University of Nairobi

Information Technology Management

Research Project

INFLUENCE OF TELECOMMUTING ON THE PERFORMANCE OF SOFTWARE ENGINEERS:

CASE STUDY, EQUITY BANK.

Submitted By

Emmanuel Kipngetich Koech – P54/33977/2019

Submitted to

Dr. Christopher Kipchumba Chepken

May 2021

DECLARATION

This project is my original work and to the best of my knowledge this research work has not been submitted for any other award in any University

Signature ....

....

Emmanuel Kipngetich Koech
(P54/33977/2019)

Date 23|08|2021

This project report has been submitted in partial fulfillment of the requirement of the Master of Science Degree in Information Technology Management of the University of Nairobi with my approval as the University supervisor.

Signature ....

Dr. Christopher Kipchumba Chepken
School of Computing & Informatics

Date 24/08/2021

Contents

Abstract

Telecommuting has been around for almost half a century, however, it has only seen an increase in popularity and general acceptance by companies around the world in recent times. Lately, this area has attracted the attention of scholars and practitioners alike in an attempt to study, understand, and make business decisions around telecommuting. There have been conflicting findings from past research about how telecommuting affects the performance of employees. This research aims to bring to light how working away from the traditional office setting affects the performance of software engineers. The research investigated how efficiency, effectiveness and quality of code changed with the shift from working from a traditional office setting as compared to telecommuting. To aid in the research, literature review and other existing frameworks were explored to help understand the extent to which effectiveness, efficiency and quality of code affects the performance of a software engineer. The study was a pure research that used questionnaires to collect data from identified respondents. The study found out that telecommuting has a positive influence on the performance of software engineers.

Chapter One: Introduction

1.0 Background of the study

Telecommuting is an employer-employee work agreement in which the employee is allowed to work outside the traditional office environment, such as working from home. Telecommuting has been around for decades, both in practice and academia. 3.9 million U.S. employees, or 2.9% of the total U.S. workforce, work from home at least half of the time, up from 1.8 million in 2005 (GWA, 2017). This represents a 115% increase in the total number of telecommuters. In the EU, those who usually work from home constituted 5% of the employed workers (Eurostat, 2018).

Video conferencing tools have proved useful for real-time communication and interaction amongst employees. It has also facilitated reporting and delegation of duties. The average telecommuter is 46 years of age or older, has at least a bachelor's degree (GWA, 2017). There has been an increase in reports that today, technological advances in how work is performed may mean that 'anywhere working' becomes business-as-usual (Blount, 2015). To bolster work-life balance, 75% of Europeans have access to a flexible work environment depending on schedule and location (Eurofound, 2017; OECD, 2016).

Despite the advancement in technology, many organizations fail to recognize the viability of telecommuting in their organizations. This raises several key questions that could make a company shy away from exploring telecommuting. How does telecommuting affect workplace job satisfaction, individual performance, team performance, and performance? Does telecommuting translate into mutual benefits for the employer and employee? Anecdotal evidence might point out some of the benefits of telecommuting; however, there is little empirical evidence to back these claims.

Advancing technology has ensured that telecommuting is easy and seamless. Cutting-edge technology and faster internet speeds mean that people can work from any part of the world while still maintaining good communication. Additionally, we now have industries that can be run by a majority of employees working remotely. For instance, tech industries like Google and Twitter or Facebook have been less impacted by COVID 19 pandemic since employees mostly work from their computers.

Therefore, their location is not consequential when fulfilling their duties. As long as they have a computer and are connected to their workstation or network, they can work. The evolution of

technology has also led to new jobs being created that never existed before. The workplace is also becoming more dynamic. Apple was founded in a garage and went to become a multibillion-dollar company. This exemplifies the modern workplace setting where 'work' does not have to be done at the office but instead can be done anywhere.

In essence, technology is the primary factor that has helped transform the workplace and by extension, made telecommuting increase in popularity, especially during the pandemic. Ideally, the uptake of telecommuting in organizations is bound to change the workplace paradigm significantly. However, research on telecommuting is still scarce and disjointed. Previous research reports did not envision a point where almost everyone would be encouraged to stay home and work remotely. Companies wishing to take this route, therefore, face a situation where they are flying blind with no research that can adequately be used to inform the decisions being taken. For instance, how many hours a week should an employee telecommute? Should it be done on a rotation basis, or should employees be asked to telecommute permanently? These are just some of the tough questions that need to be analyzed.

1.1 Problem Statement

Telecommuting has been around for decades. It offers flexibility to employees and an alternative means to work. However, telecommuting has not been accepted and embraced with enthusiasm by most companies and organizations. Studies have been conducted on telecommuting focusing on performance and societal improvement (Konradt, Hertal & Schmook, 2003), effects of telecommuting on transportation and the environment (Henderson, Miller & Hambrick, 2006). In the wake of the Covid-19 pandemic, companies have rushed to embrace telecommuting to replace or substitute the office-setting work. Equity bank initially adopted telecommuting but along the way, employees have been recalled back to the office in shifts. With this uncertainty of whether to fully telecommute or recall employees back to the office, there is a need to assess how telecommuting affects the performance of the software engineers in order to make an informed decision.

Based on the foregoing the study sort to establish how telecommuting influences the performance of software engineers at Equity bank. The findings will inform the bank on whether to allow employees to fully telecommute or recall them back to the office.

1.2 Objectives
1.2.1 General Objective
To establish how telecommuting affects the performance of software engineers.

1.2.2 Specific objectives

1. To identify the effect of telecommuting on the efficiency of a software engineer.

2. To establish how telecommuting affects the quality of work of a software engineer.

3. To establish the effectiveness of a telecommuting software engineer as compared to a non-telecommuting engineer.

4. To identify challenges facing the adaption of telecommuting as a new way of working

1.3 Research questions

1. What is the effect of telecommuting on the efficiency of software engineers?

2. What is the effect of telecommuting on the quality of work of a software engineer?

3. How effective is a telecommuting engineer as compared to a non-telecommuting engineer?

4. What challenges are software engineering facing with the new telecommuting working structure

1.4 Justification of the study

The study was informed by uncertainty in how telecommuting affects the performance of software engineers at Equity bank. The bank is in a dilemma on the decision to take between allowing the employees to permanently work away from the office or recall everyone back. This study will enable the bank to demystify the dilemma. Factors such as efficiency, effectiveness and quality of work were considered to help determine the determine performance of a software engineer.

1.5 Significance of the study.

The main aim of the study is to research how telecommuting affects the performance of Equity Bank's software engineers. The study will also be useful to:

a. Scholars and academicians.

This research will act as a source of reference to academicians and scholars and additionally identify gaps that need further research.

b. Equity Bank

The study identifies how telecommuting affects the performance of a software engineer and will provide the information needed to advise the bank. Additionally, the study comes up with a framework that can be used to assess the performance of a software engineer. This will make it easier for the company to make an informed choice on whether to allow employees to fully telecommute.

Chapter Two: Literature Review

2.0 Introduction

Over the past several decades, there has been an increase in the interest to use telecommuting as a working system in the United States of America. The term Telecommuting is thought to have been penned by Engineer Jack Niles, who was working for the National Aeronautics and Space Administration (Avery & Zabel, 2001). This was a time when the US was hit by the oil crisis in the 70s. The main idea of this working system was to bring work to workers rather than having the workers go to work. This was one way of reducing traffic and reducing energy cost, which was soaring high by the day. Soon after the government-funded research into telecommuting, 10,000 federal government employees were able to work remotely by 1997 (Avery & Zabel, 2001). This marked a huge success, a step forward into modern telecommuting.

IBM and Control Data corporations were among the first companies to explore telecommuting. This was during the 1970s, where programmers were in high demand, but there were few quality programmers in the market (Avery & Zabel, 2001). This ensured that the available workforce was able to work remotely and save on time traveling. Dual earning was also brought in place as people could better manage work and family welfare hand in hand.

Our mother nature has played a crucial role in telecommuting as well. In the early 1990s, organizations earmarked telecommuting as one of the strategies to enforce The Clean Air Act. This act had earlier been coined in 1970 but saw significant changes and reviews in 1970 and 1990. This act requires countries and states to come up with frameworks to achieve and maintain clean air standards. In an effort to achieve quality air standards, emissions from motor vehicles needed to be cut fast. One way of cutting the emissions was by coming up with ways in which people can work remotely and avoid using vehicles. In the 1990s as well, The Americans with Disabilities intensified the need for telecommuting as this was seen as a way of expanding the hiring of people with disabilities (Goluboff, 2001). This makes logical sense as People with disabilities can comfortably work from home as a way of being accommodated in the work environment.

According to a report done by Ipsos in 2011, about one in five employees reported being working from home across 24 sampled countries. India, Indonesia, and Mexico are the leading countries to have endorsed telecommuting. The American Community Survey reported that

2.6% of the US employees use their homes as the main workplace. Furthermore, the number of telecommuters increased from 1,819,355 in 2005 to 3,267,525 in 2012 (Global Workplace Analytics, 2015). Global workplace analytics further estimates that 25 million workers telecommute at least one day each month. This is a clear indication that the number of telecommuters increases every day and make up a significant percentage of our workforce.

The relationship between telecommuting and work performance has seen a never-ending debate. Several key issues have been raised. Absenteeism, job commitment, individual and teamwork performance, job satisfaction, as well as work-family balance, are some of the issues. All these, in turn, affect the performance of a firm altogether. Gajendran and Harison (2007) review empirical evidence and report a positive influence of telecommuting on performance. Wheatly (2017) also reports that among the British and German workers, telecommuting offers job satisfaction as well as leisure satisfaction.

Evidence from lab experiments suggests that their telecommuting offers negative effects on an

Individual's performance. Increased monitoring of agents by principals in work raises the efforts of the agent, which in turn lowers the controls of the agents (Dickinson et al. 2008).

2.1 Types of Telecommuting

There are several terms used to describe telecommuting within different disciplines, such as information systems, real estate, psychology, transport, and operations. This has brought about varied definitions and conceptualization used in the available literature. The terms that have been used to refer to telecommunications closely are telecommuting, telecommuting, distributed work, virtual work, flexible work, and distance work. The definitions often overlap and are used interchangeably, making it difficult to focus on one term as there is no clearly defined and accepted term. The definitions of the major terms used are as discussed below.

Telecommuting – Replacing commute to work by leveraging telecommunication technology, either partially or fully. (Mokhtarian et al., 1991)

Using technology to substitute or replace the traditional working environment that saw people commute to and from work. (Watson-Manheim, M. B., & Swan, B. R. (2013)

Telework – An arrangement of work in which work is partially or completely done outside the typical working environment with the use of telecommunication technologies. (Watson-Manheim, M. B., & Swan, B. R. 2013)

Remote Working – Employee resides and works at a different geographical location beyond the local reach of the local commute service of the employing company. It generally is full-time work.

According to Allen et al. (2015) comes up with a general definition from the varied literature definitions of telecommuting as, "Telecommuting is a work practice that involves members of an organization substituting a portion of their typical work hours (ranging from a few hours per week to nearly full-time) to work away from a central workplace—typically principally from home—using technology to interact with others as needed to conduct work tasks."

2.2 Theoretical literature review

2.20 Constructive Cost Model

First proposed by Boehm, this model is used to estimate the effort of a software engineer. Person-Months is the key metric employed by this model. Boehm proposed three variations of this model. The three models are, Organic Mode mostly used for small projects, Embedded Mode is used in very complicated and interwoven projects. These projects are characterized by rigid requirements. Semidetached model is the last model and comprises of intermediate software projects.

Efficiency

The Basic Constructive cost model computes the effort and the cost of production of the program size in terms of lines of code. Efficiency is measured by the number of resources per unit of work done. Lines of code that provide business value against the time taken to develop s termed as efficiency (Kamma, 2014). The general formula takes E= ab(KLOC)Exp(bb) persons month. E represents an effort in person-months, D is the time taken for development, KLOC, Kilo lines of the software project. BB is the are the co-efficient. According to Barb, 2014, Lines of code per staff month is used to measure the productivity of a software engineer, as the researcher found a strong correlation between Lines of code as a direct metric to determining the performance of an engineer.

Quality of Code

Typically, the software development process involves Requirement's analysis, Design, Implementation, and lastly testing. The effort distribution among these deliverables are 23% for Requirements collection and analysis, 29% for design, 22% for implementation and 21% for testing (Robert, 2004).

Error estimation is a key indicator for determining the quality of code. Boehm came up with an error estimation coefficient for the different tasks. The formula for error estimation is AFP = FP * coefficient.

2.21 Adaptive Structural Theory

It is evident that over the year's advancement of technologies drive organizational change. DeSanctis and Poole (1994) proposed the Adaptive Structural theory. This theory is key to assessing the impact of advancement in technology on the structure of organizations. With the ongoing pandemic, the overall working of organizations has seen a facelift to try and survive the hard economic times test. Employees have now been allowed to partially or fully work away from the vintage office setting.

Adaptive Structural Theory is relevant to studying the impact of telecommuting on work performance. Telecommuting in itself is a big stride in terms of technology. Employees now meet, work and report virtually. The availability of virtual conferencing tools and cloud computing tools enable telecommuting to run smoothly, (Daniel, 2010).

Daniel (2010) reports that the causative drivers for telecommuting on individual and group dynamics. Telecommuting removes the notion of one-size-fits-all, employees can now work with flexible schedules. The success was down to the causative drivers that determine the adaption of telecommuting by the individual user. It turns out that the adaption usefulness is the largest contributor to the success of telecommuting. The usefulness can be perceived through job satisfaction, the amount and quality of work turned in by the teleworker as compared to the office worker.

The conclusion by Daniel (2010) was that the impact of telecommuting on work performance is down to how organizations and employees perceive and accept the technologies as opposed to the technologies themselves.

DeSanctis and Poole (2004) found out that the Adaptive Structural framework points out that the adaptation itself of the actors is the primary issue that drives and promotes organizational change.

2.23 The productivity Servosystem Model

Developed by Hershauer and Ruch (1979), this model relates the major antecedents of productivity and aims at explaining the factors affecting performance. This model focusses on individual performance as it will eventually determine the team performance.

Elements of the model

Job Satisfaction

Job satisfaction and employee commitment are two factors that are closely related. Ideally, job satisfaction is what leads to employees being committed to an organization. In May 2020, at the height of the pandemic, 2800 employees in Silicon Valley were surveyed about their willingness to relocate and work remotely. 66% of the respondents were willing to relocate and keep their jobs remotely. Furthermore, they also said they would be willing to accept a pay cut of up to 20% if they are allowed to telecommute (Sherr, 2020). This shows how the physical locations of workplaces play a significant role in employee satisfaction. However, the relationship between telecommuting and job satisfaction is curvilinear. At lower levels, telecommuting has positive impacts, but as the amount of telecommuting time increases (above 15 hours weekly), job satisfaction plateaus (Allen et al.). This can be attributed to professional and social isolation effects due to telecommuting.

Work-Life Balance

Physical interaction improves the quality of the human-human relationship since it is a relaxed and more informal setting. Similarly, spending more time at home means that employees will interact more with their families; hence work-family stress will be reduced (Allen et al.). Essentially, these two factors improve performance. However, co-workers' relationships will be negatively affected as there will be minimal interactions. Organizations that rely on task interdependence where peer- interactions are essential need constant interactions and coordination. On this front, telecommuting tampers the smooth flow of operations and negatively affects performance (Allen et al.).

Job Commitment

In research of over 2800 companies in Europe, it was reported that companies that offered telecommuting had lower levels of staff turnover (Klindžić and Marić, 2019). In research conducted by Microsoft before implementing policies that would allow employees to work from home permanently, 82% of managers showed a desire to work from, and overall, 71% of employees also indicated their desire to work from home. Employee commitment can be attributed to the ability to choose their work settings and determine how they performed the duties they are assigned. Companies such as Alphabet, Facebook, and Twitter provide their employees with sleeping pods, gaming rooms, free meals, and other amenities to make the workplace less formal. COVID 19 pandemic added telecommuting to that list. Companies with flexible working environments have significantly low staff turnover since employees love their

jobs (Klindžić and Marić, 2019).

2.22 The Rayleigh model Framework

Quality management is a key area in software engineering. The Rayleigh framework is a handy tool for an engineering team as it provides a nice framework for quality management for a full development lifecycle. This model aims at preventing errors as early as possible to ensure the final product is of quality. Defect rates also called bug rate is a check that this model aims to check (Ning, 2013). Depending on the development phase, different types of testing is used. In the development stage, unit testing is used to measure the defect rates while in the release phase, user integration testing is used to measure the defect rates and test cases passed. This in turn translates to the quality of code written by a software engineer.

2.3 Conceptual Framework

Based on the literature review of the past studies done in this field, evidence-based information was used to come up with the conceptual framework. To measure the efficiency of a software engineer, timeliness in terms of Lines of code per staff month, and functional point per staff

month variables were identified. On the other hand, Test cases passed and defect rates variables were identified to directly determine the quality of code of a software engineer. To top it up, work-life balance, job commitment, and team interaction were identified as a variable that determines the effectiveness of a software engineer. A combination of the identified variables was used to come up with the conceptual framework. These variables test whether there is a significant relationship between the independent variables and the dependent variables. This research identifies efficiency, quality of work, effectiveness as some of the independent variables.
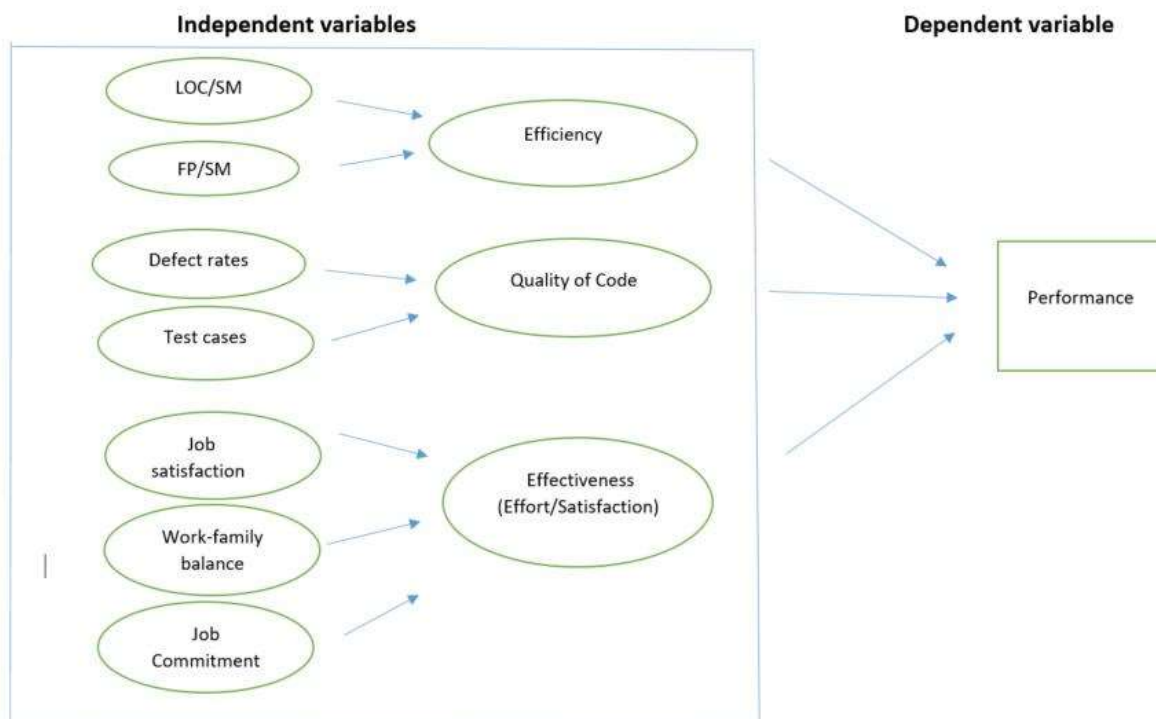
Chapter Three: Methodology

This section is dedicated to outlining the methodology that was used in the study to ensure the desired objectives are achieved. Additionally, it also contains information on the research technique used before, during, and after the study to collect and analyze the data in the research. The research designs are also detailed in this section. The main focus was on how the target population was selected, the sampling procedure and sample size that was deemed appropriate for the target sample, and the research design used in the study. The section is specifically dedicated to the data collection and analysis aspect of the study. The information derived from this section will be the foundation of the statistical aspect of the study.

3.0 Research Approach and Design

According to Ortdho (2003) research design is a plan undertaken to answer the research problem. This research used pure research. During the research study, both qualitative and quantitative data was used. This enabled the researchers to have a comprehensive understanding of the research problem. To answer the research questions and achieve the main objectives of the study, surveys were used. The surveys were applied to gather descriptive data and because they suited the research design that had been formulated. The descriptive research design helped to gather data about a subject matter during a specific time and offers insightful information on pre-existing conditions, the nature of these conditions, the standards that were used to compare the conditions, and relationships between particular events at the time.

This research design was intended to collect data on characteristics, behaviours, and attitudes. Also, it was ideal since it could be used on both individuals and groups. The researcher used interviews. Software engineers drawn from the IT Department, Equity Bank Headquarter were asked to fill questionnaires developed for the study.

3.1 Target Population of the Research Study

A population can be described as the objects, individuals, events, or entities with a common characteristic that conforms to set criteria being studied or analyzed (Rattray & Jones, 2007). They are the cases or subjects that are ideal for the topic being analyzed in a research study. The target population used in this research study was picked from Equity Bank IT Department. The Sample size was initially 170 employees. However, the number was reduced to a final figure of 100 employees from the department. The research targeted employees who fully worked from office in the first quarter of 2020, and those who fully telecommuted in the first quarter of the year 2021.

The reason for this number was because other employees previously selected for the study were dropped for various reasons. Some failed to meet the criteria of being telecommuting employees. Others were not from the department and were considered to be 'non-essential' workers. To improve the accuracy of the study, employees who were selected were those who worked exclusively in the IT Department. Specifically, the study included all employees at various seniority levels in the department. For questionnaires targeting quantitative data available from repositories, a separate questionnaire was developed to target the Team Leads and management. LOC/SM, FP/SM, Bug rates and test cases passed data were derived from repositories.

3.2 Sample Size and Sampling Procedure

A sample is the portion of an entire population that is used to represent the whole population that is being studied (Mugenda & Mugenda, 2003). The sample size drawn and analyzed is used as a measure to generalize the statistical findings from the research. Sampling is often used to reduce the resources used to conduct a study by cutting the cost and time used in the study. For a sample size to be considered ideal, the size should be approximately 10% to 20% of the entire population.

A purposive method of sampling was used to select the 100 employees that participated in the

research study. The main reason for selecting the employees from the IT Department was because they were the first to be asked to telecommute. Additionally, they were the most tech-savvy group hence the most resourceful in technological matters affecting employees. They were also the largest population of telecommuters in the company. Random sampling was used to select the 100 employees who participated in the study.

3.3 Data Collection Techniques

During the research study, both primary and secondary data were used. Secondary data was used in the literature review stage of the study where information from previous studies was analyzed and compared with the finding. Literature review was used to collect data from prior research as a way of gaining insights on what issues the project report could look at. Furthermore, the questionnaire was used to collect primary data from the IT staff. This data collection method was selected since all the respondents were literate. Also, questionnaires are easy to use, understand and analyze hence was suitable for both parties involved in the project. Questionnaires in form of Google forms questionnaire were the best method and suitable for this study since they could be used to collect qualitative and quantitative data at the same time. This method was preferred as the software engineers could receive and respond to the questionnaire remotely without any form of physical contact. Therefore, they were the main data collection instrument. Also, it presented the safest data collection method during the pandemic since minimal contact was needed (Chang, Chien, & Shen, 2021).

3.4 Reasons for Conducting the Interviews

Due to the pandemic, interviews could not be conducted in person. Therefore, a method had to be devised to collect views from potential respondents. Google forms were selected as the best way to remotely collect data since it was safe and also offered anonymity. This ensured that employees could freely share their opinions. From the pertinent issues raised by employees, a

draft of the interview questions was constructed. Also, an interview schedule in form of time allocated for respondents to acquire and fill the questionnaire was developed (Mauti, 2021).

3.4.1. Questionnaires

Questionnaires were used to collect data from the software engineers on their views about telecommuting. The questionnaire consisted of three main segments: introduction consisting of respondent's information, functional part consisted of their views about telecommuting and lastly, their demographic information.

Development of the questionnaire used in the research study took systematic steps. The first step was to determine what the questionnaire would measure. The items to be measured were attitudes, outputs, knowledge and cognitive abilities. The first part of the questionnaire was introductory and consisted of general information. The second part consisted of demographic information that identified the demographic group of the respondent. This was intended to identify specific demographic groups and their preferences. The third part was the body of the questionnaire and consisted of the functional questions. This part was intended to answer the research questions by providing insightful and specific information. Lastly, the fourth part of the questionnaire was developed to test the accuracy and reliability of the questionnaire (Chang, Chien, & Shen, 2021).

Secondly, a range of scales and response styles that would be used to collect information was developed. This led to the development of a uniform frequency (Likert) scale. Continuum responses comprising of answers ranging from strongly agree to strongly disagree was developed. Therefore, the data collected was interval data. Empirical data was collected using the yes or no response style. For the last part of the questionnaire, quantitative data collected was used to determine the accuracy and validity of the questionnaire (Rattray & Jones, 2007).

The next step was to develop the items that would be studied, questionnaire wording and order of the questions. The pilot study was conducted to determine the most significant factors and issues related to telecommuting. These factors and issues were then analyzed in relation to the research questions and objectives. The questions were then developed using the introduction-demography-functional format which was also the order of the questionnaire (Mauti, 2021). A piloting study was then conducted using 10 respondents to determine questions that lacked clarity or would lead to bias. Since the number of respondents was 100 or less, item analysis used a correlation cut-off was set at less than 0.3. Problematic questions were identified using non-response rates, the cut-off value, and feedback from respondents about bias.

The questionnaires aimed at finding out how performance affected productivity and efficiency, effectiveness and quality of code were sort as main areas to look at. From constructive cost model theory, adaptive structural theory and productivity Servosystem model the research identified the following hypothesis:

Hypothesis 1. Telecommuting positively affected the efficiency (Functional points per staff month, Lines of code per staff month) of a software engineer.

Hypothesis 2. Telecommuting positively affects quality of code (Defect rate and test cases passed) of a software engineer.

Hypothesis 3. Telecommuting negatively affects effectiveness (job satisfaction, work life balance, job commitment) of a software engineer.

3.5 Reliability and Validity

Validity entails the research being able to test the parameters it was intended to examine, while reliability looks at the relevance of the research study. To measure the research study's reliability, the statistical tools used should give similar results when administered repeatedly

(Mauti, 2021). The statistics used in the study will be a questionnaire. Therefore, to meet the reliability standards, the questionnaires were administered repeatedly during a trial period to measure the reliability of both the subjects and the questionnaire being used. The validity of the statistical tool is the wording and formatting of the questionnaire. A pilot test/survey items was sent to select pilot group to gain insights and suggestions for modification (Rousson, Gasser and Seifer, 2002). Poor wording, sequencing of the questions and general design are essential factors that affect the validity of the research. The wording and question sequence ensures that specific information is obtained. The content of questionnaires in the form of the answers given by the respondents, therefore, will be the data validity measure. Two questionnaires were formulated, one for the management, which ensured the data from repositories were valid and also consistent with the regular engineers. The second questionnaire targeted the engineers themselves on their take on telecommuting.

3.6 Interview Schedule

The interview schedule was developed as a way to manage the data collection process. This process was used to ensure that all the respondents had adequate time and opportunity to fill their questionnaires. In turn, it led to the collection of in-depth data and improved the response rate. Also, it ensured that all the answers given were natural and factual.

3.7 Data Analysis and Representation

To analyze the data obtained, data was categorized in their specific groups, packaged, and written in a form that can be easily communicated. Data analysis was done using statistical software. Quantitative data obtained from the survey was analyzed using SPSS (Statistical Package for Social Sciences). The data was coded and edited in a form that could be fed into the software for subsequent analysis. SPSS software was used to generate the measures of central tendency and further the measures of dispersion in the form of percentages and ranks. The qualitative data was also coded and analyzed using SPSS. The presentation of the data was done

through charts and graphs. Explanatory notes were added to the presentation to provide more information on the presentation and explain the ideas being presented.

3.8 Ethical Considerations

The research study was social research. Therefore, the ethical factors considered were confidentiality, avoiding presenting deceptive data or information, and subjects' anonymity (Mugenda & Mugenda, 1999). All subjects or employees who participated in the study did it of their own volition. The anonymity was achieved by ensuring the questionnaires did not have the subjects' names. Additionally, the data was transformed into numerical and qualitative data with any information that could identify individuals erased. The data collection methods were devoid of any bias, and permission will be sought from the Department Manager before the research study commenced. The objectives of the study were in written form to ensure each participant understood what the researchers want to analyze to reduce the risk of wrong information being given. The research study also acknowledged all the sources and information derived from other scholarly works.

Chapter Four: Data Analysis, Presentation and Interpretation

4.0 Introduction

This chapter was dedicated to data analysis, its presentation in a format that could be read, and interpretation of the collected data. This was aimed at the organization of the collected data to understand how telecommuting affected the productivity of employees drawn from Equity Bank's IT Department. The data collected and subsequent analysis was based on the goals of the research study and sought to answer the research question as stipulated. The objectives included assessing the impact of telecommuting on employee productivity, analyzing how it affected their job satisfaction, their work-life balance, and how these factors directly affected their output or influenced job retention.

4.1 Response Rate

The research study achieved a response rate that was sufficient to achieve the objectives of the research study. As stipulated in her research paper, Mugenda and Mugenda (2003) asserts that the sufficiency of research response rate is categorized as follows: a response rate of 50% is considered to be adequate, a response rate of 60% is considered good and if it is above 70% it is considered to be very good. Initially, the research study targeted 170 employees drawn from the IT Department. However, the final figure of respondents given the questionnaires was 100 employees. Those excluded from the final study included support staff and employees who had no prior telecommuting experience.

Of the 100 employees who participated in the study, 92 returned the questionnaires representing 92% as tabulated below.

Table 1: Response Rate of Questionnaires

Questionnaire Sent	Questionnaire Returned		Percentage of Questionnaires not returned	
	Number	Percentage	Number	Percentage
100	92	92%	8	8%

4.3 Demographic Characteristic of the Respondents

In this research study, the demographic characteristic of the respondents had a critical role. This is because certain demographic groups exhibited unique characteristics. Also, telecommuting is heavily reliant on technology. In this case, it required adopting the latest technology and its preference was dependent on the demographic group. The personal characteristics that made up the demographic groups were age, gender, seniority and marital status.

4.3.1 Gender

For this research study, gender was described as the state of a respondent being male or female. Equity Bank's IT Department had 76 male employees and 24 female employees. The final tally of respondents who returned their questionnaires was 72 male and 20 female respondents. This translated to 78% male respondents and 22% female respondents as illustrated in figure 2 below.

Figure 2: Gender Distribution of Respondents

Variables	Classification	Frequency	Percentage
Gender	Male	72	78%
	Female	20	22%

4.3.2 Age

The age of respondents who participated ranged from 18 years (legal working age) to 65 years (legal retirement age). This was used to determine the preference of telecommuting among certain age groups and its impact on their productivity. Also, in certain age groups, it was an important factor in analysing the ability to quickly adapt. The table below shows the distribution of age groups.

Table 3: Age Distribution

Age	Frequency	Percentage
18 - 28	28	32%
29 - 39	47	55%
51 – 61	10	11%
>61	3	2%
Total	**88**	100

4.3.2 Seniority Level

Seniority level was also a factor analyzed during the research study. Employees were grouped according to their level of experience which determined their seniority level within the company. The seniority levels were categorised as junior, intermediate, and senior.

Junior employees were entry-level staff who had recently joined the company within the last 2

years. Intermediate employees had been working for the bank for more than 2 years but less than 5 years. Employees who had been working for the bank for more than 5 years were considered seniors. On the other hand, rank was also used to categorise the employees according to the role assigned and seniority within the organizational structure. From the data collected, most of the employees in Equity Bank's IT Department are mid-level employees.

Table 4: Seniority

Seniority Level	No. of Years Worked	Frequency	Percentage
Junior Staff	< 2 years	23	29%
Intermediate Staff	2 – 5 years	44	57%
Senior Staff	>5 years	11	14%

4.3.3 Marital Status

Ideally, the family setup status of employees was adopted as a variable to enable the researchers to study the work-life balance of employees. Married individuals have more family responsibility and thus could impact the working hours. For the purpose of this study, family setup status was considered to be anyone having a partner, or those living with members of their family (including extended family). Also, any parent living with their child was considered as living in a family. Single employees were taken to be employees living by themselves and not sharing their houses with other people. It was noted that most of the single employees were the junior staff. Being single or married was taken in the concept of responsibility and not the traditional description by status. The data showed that 22% of employees were single while 78% had varying types of family responsibilities and fit the category of being married. Therefore, most of the employees lived in a family setup.

Figure 2: Family Setup Status (Living in a family 78%, Single 22%)

Classification	Frequency	Percentage
Married	72	78%
Single	22	22%

4.4 Results from the Research Study

From the interview responses, 89.77% of those interviewed said that they voluntarily opted to telecommute. Despite, the research study being conducted during the pandemic (Covid 19), most respondents did not feel they were compelled or forced by the Equity Bank to telecommute. 67% (59 employees) of those interviewed agreed that telecommuting had been a better experience as compared to physical working. Of this number, 40.68% (24 employees) strongly agreed while 59.32% (35 employees) agreed to this assertion. 23% (29 employees) felt that they had been forced to work from home against their wishes.

Efficiency

Table 4: **Efficiency**

Questionnaire Item	Strongly agree	Agree	Neutral	Disagree	Strongly Disagree
Telecommuting improves efficiency compared to physical working	10%	35%	40%	15%	5%
Telecommuting has increased the Functional points per staff month	6%	36%	43%	12%	3%
Telecommuting has increased the number of lines of code per staff month	9%	43%	35%	13%	0%
Average score	7%	38%	39%	14%	3%

Average Lines of Code per Staff Month as a telecommuter and as non-telecommuter

Table 4.1: **Lines of Code**

Type	Telecommuter	Non-telecommuter
Lines of Code	755	743

Average Lines of Code per Staff Month as a telecommuter and as non-telecommuter. The average test cases passed reduced by 0.1%.

Table 4.2: **Functional point**

Type	Telecommuter	Non-telecommuter
Functional points per staff month	7	9

Table 4 Findings, the research established that 38% concurred that telecommuting improved their efficiency, 39% were neutral and 14% opposed the statements. The FP/SM slightly improved by 20%.

Quality of Code

Table 5: **Quality of Code**

Questionnaire Item	Strongly agree	Agree	Neutral	Disagree	Strongly Disagree
Telecommuting has positively affected the quality of my work compared to physical working	15%	43%	**35%**	**6%**	**3%**
Telecommuting has increased my test cases passed	**12%**	**40%**	**38%**	**6%**	**4%**
Telecommuting has reduced my defect rate/bug rate	**17%**	**43%**	**30%**	**10%**	**0%**
Average score	**15%**	**42%**	**34%**	**7%**	**2%**

Average bug rates as a telecommuter and as non-telecommuter

Table 5.1: **Quality of Code**

Type	Telecommuter	Non-telecommuter
Bug Rates	65%	73%

Average test cases passed as a telecommuter and as non-telecommuter, the quality of code improved by 10%

Table 5.1: **Quality of Code**

Type	Telecommuter	Non-telecommuter
Test cases passed	61%	67%

Table 4 Findings, the research established that 7% opposed the statement focused on quality of code, 42% concurred that telecommuting improved their quality of code, increasing test cases passed and reducing the defect rates, while 34% were neutral.

Effectiveness

Table 6: **Quality of Code**

Questionnaire Item	Strongly agree	Agree	Neutral	Disagree	Strongly Disagree
Telecommuting has positively affected my work-life balance compared to physical working	15 %	20%	**25%**	33%	7%
Telecommuting has increased my job commitment	**10%**	**30%**	**28%**	**28%**	**4%**
Telecommuting improves employee satisfaction compared to physical working	**16%**	**43%**	**20%**	**12%**	**8%**
Average score	**15%**	**35%**	**24%**	**18%**	**8%**

Table 6 Findings reveals that 35% of the respondents concurred with statements that focused on effectiveness, 24% were neutral while 18% disagreed with the statements.

4.4.1 Data Analysis and Interpretation

Descriptive statistics used in this study provided an overview of the mean, standard deviation, minimum and maximum data derived from the questionnaires. During analysis, the Likert Scale was given values ranging from 1- 5. Therefore, the maximum value was 5 and the minimum 1.

	N	Minimum	Maximum	Mean	Standard Deviation
Effeiciency	88	1	5	3.71	0.824
Effectiveness	88	1	5	2.49	0.871
Quality of Code	88	1	5	3.62	0.885

Descriptive Statistics of Data

The data was further analyzed using SPSS to get a clear statistical interpretation of the relationship between the variables. The variables were categorized into 3 main attributes as seen in the descriptive statistics table above.

    a. Predictors: Independent variable: (Constant), Efficiency, quality of code, effectiveness (Lines of code/staffmonth, functional points per staff month, bug rates, test case pass rate, work family balance, job satsifaction)

b. Dependent variable: Effects of telecommuting on performance

Coefficients

Model	Unstandardized Coefficients		Standardized Coefficients		
	B	Std. Error	Beta	t	Sig.
(Constant)	3.614	.710		5.388	.000
Effeiciency	.841	.219	.245	.468	.434
Effectiveness	.0121	.212	-.112	.252	.812
Quality of Code	.517	.229	.292	.443	.325
Work-life Balance	-.431	.246	-.208	-.628	.535
Bug rate	.846	.179	.145	.468	.367
Test case pass rate	.442	.176	.056	.427	.531
Job satisfaction	.235	.251	-.251	-.526	.342
Lines of code per staff month	-.187	.129	-.291	.017	1.433
Functional points per staff month	.820	.183	.135	.356	.442

The Regression model was $Y = 3.614 + 0.841X_1 - 0.0121X_2 + 0.517X3 - 0.431X_4 + 0.846X_5$

$0.442X_6 \, 0.235X_7 + 0.235X_8 + 0.820X_9 + e$

The research study utilized the one-tailed t-test for the analysis. This was used to determine how telecommuting affects the IT staff of Equity Bank. From the co-efficient table, the Efficiency and quality of code had a co-efficient value of 0.841 and 0.571 respectively. This shows that they had a significant impact on employee functionality. Their effect was positive hence shows that most employees felt that efficiency and quality of code had improved as a result of telecommuting. On the other hand, effectiveness had a co-efficient of -0.0121. Therefore, this shows that effectiveness has a slight negative impact as an effect on employee functionality.

Model Summary

R	R Squared	Adjusted R	Error of Estimation	Accuracy
0.761	0.243	-.012	0.30748	2.265

The model summary table gave the correlation (R) figure at 0.761. This means that there was a strong positive correlation between the dependent and the independent variables. This means that the dependent variables had a direct impact on the independent variable. Also, the independent variables (predictors) could predict 24.3% of the variations in employee functionality of telecommuting IT Staff. The remaining 76.7% of the variations are due to the other variables.

Discussion of Results

Overall, the findings from the analysis of the independent variable (effectiveness) employee relation/teamwork and job satisfaction/ commitment were positively constructed. This means that they had a positive effect on employee functionality among telecommuting staff. On the other

hand, telecommuting led to employees working for longer hours and negatively impacted their work-life balance. However, the impact on productivity was slight. This minimal effect can be attributed to many factors. Also, it is interesting that employees worked for longer hours but their productivity slightly increased. Therefore, this is an area that requires more research hence could be a future research topic. The resulting framework is as below.
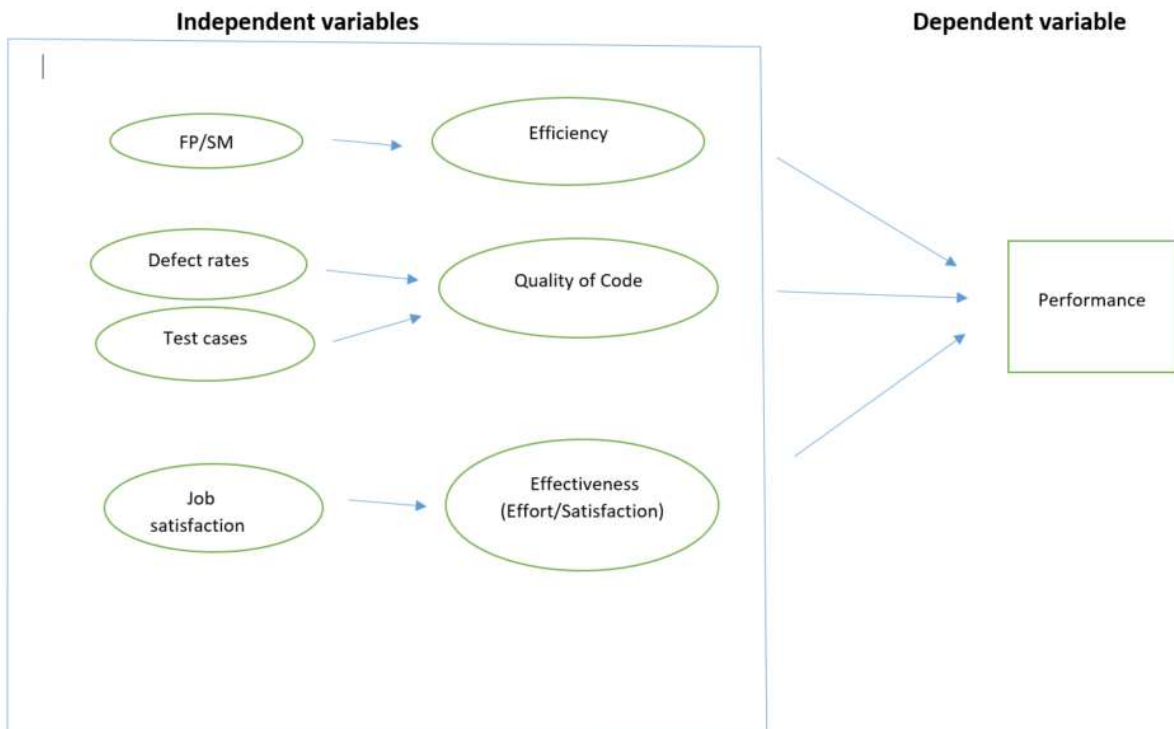
Chapter Five: Conclusion and Recommendations

The project was intended to study the effects of telecommuting and how it affected employee productivity, output, and welfare.

Conclusion of the Study

Before the COVID-19 pandemic, telecommuting was not a common working arrangement. However, employers and employees had to quickly adapt to changing times which was also necessitated by the need to adhere to safety protocols. Telecommuting enabled companies to operate at a time when safety protocols meant that people could not congregate and effectively perform their duties at their physical workstations.

Interestingly, despite telecommunication being necessitated by events, many employees at Equity Bank fully embraced the change voluntarily. Also, it is evident that telecommuting affects the performance of a software engineer. Quality of work slightly improves by telecommuting. Efficiency also improves by a small percentage for a telecommuter. Ironically, despite working remotely, it did not affect teamwork and employee relationship. On the other hand, Equity Bank IT Department employees reported working for long hours as compared to physical working. Working for longer hours meant that employee work-life balance was negatively impacted.

Achievements

The research proved that despite being a relatively new thing, telecommuting is a working arrangement that can be implemented when required. The findings of the research established that employees could adapt well to the rigours of telecommuting and changing work arrangements. This can be used a future reference material when formulating new working arrangements.

Limitation of the Study

The respondents who participated in the study were professionals with expertise in the field of IT. This means they could easily adapt to using technology to perform their duties. Ideally, they only swapped the physical location of their workstation without the need to undergo training or change how they performed their duties. Therefore, the findings may not be a representation of how telecommuting would affect employees from other fields. For instance, teachers had to learn new skills on how to use new technology like videoconferencing when teaching.

Recommendation

Telecommuting had no significant effect on employees with regards to performing their duties. However, further research is required on its sustainability and its long-term effects on employees. Similarly, future studies should expand their scope by selecting professionals drawn from different fields. This would help have a better understanding of its effects hence guide future decisions or policies.

Appendix 1: Questionnaire

Introduction

The purpose of this study is to collect data for this research. Information gathered from this survey will be strictly confidential and will exclusively be used for the research paper. Please provide the correct information.

Part A: General Information (Please tick as appropriate**)**

1. Name of Respondent:_____ (Optional)

2. Gender:

   [ ] M   [ ] F

3. Age Group (Years)

   [ ] 18-28 [ ] 29-39 [ ] 40-50 [ ] 51-61 [ ] Above 61

4. Highest level of education

   Certificate [ ] Diploma [ ] Bachelors [ ] Masters [ ] Ph.D. [ ]

5. Have you ever telecommuted ("Work from home")?

   [ ] Yes   [ ] No

6. If Yes to 5 above, how often have you telecommuted?

   [ ] Regularly [ ] Occasionally

7. Was telecommuting voluntary or necessitated by events?

   [ ] Voluntary [ ] Necessitated by events

8. Level of the developer

   [ ] Junior [ ] Intermediate [ ] Senior

Part B: Specific information (Please tick as appropriate**)**

9. The following are perceived effects of telecommuting on productivity. Indicate the extent to which you agree with the following statements.

1-Strongly Agree, 2-Agree, 3-Neutral, 4-Disagree, 5-Strongly Disagree

Statement	1	2	3	4	5
Telecommuting improves efficiency compared to physical working					
Telecommuting has increased the number of lines of code per staff month					
Telecommuting has increased the Functional points per staff month					
Telecommuting has positively affected the quality of my work compared to physical working					
Telecommuting has increased my test cases passed					
Telecommuting has reduced my defect rate/bug rate					
Telecommuting has positively affected my work-life balance compared to physical working					
Telecommuting improves employee satisfaction compared to physical working					
Telecommuting has increased my job commitment					
Telecommuting has improved effectiveness of my job					

10. How would you rate your experience of telecommuting?

[ ] Very good [ ] Good [ ] Bad [ ] Very bad

11. Given a choice, would you choose telecommuting or physical working?

[ ] Telecommuting [ ] Physical working

12. Would you leave your organization due to the experiences from telecommuting?

[ ] Yes [ ] No

13. What are your comments on telecommuting?

Questionnaire II

Introduction

The purpose of this study is to collect data for this research. Information gathered from this survey will be strictly confidential and will exclusively be used for the research paper. Please provide the correct information.

Part A: General Information (Please tick as appropriate**)**

1. Name of Respondent:_____ (Optional)

2. Management level:_____

3. Gender:

[ ] M   [ ] F

4. Age Group (Years)

[ ] 18-28 [ ] 29-39 [ ] 40-50 [ ] 51-61 [ ] Above 61

5. Highest level of education

Certificate [ ] Diploma [ ] Bachelors [ ] Masters [ ] Ph.D. [ ]

6. Have you ever telecommuted ("Work from home")?

[ ] Yes   [ ] No

7. If Yes to 5 above, how often have you telecommuted?

[ ] Regularly [ ] Occasionally

8. Was telecommuting voluntary or necessitated by events?

[ ] Voluntary [ ] Necessitated by events

9. Level of the developer

[ ] Junior [ ] Intermediate [ ] Senior

Part B: Specific information (Please tick as appropriate**)**

10. The following are perceived effects of telecommuting on productivity. Indicate the extent to which you agree with the following statements.

1-Strongly Agree, 2-Agree, 3-Neutral, 4-Disagree, 5-Strongly Disagree

Statement	1	2	3	4	5
Telecommuting improves efficiency compared to physical working					
Telecommuting has increased the number of lines of code per staff month					
Telecommuting has increased the Functional points per staff month					
Telecommuting has positively affected the quality of my work compared to physical working					
Telecommuting has increased my test cases passed					
Telecommuting has reduced my defect rate/bug rate					
Telecommuting has positively affected my work-life balance compared to physical working					
Telecommuting improves employee satisfaction compared to physical working					
Telecommuting has increased my job commitment					
Telecommuting has improved effectiveness of my job					

11. What is the average LOC/SM as telecommuter and as non-telecommuter

Range	Telecommuter	Non-telecommuter
<100		
100-500		
500-1000		
1000 >		

12. What is the average FP/SM as telecommuter and as non-telecommuter

Range	Telecommuter	Non-telecommuter
<100		
100-500		

500-1000		
1000 >		

13. What is the average test cases passed as telecommuter and as non-telecommuter

Range	Telecommuter	Non-telecommuter
<100		
100-500		
500-1000		
1000 >		

14. What is the average defect rates passed as telecommuter and as non-telecommuter

Range	Telecommuter	Non-telecommuter
<100		
100-500		
500-1000		
1000 >		

15. How would you rate your experience of telecommuting?

[ ] Very good [ ] Good [ ] Bad [ ] Very bad

16. Given a choice, would you choose telecommuting or physical working?

[ ] Telecommuting [ ] Physical working

17. Would you leave your organization due to the experiences from telecommuting?

[ ] Yes [ ] No

18. What are your comments on telecommuting?

References

Allen, T.D., Golden, T.D. and Shockley, K.M., 2015. How effective is telecommuting? Assessing the status of our scientific findings. *Psychological Science in the Public Interest*, *16*(2), pp.40-68.

Kamma, D., 2014, May. Study of task processes for improving programmer productivity. In *Companion Proceedings of the 36th International Conference on Software Engineering* (pp. 702-705).

Bhattacherjee, A., & Harris, M. (2009). Individual adaptation of Information Technology. Journal of Computer Information Systems, 50(1), 37-45.

Ning, J. and Hu, M., 2013. Study on software quality improvement based on Rayleigh model and PDCA model. *Telkomnika: Indonesian Journal of Electrical Engineering*, *11*(8), pp.4609-4615.

Barb, A.S., Neill, C.J., Sangwan, R.S. and Piovoso, M.J., 2014. A statistical study of the relevance of lines of code measures in software projects. *Innovations in Systems and Software Engineering*, *10*(4), pp.243-260.

Barkmann, H., Lincke, R. and Löwe, W., 2009, May. Quantitative evaluation of software quality metrics in open-source projects. In *2009 International Conference on Advanced Information Networking and Applications Workshops* (pp. 1067-1072). IEEE.

DeSanctis, G., & Poole, M. S. (1994). Capturing the Complexity in Advanced Technology Use: Adaptive Structuration Theory. Organization Science, 5(2), 121-147. INFORMS. doi: 10.1287/orsc.5.2.121.

Gajendran, R.S., Harrison, D.A. and Delaney-Klinger, K., 2015. Are telecommuters remotely good citizens? Unpacking telecommuting's effects on performance via i-deals and job resources. *Personnel Psychology*, *68*(2), pp.353-393.

Monteiro, N.P., Straume, O.R. and Valente, M., 2019. Does remote work improve or impair firm labour performance? Longitudinal evidence from Portugal.

Brueggen, A., Feichter, C. and Haesebrouck, K., 2020. Home office: Causal Evidence on Selection and Location Effects from Telecommuting. *Available at SSRN 3020221*.

Klindžić, M. and Marić, M., 2019. Flexible Work Arrangements and Organizational Performance–The Difference between Employee and Employer-Driven Practices. *Društvena istraživanja*, *28*(1), pp.89-108.

Rattray, J., & Jones, M. C. (2007). Essential Elements of Questionnaire Design and Development. Journal of clinical nursing, 16(2), 234-243.

Chang, Y., Chien, C., & Shen, L. F. (2021). Telecommuting during the coronavirus pandemic: Future time orientation as a mediator between proactive coping and perceived work productivity in two cultural samples. Personality and individual differences, 171, 110508.

Mauti, N. O. (2021). The Contribution of Telecommuting to Productivity and Innovation in Academic Libraries in Kenya in the Wake of COVID 19.

Sherr, I., 2020. *Tech Giants Reshape Work-From-Home Policies*. [online] CNET. Available at: https://www.cnet.com/news/the-new-work-from-home-policies-at- facebook-twitter-apple-and-more.

365 NEWS. 2020. *Microsoft Will Let Some Staff Work From Home Routinely Post-Pandemic*. [online] Available at: https://www.365news.com/2020/10/microsoft-will-let- some-staff-work-from-home-routinely-post-pandemic].

Konradt, U., Hertel, G. and Schmook, R., 2003. Quality of management by objectives, task-related stressors, and non-task-related stressors as predictors of stress and job satisfaction among telecommutingers. *European Journal of Work and Organizational Psychology*, *12*(1), pp.61-79.satisfaction among telecommutingers. *European Journal of Work and Organizational Psychology*, *12*(1), 61-79.

Henderson, A.D., Miller, D. and Hambrick, D.C., 2006. How quickly do CEOs become obsolete? Industry dynamism, CEO tenure, and company performance. *Strategic Management Journal*, *27*(5), pp.447-460.