tr>
<tr>
<td></td>
<td>NO</td>
<td>9</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>32</td>
</tr>
</tbody>
</table>

**Source:** Survey data (2011)

As shown in table 4.6, 71.9 % of the participants respond to information received electronically, electronically while 28.1 % do not respond to it electronically.

Figure 4.6 shows the information that was received electronically and responded to electronically.

**FIGURE 4.6:**

For any information received electronically, do you respond electronically?

**Source:** Survey data (2011)
Figure 4.6 show that most of the project work received electronically is responded to electronically. However, a few participants do not respond electronically.

4.7 Effects of employee training/ involvement on ICT adoption in building and construction projects.

The first objective of the study was to determine if employee training/ involvement affects the adoption of ICT in building and construction projects in Nairobi County. To address this research objective, first the respondents were presented with 5 items to measure the extent according to their experience on whether adoption of ICT helps in various options provided. They were asked to respond on a 5-point Likert scale ranging from 5 (Very High) to 1 (Low). Their responses are summarized in Table 4.7.

Table 4.7: Effects of employee training/ involvement on ICT adoption in building and construction projects

<table>
<thead>
<tr>
<th>Employees’ Training</th>
<th>L</th>
<th></th>
<th></th>
<th>M</th>
<th></th>
<th></th>
<th>H</th>
<th></th>
<th>VH</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>F</td>
<td>%</td>
<td>F</td>
<td>%</td>
<td>F</td>
<td>%</td>
<td>F</td>
<td>%</td>
<td>F</td>
<td>%</td>
</tr>
<tr>
<td>Enabling culture/ change among project members</td>
<td>4</td>
<td>12.5</td>
<td>0</td>
<td>0</td>
<td>9</td>
<td>28.1</td>
<td>17</td>
<td>53.1</td>
<td>2</td>
<td>6.2</td>
</tr>
<tr>
<td>The level and frequency of training provided</td>
<td>1</td>
<td>3.1</td>
<td>0</td>
<td>0</td>
<td>11</td>
<td>34.4</td>
<td>19</td>
<td>59.4</td>
<td>1</td>
<td>3.1</td>
</tr>
<tr>
<td>Improved computer/ICT literacy</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>6</td>
<td>18.8</td>
<td>23</td>
<td>71.9</td>
<td>3</td>
<td>9.4</td>
</tr>
<tr>
<td>Time saving</td>
<td>1</td>
<td>3.1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>19</td>
<td>59.4</td>
<td>12</td>
<td>37.6</td>
</tr>
<tr>
<td>Facilitate document transfer and handling</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>11</td>
<td>34.4</td>
<td>5</td>
<td>15.6</td>
<td>16</td>
<td>50.0</td>
</tr>
</tbody>
</table>

Source: Survey data (2011)

Table 4.7 shows that while most of the respondents rated various statements regarding employee training highly, quite a considerable proportion rated some of the statements lowly. 3.1% of the respondents rated lowly and very highly the level and frequency of training
provided while 34.4% rated it medium and the highest response was 59.4% who rated it highly. The respondents, who rated the level and frequency of training highly, highly rated training enabling culture/change among project members, training leading to improved computer/ICT literacy as well as time saving. In addition, 50% rated training facilitating document transfer and handling very highly. However, 12.5% rated training enabling culture/change among project members lowly as 3.1% rated training leading to time saving lowly.

From the response of various respondents as displayed on the table, the researcher concluded that training of employees was very important and that it affected the adoption of ICT in construction projects since those that were receiving training frequently rated highly various statements regarding employee training while those that were not trained frequently, rated lowly some statements regarding employee training. From this, it can be assumed that those rating various statements regarding employee training low would not be quick in adopting ICT in their work as compared to them that rated it highly.

4.8 Effect of cost/benefits on ICT adoption in building and construction projects

The second objective of the study was to investigate the extent to which cost/benefits affect the adoption of ICT in building and construction projects in Nairobi County. To address this research objective, first the respondents were presented with 5 items to measure the extent according to their experience on whether adoption of ICT helps in various options provided. They were asked to respond on a 5-point Likert scale ranging from 5 (strongly agree) to 1 (strongly disagree). Their responses are summarized in Table 4.8.

<table>
<thead>
<tr>
<th>Cost/Benefit</th>
<th>SD</th>
<th>D</th>
<th>N</th>
<th>A</th>
<th>SA</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>F%</td>
<td>F%</td>
<td>F%</td>
<td>F%</td>
<td>F%</td>
</tr>
<tr>
<td>Cost saving</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>23</td>
</tr>
<tr>
<td>Reduction of cost of production</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>3.1</td>
<td>15</td>
</tr>
</tbody>
</table>

Table 4.8: Effects of cost/benefit on ICT adoption in building and construction projects
<table>
<thead>
<tr>
<th>Decreased number of design errors</th>
<th>0</th>
<th>0</th>
<th>1</th>
<th>3.1</th>
<th>10</th>
<th>31.2</th>
<th>15</th>
<th>46.1</th>
<th>6</th>
<th>18.8</th>
</tr>
</thead>
<tbody>
<tr>
<td>Accuracy and quality of the system output</td>
<td>0</td>
<td>0</td>
<td>8</td>
<td>25.0</td>
<td>5</td>
<td>15.6</td>
<td>14</td>
<td>43.8</td>
<td>5</td>
<td>15.6</td>
</tr>
<tr>
<td>Improved document quality</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>23</td>
<td>71.9</td>
<td>9</td>
<td>28.1</td>
<td></td>
</tr>
</tbody>
</table>

**Source:** Survey data (2011)

The table shows that majority of the study participants agreed that various options in cost/benefit affect the adoption of ICT in building and construction projects. It is however noticeable that a small but considerable percentage of building and construction projects did not agree with some of the options provided. 71.9% agreed and 28.1% strongly agreed that ICT adoption helped in cost saving. Another 71.9% agreed and 28.1% strongly agreed that ICT adoption helped in improved document quality, as 46.1% and 43.8% agreed that its adoption helped in decreased number of design errors and accuracy and quality of the system output respectively. However, 46.9%, 31.2% and 15.6% were neutral about ICT adoption helping in reduction of cost of production, decrease number of design errors and accuracy and quality of the system output respectively. 3.1% and 25% disagreed on ICT adoption helping in reduction of price and accuracy and quality of the system output respectively.

From the above findings, the researcher concluded that cost/benefit played a key role in adoption of ICT in the building and construction projects. This is because those who felt that its adoption helped in various options provided, were comfortable adopting it while those who were neutral or disagreed with some of the options provided were slow in adopting it since the cost incurred in adoption was a key as compared to the benefit they got.

### 4.9 Effect of management commitment on ICT adoption in building and construction projects

The third objective of the study was to examine the role of management commitment in the adoption of ICT in building and construction projects in Nairobi County. To address this research objective, first the respondents were presented with 5 items to measure the extent according to their experience on whether adoption of ICT helps in various options provided.
They were asked to respond on a 5-point Likert scale ranging from 5 (strongly agree) to 1 (strongly disagree). Their responses are summarized in Table 4.9.

**Table 4.9: Effects of management commitment on ICT adoption in building and construction projects**

<table>
<thead>
<tr>
<th>Management Commitment</th>
<th>SD</th>
<th>D</th>
<th>N</th>
<th>A</th>
<th>SA</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>F</td>
<td>%</td>
<td>F</td>
<td>%</td>
<td>F</td>
</tr>
<tr>
<td>The level and frequency of technical support provided</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>14</td>
</tr>
<tr>
<td>Enable immediate reporting and receiving feedback</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>Establish and support the project team</td>
<td>0</td>
<td>0</td>
<td>4</td>
<td>12.5</td>
<td>12</td>
</tr>
<tr>
<td>Enhanced organization's image in the industry</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>15</td>
</tr>
<tr>
<td>Empowered participation to make decisions</td>
<td>0</td>
<td>0</td>
<td>8</td>
<td>25.0</td>
<td>9</td>
</tr>
</tbody>
</table>

**Source:** Survey data (2011)

The table shows that majority of the study participants agreed that various options in management commitment affects the adoption of ICT in building and construction projects. It is however noticeable that a small but considerable percentage of building and construction projects were neutral or did not agree with some opinions provided. From the table, there was a tie of 43.8% for those who agreed and neutral about ICT adoption helping in the level and frequency of technical support provided. 81.2% agreed on its adoption helping in enabling immediate reporting and receiving feedback. Another 43.8% agreed that its adoption helped in establishing and supporting the project team although 37.5% were neutral while 12.5 disagreed on the same. 46.9% were neutral on ICT adoption helping in enhanced organization’s image in the industry. A further 25% disagreed with ICT adoption helping in
empowered participation to make decisions, an option that both the project managers and supervisors disagreed on.

From this the researcher concluded that the management commitment was not felt as far as ICT adoption was concerned since most respondents were neutral on some options provided as others disagreed. However, a small number of respondents agreed as others strongly agreed with some options provided as seen on the table.

4.10: Effects of project size on ICT adoption in building and construction projects

The fourth objective of the study was to assess if project size affects the adoption of ICT in building and construction projects in Nairobi County. To address this research objective, first the respondents were presented with 5 items to measure the extent according to their experience on whether adoption of ICT helps in various options provided. They were asked to respond on a 5-point Likert scale ranging from 5 (strongly agree) to 1 (strongly disagree). Their responses are summarized in Table 4.10.

Table 4.10: Effects of project size on ICT adoption in building and construction projects

<table>
<thead>
<tr>
<th>Project Size</th>
<th>SD</th>
<th>D</th>
<th>N</th>
<th>A</th>
<th>SA</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>F</td>
<td>%</td>
<td>F</td>
<td>%</td>
<td>F</td>
</tr>
<tr>
<td>Enhanced coordination between project participants</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>3.1</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lead to more streamlined processes</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>3.1</td>
<td>12</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Improved project communication</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Identify errors and/or inconsistencies</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>16</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Reduce response time to answer queries</td>
<td>1</td>
<td>3.1</td>
<td>1</td>
<td>3.1</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Source: Survey data (2011)
The table shows that majority of the study participants agreed that various options in project size affect the adoption of ICT in building and construction projects. It is however noticeable that a small but considerable percentage of building and construction projects participants did not agree with some of the options provided. 71.9% agreed that ICT adoption helped in enhanced coordination between project participants are concerned in relation to project size. Another 37.5% were neutral on its adoption helping in leading to more streamlined processes. However, 68.8% agreed that ICT adoption helped in improved project communication as another 59.4% agreed that its adoption helped to reduce response time to answer queries. However, a small number of respondents disagreed on some options provided. For instance 3.1% disagreed that it led to more streamlined processes and reduced response time to answer queries.

From the above responses, it can not go unnoticed that 28.1% strongly agreed that ICT adoption helped in improved project communication as well as reduced response time to answer queries, 21.9% strongly agreed that ICT adoption helped in error identification and/or inconsistencies, 18.8% strongly agreed that ICT adoption lead to more streamlined processes and 12.5% strongly agreed enhanced coordination between project participation.

It can be concluded from this that project size affects ICT adoption since from the responses, majority strongly agreed and/or agreed with various options provided. It can be assumed that this was so since all the contractors picked were drawn from category A of the registered contractors with the ministry of works who deal with multiple and complex projects due to their capital investments and capacity to handle them.
CHAPTER FIVE

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

5.1 Introduction

This chapter presents a summary of the study, conclusions and recommendations arrived at. These were arrived at as a result of the responses and findings in chapter 4. The tables in chapter 4 represented the feelings of the respondents based on their experiences in the industry. This was demonstrated by how they responded on various options provided as to whether they strongly disagreed, disagreed, neutral, agreed or strongly agreed to the various options provided. The chapter also presents suggestions for further studies.

5.2 Summary of the Study

This study was aimed at determining the factors affecting the adoption of ICT in building and construction projects in Nairobi County. The study specifically investigated whether the following variables affect the adoption of ICT in building and construction projects: employee training/involvement, project size, management commitment and cost/benefit. Data for the study was collected from 42 registered contractors from category A. Given below is a summary of the main research findings which implied that all the four variables discussed as affecting the adoption of ICT in the construction and building projects affected. This was as a result of the response of the contractors who participated in the survey and findings discussed in chapter 4.

5.2.1 Employee Training/Involvement

The study established that due to their experience, the contractors felt that ICT adoption helped in various ways therefore its adoption was pegged on those benefits. 50% felt that ICT adoption helped in facilitating document transfer and handling, 71.9% felt that training helped in improved computer/ICT literacy, 59.4% felt that ICT adoption helped in saving time. However, 34.4% were neutral about help from the level and frequency of training provided and 12.5% had a low opinion about it enabling culture/change among project members.
5.2.2 Cost/Benefit

Most of the building and construction projects felt that various options in cost/benefit affect the adoption of ICT in the industry. However, 32.2% and 46.9% of the respondents were neutral about ICT adoption decreasing the number of design errors and reducing the cost of production respectively. 25% disagreed about ICT adoption improving the accuracy of quality of the system output. Nevertheless 28.1% strongly agreed on ICT adoption leading to cost saving and improved document quality while 71.9% agreeing on the same.

5.2.3 Management Commitment

Majority of the top management in their organizations were engaging in various activities that demonstrate commitment to ICT adoption. However, 43.8% of the respondents were neutral about management commitment on the level and frequency of technical support provided while 25% disagreed on empowered participants to make decision. Nevertheless 31.2% strongly agreed that management commitment in ICT adoption enhanced organization’s image in the industry while 81.2% agreed that it enabled immediate reporting and receiving feedback.

5.2.4 Project Size

The study established that most of the contractors felt that the size of the project determined the level of ICT adoption. 28.1% strongly agreed that ICT adoption led to improved project communication and reduced response time to answer queries. 71.9% agreed on enhanced coordination between project participants. However, 50% were neutral about ICT adoption helping in identifying errors and/or inconsistencies while 3.1% disagreed that it led to a more streamlined processes.

5.3 Conclusions

Based on the findings of the study, it can be concluded that the registered contractors in the building and construction projects have adopted ICT. However, the people who use it frequently are the project managers who are both in office work and site while the project supervisors rarely use the computers while on the site. This is shown by 71.9% who receive, use and respond to information received electronically and 28.1 who do not. The study
established that ICT adoption in building and construction projects by registered contractors is positively associated with training of employees, cost/ benefit, management commitment and project size. Thus, in concordance with previous studies by other researchers in different part of the world as highlighted in the literature review, the four variables of the study – training of employees, cost/ benefit, management commitment and project size – are key determinants of ICT adoption in building and construction industry projects.

5.4 Recommendations

The following recommendations should be considered based on the findings of the study as seen on the tables in chapter 4 which represents responses of the respondents on various options provided and the findings discussed on the same chapter:

5.4.1 Employee Training

Training in ICT usage should always be part of each employee’s staff development plan. Key stakeholders should be involved in formulating training policies and objectives to achieve full implementation of training and development in the organization. Training is necessary due to the changing technology world. Thus if this is fully achieved it can lead to significant improvement in organization performance.

5.4.2 Cost/ benefit

Since the commonly used cost and benefit analysis are often found lacking due to difficulty of quantifying intangible benefits, management should view ICT investment as capital expenditure rather than as a process of consumption and be motivated to innovate and introduce new ICT tools in the building and construction projects.

5.4.3 Management Commitment

According to the findings of the study, some respondents in the building and construction projects felt that the project participants were not empowered to make decisions in regards to ICT adoption. The researcher recommends that the management to involve all stakeholders involved since new ICT should be integrated in an organization where people would be
affected by it. Also, before undertaking any changes, research should be done and analyze the processual and emergent nature of ICT mediated change.

5.4.4 Project Size

The size and complexity of the projects affect ICT adoption where large and more complex projects push management to use the ICT more in order to coordinate and manage their internal information flow. The researcher calls upon other project participants whether small or big, to embrace ICT usage and to adopt the changes that come along with ICT adoption and technology changes.

5.5 Suggestions for Further Research

1. A similar study to this research could be conducted in registered contractors in building and construction projects.
2. A study on factors hindering ICT adoption in building and construction projects in Nairobi County.
3. A comparative study of the performance of both registered and unregistered contractors in Nairobi County.
4. Further studies are needed on the challenges in expanding the use of ICT in building and construction projects by registered contractors.
REFERENCES


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Neuman, W.L. (1997), Social Research Methods: Qualitative and Quantitative Approaches, Allyn & Bacon, Needham Heights, MA.


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Wikforss, Ö. and Löfgren, A. (2007). Rethinking communication in construction. ITcon, 12, 337-346
COVER LETTER

Njue Lucy Kawira

P.O. Box 72341- 00200

Nairobi.

Dear Respondent,

RE: QUESTIONNAIRE

I am a post graduate student in the school of business at Kenyatta University for the fulfillment of the requirements for the Masters of Business Administration Degree. I am required to undertake a research study whose title is factors affecting the adoption of ICT in building and construction projects in Nairobi County. This letter is aimed at requesting you to truthfully fill the attached questionnaire. The data you provide will enable the researcher to examine the ICT adoption in the building and construction projects. I would also like to assure you that all information provided will be treated with utmost confidentiality and used for academic purpose only.

Your assistance and corporation is highly appreciated. Thank you.

Sincerely

Njue Lucy Kawira

Researcher
Appendix B

Questionnaire for project managers and project supervisors in Nairobi area.

Dear respondents,

Kindly respond to the following questionnaire as honestly as possible. All information collected will be used for my research work and will be treated with utmost confidentiality.

Date: ..............................................................................................

Name: ..............................................................................................

Company: ..............................................................................................

Position/Role: ..............................................................................................

Project Phase: ..............................................................................................

GENERAL

1. Do you use computers in your work?
   Yes □  ii) No □

If yes please tick on the box provided the purpose for which you used it for

Pricing / costing (spreadsheet etc.) □ ..............................................................

Word processing (letters, faxes etc) □ ..............................................................

Programming concept project etc □ ..............................................................

Cost control (MYOB etc) □ ..............................................................

Drawing/Design (AutoCAD etc) □ ..............................................................

Email □ ..............................................................

Web Based □ ..............................................................

(Specify: Internet, extranet, intranet) □ ..............................................................
2. Approximately how much of your work on your current project requires a computer?
   i) 1% to 20%  
   ii) 21% to 40%  
   iii) 41% to 60%  
   iv) 61% to 80%  
   v) 81% to 100%  

3. Do you believe computers can improve your work capabilities?
   i) Yes  
   ii) No  

5. For any project information that you receive electronically:
   i) Do you use the information electronically?  
      Yes  
      No  
   ii) Do you respond electronically?  
      Yes  
      No  

INFORMATION COMMUNICATION TECHNOLOGY ADOPTION

Is your company using ICT software to support activities related to building and construction?

Yes  
No  

If yes, please tick the ICT softwares that are being used in the list provided below:

AutoCAD  
Prokon  
ArchiCAD  
Orion  
Master series  
Others (please specify)  


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**SECTION A. PROJECT SIZE PERSPECTIVE**

Thinking about information communication technology (ICT) in the building and construction projects, please rate on the scale of 1 to 5 by circling the appropriate number, your experience on whether its adoption helps in:

<table>
<thead>
<tr>
<th>Strongly Disagree (SD)</th>
<th>Disagree (D)</th>
<th>Neutral (N)</th>
<th>Agree (A)</th>
<th>Strongly Agree (SA)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1 2 3 4 5</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- Enhanced coordination between project participants: 1 2 3 4 5
- Led to a more streamlined processes: 1 2 3 4 5
- Improved project communication: 1 2 3 4 5
- Identify errors and/or inconsistencies: 1 2 3 4 5
- Reduced response time to answer queries: 1 2 3 4 5

**SECTION B. MANAGEMENT COMMITMENT PERSPECTIVE**

Thinking about information communication technology (ICT) in building and construction projects, please rate on a scale of 1 to 5 by circling the appropriate number, your experience on whether its adoption helps in:

<table>
<thead>
<tr>
<th>Strongly Disagree (SD)</th>
<th>Disagree (D)</th>
<th>Neutral (N)</th>
<th>Agree (A)</th>
<th>Strongly Agree (SA)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1 2 3 4 5</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- The level and frequency of technical support provided: 1 2 3 4 5
- Enable immediate reporting and receiving feedback: 1 2 3 4 5
- Establish and support the project team: 1 2 3 4 5
- Enhanced the organization's image in the industry: 1 2 3 4 5
- Empowered participation to make decisions: 1 2 3 4 5
SECTION C. EMPLOYEE/ TRAINING INVOLVEMENT PERSPECTIVE

Thinking about information communication technology (ICT) in building and construction projects, please rate on a scale of 1 to 5 by circling the appropriate number, your experience on whether its adoption helps in:

<table>
<thead>
<tr>
<th>Low (L)</th>
<th>Very Low (VL)</th>
<th>Medium (M)</th>
<th>High (H)</th>
<th>Very High (VH)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

| Enabling a culture/ change among project members | 1 | 2 | 3 | 4 | 5 |
| The Level and frequency of training provided | 1 | 2 | 3 | 4 | 5 |
| Improved computer/ ICT literacy | 1 | 2 | 3 | 4 | 5 |
| Time saving (processing, responding) | 1 | 2 | 3 | 4 | 5 |
| Facilitate document transfer and handling | 1 | 2 | 3 | 4 | 5 |

SECTION D. COST/ BENEFIT PERSPECTIVE

Thinking about information communication technology (ICT) in building and construction projects, please rate on a scale of 1 to 5 by circling the appropriate number, your experience on whether its adoption helps in:

<table>
<thead>
<tr>
<th>Strongly Disagree (SD)</th>
<th>Disagree (D)</th>
<th>Neutral (N)</th>
<th>Agree (A)</th>
<th>Strongly Agree (SA)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
</tbody>
</table>

| Cost saving (rework, travelling, overhead) | 1 | 2 | 3 | 4 | 5 |
| Reduction of cost of production | 1 | 2 | 3 | 4 | 5 |
| Decreased number of design errors | 1 | 2 | 3 | 4 | 5 |
| Accuracy and quality of the system output | 1 | 2 | 3 | 4 | 5 |
| Improved document quality | 1 | 2 | 3 | 4 | 5 |
## APPENDIX C: TIME SCHEDULE

<table>
<thead>
<tr>
<th>ACTIVITY</th>
<th>TIME</th>
</tr>
</thead>
<tbody>
<tr>
<td>Approval of research topic by supervisor</td>
<td>January 2011</td>
</tr>
<tr>
<td>Literature review and writing of the proposal</td>
<td>February – June 2011</td>
</tr>
<tr>
<td>Defense of the proposal at the department</td>
<td>September 2011</td>
</tr>
<tr>
<td>Developing of data collection tools</td>
<td>September 2011</td>
</tr>
<tr>
<td>Field research</td>
<td>September 2011</td>
</tr>
<tr>
<td>Data analysis</td>
<td>October 2011</td>
</tr>
<tr>
<td>Presentation and review</td>
<td>February 2012</td>
</tr>
<tr>
<td>Final presentation</td>
<td>April 2012</td>
</tr>
<tr>
<td>BUDGET</td>
<td>COST</td>
</tr>
<tr>
<td>--------------</td>
<td>--------</td>
</tr>
<tr>
<td>ITEM</td>
<td>COST</td>
</tr>
<tr>
<td>Stationery</td>
<td>5,000</td>
</tr>
<tr>
<td>Transport</td>
<td>5,000</td>
</tr>
<tr>
<td>Subsistence</td>
<td>10,000</td>
</tr>
<tr>
<td>Proposal</td>
<td></td>
</tr>
<tr>
<td>Typing</td>
<td>5,000</td>
</tr>
<tr>
<td>Photocopying</td>
<td>1,000</td>
</tr>
<tr>
<td>Binding</td>
<td>500</td>
</tr>
<tr>
<td>Project</td>
<td></td>
</tr>
<tr>
<td>Typing</td>
<td>5,000</td>
</tr>
<tr>
<td>Photocopying</td>
<td>2,000</td>
</tr>
<tr>
<td>Binding</td>
<td>1,000</td>
</tr>
<tr>
<td>Miscellaneous</td>
<td>5,000</td>
</tr>
<tr>
<td>Grand Total</td>
<td>39,500</td>
</tr>
</tbody>
</table>