EFFECTS OF MONITORING & EVALUATION SYSTEMS AND THE PERFORMANCE OF SLUM UPGRADING PROJECTS IN SUB-SAHARAN AFRICA

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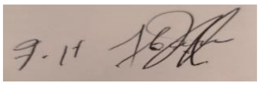
AN APPLIED RESEARCH PROJECT SUBMITTED IN PARTIAL FULFILMENT OF THE REQUIREMENT FOR THE AWARD OF MASTER OF ARTS DEGREE IN MONITORING AND EVALUATION DEGREE IN THE BUSINESS SCHOOL OF AFRICA NAZARENE UNIVERSITY

JULY 2020

DECLARATION

I declare that this applied research is my original work and that it has not been presented in any other University for academic credits.

Signature:  _________ Date: 13 July 2020__________________

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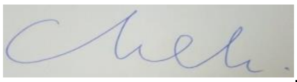
SUPERVISOR'S DECLARATION

This applied research proposal is submitted for examination with my/our approval as the University Supervisor.

Signature: _______ Date: 13 July 2020___________________

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DEDICATION

I would like to dedicate this research proposal to my two lovely kids Farnyi Louibeuka Abanda and Mason Wofarnyi Abanda.

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ABSTRACT

Recent research reveals a surge in the number of slums in Sub-Saharan Africa with no sign of abating, evident from the continuous mass influx of youths from rural villages to cities. Thus, the upgrading of slums to improve the living conditions of those who live in such environments is imperative. However, the performance of past slum upgrading projects has quite been contentious with many failing to meet their pre-defined objectives. This study investigated the effects of integrated BIM and M&E on the performance of slum upgrading projects in Sub-Saharan Africa. The specific objectives are fourfold. Firstly, the study determined the effects of M&E systems on the performance of slum upgrading projects in Sub-Saharan Africa. Secondly, it examined the effects of emerging BIM on the performance of slum upgrading projects in Sub-Saharan Africa. Thirdly, the study investigated the effects of human resource capacity on the performance of slum upgrading projects in Sub-Saharan Africa. Lastly, it investigated the effects of integrated BIM and M&E in maximising the performance of slum upgrading projects in Sub-Saharan Africa. A quantitative research method was used to achieve the aim of this study. From a quantitative perspective, a questionnaire was used to gather data about the different factors. The target population for the structured questionnaire was 88 which comprised M&E and BIM experts. Using the target population, a sample size of 72 was computed using the Yamane formula. The quantitative data collected was analyzed using descriptive statistics and inferential techniques. Three main findings emerged from this study. Firstly, 63.1 % and 68.1% were of the view (Agreed and Strongly Agreed) that M&E and BIM have effects on the performance of slum upgrading projects. Secondly, 65.9% of respondents opined (Agreed and Strongly Agreed) that a professional with both M&E and BIM skills have effects on the performance slum upgrading projects compared to 27.3% and 23.9% if the same professional is proficient in only one of the skills respectively. Lastly, it emerged that 68.6% is of the opinion (Agreed and Strongly Agreed) that integrating both M&E and BIM can significantly improve the performance of slum upgrading projects compared to each when applied in isolation. The findings were presented using tables with detailed analytical interpretations outlined. The fact that integrating both M&E and BIM skills can significantly improve the performance of slum upgrading projects compared to each when applied in isolation, a major recommendation is that future studies should focus on investigating and developing an integrated BIM and M&E framework for delivering and monitoring slum upgrading projects. The framework should aim at guiding professionals in using BIM and M&E in the delivering of slum upgrading. The framework is imperative given the emerging and complex nature of BIM and M&E.

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I gratefully acknowledge the support and guidance of my supervisor Dr. Charles Weda who has always been available to answer my questions on WhatsApp, e-mails and the phone even at late hours. Also, I would like to thank the administrative and teaching staff of the Business School of Africa Nazarene University for their support during my time as a student on the M.A. M&E Programme.

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LIST OF ABBREVIATIONS

ANU	Africa Nazarene University
BIM	Building Information Modelling
ICT	Information and Communications Technology
FEDUP	Federation of the Urban and Rural Poor
LFA	Logical Framework Approach
M&E	Monitoring and Evaluation
SDG	Sustainable Development Goals
SPSS	Statistical Package for the Social Sciences
UNDP	United Nations Development Programme

DEFINITION OF TERMS

Human Resource Capacity: For the purposes of this study**,** this refers to the ability of professionals to use BIM and/or M&E techniques in delivering slum upgrading projects. In other words, it refers to professionals' BIM and/or M&E skills required in delivering slum upgrading projects.

BIM: Operationally defined as a coordinated set of processes, supported by technologies that add value by creating, managing and sharing the properties of an asset throughout its lifecycle (Mott MacDonald, undated). Models incorporate graphic, physical, commercial, environmental and operational data.

BIM Applications: For the purposes of this study, BIM applications refer to the different uses of BIM in improving the performance of slum upgrading projects.

Monitoring and Evaluation (M&E): Operationally defined**,** monitoring is a process of continuous observation and assessment throughout the project execution while evaluation is a periodic assessment of the same and includes interim and terminal evaluations.

M&E systems: Operationally defined, an M&E system is an M&E concept which refers to all the indicators, tools and processes that can be used to assess whether a program has been implemented according to the plan (monitoring) and is having the desired result (evaluation) (Bullen, undated). Therefore, this definition encompasses all the independent variables in the conceptual framework (see Figure 1.1) of this study. More importantly, BIM can be used to enhance the M&E process.

M&E types: Operationally defined as the different types of activities (e.g. monitoring, ex-ante, mid-term, terminal and ex-post evaluations) performed at specified times during the M&E process.

Integrated BIM and M&E: For purposes of this study, this refers to the merging of BIM and M&E approaches and applying them together on a slum upgrading project as opposed to applying each independently.

Project: Operationally defined, a project is a temporary endeavour undertaken to create a unique product, service or result. Furthermore, a project has well-defined start and end dates, hence with defined scope and resources. In other words, a project is a series of activities aimed at bringing about clearly specified objectives within a well-defined time-period and budget.

Project Management: Operationally defined as a set of principles, methods, techniques for effective planning of objective oriented work; therefore, establishing a sound basis for effective scheduling, controlling and planning in the management of projects and/or programmes.

Indicators (Criteria for Performance Measurement): Operationally defined, performance indicators are measures of inputs, processes, outputs, outcomes, and impacts for development projects, programs, or strategies. Benchmark data is a reference data that can be used in measuring the performance of a project or programme against a chosen indicator.

Slum Upgrading Project Performance: For purposes of this study, this refers to the accomplishment of a slum upgrading project vis-à-vis a pre-set known standards or requirements, such as cost, time, quality, etc.. In other words, it refers to how the deliverables from a project aligns with the set project's or programme's objectives.

Theory of Change: For purposes of this study, the theory of change is a sequence of events that is expected to lead to a particular desired outcome.

Logic frame: For purposes of this study, a logic frame describes a holistic approach in planning, monitoring and evaluating projects or programmes using structured models or matrix forms. Its other synonyms are log frame, logic framework, planning tool and framework.

Logical Framework Approach (LFA): For purposes of this study, the LFA is an analytical process and set of tools used to support project planning and management. It is imperative to distinguish the Logical Framework (logframe) – the matrix which summarises the main elements of an intervention and connects them to each other – from the LFA – the process by which these elements are formulated.

CHAPTER 1: INTRODUCTION AND BACKGROUND OF THE STUDY

1.1. Introduction

This chapter commences with an overview of the challenges facing the upgrading of slum communities. Building on the challenges, the need for improving the performance of the delivery of slum upgrading projects was examined. The core strategies for performance improvement discussed are monitoring and evaluation (M&E) and emerging Building Information Modelling (BIM). The chapter then spells out the project statement, objectives, research questions, justifications, scope, limitation, delimitations and conceptual framework of the study. It is hoped that this study will illuminate light on how integrated BIM and M&E influences the performance of slum upgrading projects.

1.2. Background of the Study

1.2.1. Dependent variables

When slums are upgraded, they are expected to meet the stakeholders' including dwellers' needs. The needs of the dwellers are assessed through set indicators against which the performance of the slum upgrading projects are measured. These performance indicators are known as dependent variables as they rely by some input actions by stakeholders involved in the project. Some examples of the dependent variables include time, cost, quality, stakeholders' participation/collaboration and social acceptability. For purposes of this study, these will be considered under the umbrella term "slum upgrading project performance".

1.2.2. Independent variables

An M&E system is an M&E concept which refers to all the indicators, tools and processes that can be used to assess whether a program has been implemented according to the plan (monitoring) and is having the desired result (evaluation) (Bullen, undated). Chen et al. (2019)

use a system theory to define M&E system as ‘input’ that when fed into a system and ‘transform’ yields ‘output’. According to Chen et al. (2019) the input are resources needed for to assess whether a program is operating as per designed. Some examples of the resources suggested by Chen et al. (2019) include funding, the guide for reporting, state M&E coordinator, software, and data depository facilities. This provides the basis to define the M&E systems that can potentially influence the performance of slum upgrading projects, classified as independent variables. The different independent variables defined in the operationalised definitions section include: M&E types (monitoring, ex-ante, mid-term, terminal and ex-post evaluations), M&E planning tool (Logframe), BIM application, Human resource capacities and integrated BIM and M&E.

1.2.3. Context of study

Sub-Saharan Africa is home to some of the largest slums in the world with an estimate of over 55% of the urban population living in areas classified as slums and informal settlements (Adegun, 2018). The slums are characterised by very poor living conditions such as lack of services, easy susceptibility to health hazards and chronic poverty. Thus, many governments and international organisations are now implementing strategies to upgrade slum communities (Danso-Wiredu & Midheme, 2017). The long-term success of such projects requires effective decision-making informed by effective monitoring and evaluation (M&E).

However, due to the scale and complexity of such projects, traditional M&E have not led to any significant improvement in their performance. Many failed upgrading projects are now too common especially in developing countries. A classic example is the Kibera slum in Kenya, where, out of the study participants only 15% thought better houses were the solution to their slum (Tairo, 2013), an indication of poor residents’ requirements captured early on. Another major weakness that has plagued the construction industry in general and especially the upgrading projects is poor M&E.

Recent studies by Damoah et al. (2015) and Damoah & Kumi (2018) revealed that, out of the 32 factors that cause project failures, poor monitoring is amongst the top ten. Furthermore, this is exacerbated by the fact that the participation in the design, monitoring and evaluation of slump upgrading projects of all stakeholders including residents or slum dwellers are often limited. The roles of slum dwellers are often limited to providing information to officials and designers of projects. In essence, there is a failure of interactive and in-depth participation for informed decision-making. This is not just due to lack of political will. The fact is that effective citizen participation, particularly in informal communities, is quite a challenge. This is manifested in a number of ways including different and sometimes conflicting interests within communities, domination of the process by vested interests or sections of the community, lack of a common language (understanding) and protocol of information exchange, costs of travelling to workshop/meeting venues if outside the community and cultural perceptions. Furthermore, both 'one-way' and 'interactive' participatory methods are limited in capturing 'real-time' information over the project lifecycle especially given that informal community members may change their requirements many times during the project lifecycle.

According to UNCHS (2001), effective slum upgrading requires active involvement of the target beneficiaries. The World Bank (2012) proposed digital options instead of old fashioned "paper and pen" for data collection. Dickinson & Bostoen (2013) proposed an ICT-based conceptual framework for monitoring and evaluation of water projects to ensure better service delivery. Raftree and Bamberger (2014) explored how emerging ICT can be used to bring monitoring and evaluation up to speed. Emerging ICT provides the opportunity to involve citizens in the M&E of slum upgrading projects. However, given M&E is a domain often considered in development studies, the typical ICTs in use include mobile phones and smart devices with limited applications of specialised construction related software such as BIM software systems. Although still emerging, BIM has been hailed as a solution in overcoming long standing challenges in the construction industry where, slum upgrading partially fits. Furthermore, BIM can be easily used to foster participation of dwellers, manage and process huge data associated with slum upgrading projects due to their complex nature. Without a clear, effective and smarter way of monitoring and evaluating upgrading projects, ensuring access to sustainable, affordable and adequate housing and promoting slum upgrading as stated in the New Urban Agenda (UN-Habitat, 2016) and Sustainable Development Goal 11 will hardly be achieved. Thus, by integrating BIM and M&E, both systems can complement each other with a potential benefit of improving the monitoring and evaluation process, leading to the overall slum upgrading performance.

1.2.4. Slums of the World

Ideas about what slums are vary greatly with no universally agreed definition (UN-Habitat, 2014). However, the only common area amongst the various definitions is the fact that slums are communities or neighbourhood that are in some respects sub-standard characterized by inadequate infrastructure and tenure security (Rains and Krishna, 2020; UN-Habitat 2014). Similar to the disparity in the definitions, slums are commonly referred to in various terms such as informal settlement, slum, shantytown, squatter camp, favela (Brazil), barrio (Latin America), masseque (Angola), basti (Bangladesh), kampung (Indonesia), varoş (Turkey), katchi abadi (Pakistan), ghetto, bidonvilles (France/Francophone Africa) and campamentos (Guibrunet & Castán Broto, 2015; UN-Habitat, 2010). The 5 biggest slums in the world are: Orangi Town in Karachi (Pakistan), Neza (Mexico), Dharavi in Mumbai (India), Kibera in Nairobi (Kenya), Khayelitsha in Cape Town (South Africa) (Totaro, 2016).

1.2.5. Slums in Sub-Saharan Africa

Compared to other regions, Sub-Saharan Africa is the least urbanised in the world. Despite this, its urban population of about 760 million is projected to double by 2030 (Ramin, 2009).

A study by the World Bank revealed, the population living in slums was 55.281% of the urban population in 2014 (WHO, 2019). Some of the largest slums in Sub-Saharan Africa are: West Point in Liberia's capital, Monrovia, with more than 75 000 people, and Kenya's Kibera slum in Nairobi- the largest in Africa with a population of over 2 million (Africa Renewal, 2016).

1.2.6. M&E

In every project, it is imperative to make sure the project objectives or client's requirements are met. This can be done through observing, checking and taking corrective actions during the life cycle of the project. It may be too late to check whether the project objectives have been attained when the project has been completed. The concept of regular performance checks during a project life cycle was first proposed by Herb Turner in the 1970s (Cracknell, 2000). Checking the performance of projects is the kernel of M & E. Project or programme monitoring is the collection and analysis of data prior to and when the project is still ongoing (The World Bank, 1996; SGE, 2014). On the other hand, evaluation is the periodic, retrospective assessment of an organisation, project or programme (SGE, 2014). Monitoring serves as the foundation to evaluation. Monitoring is a continuous assessment throughout the project execution while evaluation is a periodic assessment and includes interim and terminal evaluations (The World Bank, 1996). A common tool often used in M&E is the logical framework (a.k.a log frame, logic framework, planning tool, and framework) which describes a holistic approach in planning, monitoring and evaluating projects or programmes using structured models or matrix forms. In addition to the logframe, for a project to be effectively monitored and evaluated, benchmark data and performance indicators are two most important concepts required. Performance indicators are measures of inputs, processes, outputs, outcomes, and impacts for development projects, programs, or strategies (The World Bank, 2004). Benchmark data is a reference data that can be used in measuring the performance of a project or programme against a chosen indicator.

An M&E system is an M&E concept which refers to all the indicators, tools and processes that can be used to assess whether a program has been implemented according to the plan (monitoring) and is having the desired result (evaluation) (Bullen, undated). Chen et al. (2019) use a system theory to define M&E system as 'input' that when fed into a system and 'transform' yields 'output'. According to Chen et al. (2019) the input are resources needed for to assess whether a program is operating as per designed. Some examples of the resources suggested by Chen et al. (2019) include funding, the guide for reporting, state M&E coordinator, software, and data depository facilities. On the basis these definitions, M&E types (monitoring, ex-ante, mid-term, terminal and ex-post evaluations), M&E planning tool (Logframe), BIM application, human resource capacities and the integration of BIM and M&E are considered M&E systems. Organisations used M&E systems to enable them to achieve the main goal of monitoring and evaluation of projects/programs – whether the project/program goals have been achieved (Görgens & Kusek, 2009).

1.2.7. M&E in the Construction Project Domain

The construction industry is a vital sector in the economies of most countries. According to Rhodes (2015), in 2014 the construction industry in UK contributed £103 billion in economic output, 6.5% of the total and 2.1 million jobs or 6.2% of the UK totals were in the construction industry in 2015. Notwithstanding above contributions, the sector is known for its adversarial nature, lack of collaboration, fragmentation, not being customer oriented, inefficiencies, lack of research and innovations, health and safety issues. It also impacts severely on the environment (Abanda et al., 2014). According to Ahmed (2003), 45% of funds allocated for national development plans in Egypt since 1981 were for the construction sector. In India, construction is the second largest economic activity after agriculture, and contributes around 6 to 9% of India's Gross Domestic Product (GDP) (Doloi et al., 2012). It registered a GDP growth of 8 to 10% per annum in India (Doloi et al., 2012).

Yet, the industry has been very unproductive for generations. Project delays are very common (Enshassi et al., 2009) and cost overruns have become an unwritten norm (Enshassi et al., 2009). Evidence of the poor performance of the construction industry is too common in the literature and varies from country to country. A study by Flyvbjerg et al. (2004) revealed that construction cost overruns are a major challenge, where 9 out of 10 construction projects encounter cost overruns. In the Netherlands, on average construction projects can have a cost overrun of 16.5% (Cantarelli et al., 2012). A recent study revealed that globally megaprojects can experience cost overruns of 64% (Olaniran et al., 2015). A recent study of 14 infrastructure projects in Jordan revealed that the average percentage time and cost overruns of infrastructure projects in Jordan are 226 and 214 respectively (Al-Hazim, Salem. & Ahmad 2017). In India a study by Ahsan and Gunawan (2010) found that the average schedule overrun is about 55% of actual schedule compared to China, Bangladesh and Thailand. Thus, the monitoring and evaluation of projects have become imperative in an effort to ensure project stays within budget and schedule.

1.2.8. M&E for Slum Upgrading Projects

Slum upgrading refers to interventions for improving the conditions of services such as housing and/or basic infrastructure in slum areas with the ultimate goal of ameliorating the living standards of dwellers (UN-Habitat, 2014). The interventions or services can generally be classified into the following: legal (land tenure), physical (infrastructure), social (such as crime or education) or economic. The physical services often include construction or rehabilitation of community facilities such as nurseries, health posts and community open spaces; installation or improvement of basic infrastructure such as water reticulation, sanitation, waste collection, road networks, storm drainage and flood prevention, electricity, security lighting and public telephones (UN-Habitat, 2014).

In Ghana, Indonesia, Sri Lanka and Tanzania, M&E has been used in assessing the performance of slum upgrading projects (UN-Habitat,2011). Specifically, the M&E systems used were terminal evaluation and logframe (UN-Habitat, 2011). Ljung & Gavino (2011) conducted an end-of-programme evaluation of slum upgrading facility in Ghana, Indonesia, Sri Lanka and Tanzania. Upon completion of this end-of-programme or terminal evaluation, the authors confirmed that in situ upgrading is preferable to slum redevelopment, especially if the latter involves construction of apartments. Platt (2018) conducted an evaluation study aimed at the verification of achievements as reported, how well objectives were met, the project's relevance, effectiveness, efficiency, both intended and unintended impacts on slum dwellers and their communities in Freetown, Sierra Leone. Some aspects related to the physical infrastructure evaluated include water and sanitation services, and upgrading the slum environment for resilience against disaster. As an example of an M&E system, the logical framework with flexible indicators was used in the evaluation (Platt, 2018).

Meredith and MacDonald (2013) conducted a terminal evaluation study about the Kibera Integrated Water Sanitation and Waste Management Project (K-WATSAN), part of the Kenya Slum Upgrading Programme (KENSUP) initiative. The aim of the project was to contribute to improving the livelihoods of the urban poor in Soweto East by supporting small-scale community based initiatives in water, sanitation and waste management. The different slum upgrading activities include: the construction of sanitation blocks and the implementation of community-based management, the improvement of drainage, the improvement of access, including the construction of an access road and the construction of a community resource centre (Meredith & MacDonald, 2013).

1.3. Statement of the Problem

To identify current problem, there is need to first of all understand the existing context or reality about the domain of interest and secondly compare with what is supposed to be the solution (ideal) for the problem to be solved. Also, the consequences or importance of what will happen if the proposed solution or research (ideal) is implemented should be discussed (Newman and Covrig, 2013).

In Sub-Saharan Africa, the delivery of slum upgrading projects has been known to be underperforming (Danso-Wiredu & Midheme, 2017). M&E strategies and emerging BIM have been hailed as solutions to improve the performance of slum upgrading projects. However, the concept of M&E is a widely developed field in the aid development domain while BIM is still emerging in the construction field and hardly in aid development projects or programmes. In construction, although the monitoring of projects is common, it is not viewed at the scale of M&E as a separate discipline. Monitoring of projects is viewed as part of project management with very little emphasis on the evaluation aspect. The whole term “M&E” is hardly used in construction practice except recently, where a few construction researchers have expressed interest. Callistus & Clinton (2016) conducted a study aimed at investigating the barriers of implementing of M&E in the Ghanaian construction industry. This study was followed by another one on the role of M&E in construction project management (Callistus & Clinton 2018). In fact, Callistus & Clinton (2018) argued that the practice of M&E in the construction industry appears to be side-lined although well-developed in the development fields with donor agencies supporting its applications on various programmes. The monitoring aspect of M&E in construction is similar to performance measurement in construction practice. For example, the survey of project or programme sites to establish progress is one of the most common ways to monitor projects. Other factors that are often monitored are cost, schedule, time and quality of projects. Monitoring and evaluation systems as a paradigm are seldom heard of in construction practice. Key concepts of M&E system such as project cycle (i.e. ex-ante, monitoring, mid-term, terminal and ex-post evaluation), logframe and human capacity for M&E are not commonly considered in construction practice. On the other hand, emerging BIM is being recommended for use to effectively manage and improve the performance of construction projects, while its use on slum upgrading projects is yet to receive significant attention. Also, the nascent nature of BIM makes it limited as a structured organised paradigm like M&E. Thus, it is imperative to integrate BIM and M&E to foster greater collaboration amongst stakeholders including slum dwellers in the management of projects while monitoring and evaluating the same in an effective way.

Without such innovative performance strategies providing decent homes to 2/3 (about 6.5 billion) of the world population estimated to live in urban areas by 2050 (UNDP, 2018) will be a huge challenge. One of the key principles of sustainable development goal (SDG) 11 is making cities safe and sustainable through various means including access to safe and affordable housing and upgrading slum settlements. This is re-echoed in one of the actions of the New Urban Agenda which recommends measures that strengthen and retrofit all risky housing stock, including slums and informal settlements, to make it resilient to disasters, in coordination with local authorities and stakeholders (UN-Habitat, 2016). Without the adoption of innovative ways to build, monitor and manage the urban spaces, it will be highly unlikely to meet the aforementioned aspirations in SDG 11 and the New Urban Agenda. The innovative approach proposed hinges on strategies that make BIM, an emerging ICT and M&E effective in practice. BIM capability is in the management of complex data and fostering participation amongst stakeholders while M&E is a more established systematic approach to monitoring slum upgrading projects. Integrating both paradigms has the potential of improving the performance of slum upgrading projects. Previous studies (e.g. Shihemi (2016)) have focused only on the influence of M&E on the performance of construction projects in Kenya.

1.4. Objectives of the Study

The study will be guided by the following general and specific objectives.

1.4.1. General Objective of the Study

The main objective of this study is to investigate the influence of monitoring and evaluation strategies on the performance of slum upgrading projects in Sub-Saharan Africa.

1.4.2. Specific Objectives of the Study

i. To determine the effects of M&E (project cycle and logframe) on performance of slum upgrading projects in Sub-Saharan Africa
ii. To examine the effects of emerging BIM on the performance of slum upgrading projects in Sub-Saharan Africa
iii. To assess the effects of human resource capacity on the performance of slum upgrading projects in Sub-Saharan Africa
iv. To establish the effect of integrated BIM and M&E in maximising the performance of slum upgrading projects in Sub-Saharan Africa

1.5. Research Questions

The research was guided by the following research questions:

i. How does M&E project cycle and logframe affect slum upgrading project performance in Sub-Saharan Africa?
ii. Does the use of emerging BIM affect the performance of slum upgrading projects in Sub-Saharan Africa?
iii. Do the skills of stakeholders affect the performance of slum upgrading projects in Sub-Saharan Africa?
iv. Can integrated BIM and M&E affect the performance of slum upgrading projects?

1.6. Justification of the Study

The significance of a study is its contribution to the society. As espoused by Kothari and Garg (2014), such contributions could be in solving various operational and planning problems of business and industry. Also, it could unlock an area never known before leading to the discovery of new knowledge and serving as a foundation of exploring and discovering further knowledge. To the researchers, the integrated BIM-M&E framework will serve as a methodological basis to further explore the effective ways of involving slum dwellers, collecting and analysing data for the M&E of upgrading projects. From a professional perspective, the framework illuminates the effective use of BIM in enhancing participation needed for capturing realistic settlers' requirements for upgrading projects which is quite important for projects' success. Furthermore, an integrated BIM-M&E framework has the potential to aid professionals to deliver efficiently upgrading projects, thereby being able to achieve the New Urban Agenda and one of the SDGs, specifically SDG 11.

1.7. Scope of the Study

This research cuts across three main areas, namely: slum upgrading, BIM and M&E. Research has revealed that BIM can be used to improve the performance of construction projects. Also, M&E can be used in ensuring performance targets are achieved through formative and summative M&E of the various stages in the construction project life cycle. Furthermore, collaboration is key to ensuring the different stakeholders' requirements are captured and met. Consequently, the scope of this study will be considered at three levels. Firstly, the study will focus on how BIM can be used to foster collaboration between slum settlers and project developers. Secondly, the study will focus on how conventional M&E approaches can be used in improving the performance of collaboration between settlers and project developers. Thirdly, building on the latter, BIM will be used to enhance the M&E of collaboration process between the slum settlers and project developers.

1.8. Limitations of the Study

Study limitations are weaknesses in a study out of control of the researcher (Simon, 2011; Baltimore County School, 2015). Given the fact that BIM and M&E are very distinct disciplines, especially with the former still emerging, it was not possible to have experts with complete knowledge of both. Thus, the respondents were either experts in BIM or M&E and not on both. To mitigate this limitation, the definitions of BIM and M&E were provided on the questionnaire.

1.9. Delimitations of the Study

The delimitations of a study are characteristics that limit the scope and define the boundary of a study (Simon, 2011). The delimitation factors are within the control of a researcher and include choice of objectives, the research questions, variables of interest, theoretical perspectives that you adopted (as opposed to what could have been adopted), and the population you choose to investigate (Simon, 2011). What is critical in the delimitations of a study is the justification of things that the researcher will not consider and why (Baltimore County School, 2015). In this study, it will be unrealistic to consider all the performance indicators of upgrading projects; hence my focus is on participatory indicators and how these fit within the wider M&E of projects using BIM. With regards to the study population, the focus is on individuals that have participated in the M&E of slum upgrading projects in sub-Saharan Africa while BIM experts are from anywhere developing country. The latter choice is to ensure the BIM experts understand the context or challenges faced by developing countries when implementing BIM in construction practice.

1.10. Conceptual Framework

A conceptual framework is a written or visual/graphical presentation of things, i.e. factors, concepts and variables including the relationships between them (Miles and Huberman, 1994, pp.18). As argued by Bordage (2009), it clarifies the relationship between variables. The conceptual framework depicting the relationship between the independent and dependent variables have been presented in Figure 1.1. Furthermore, connections between the variables and research objectives a, b, c, d, e (see section 1.4.2) have been captured and presented in Figure 1.1.

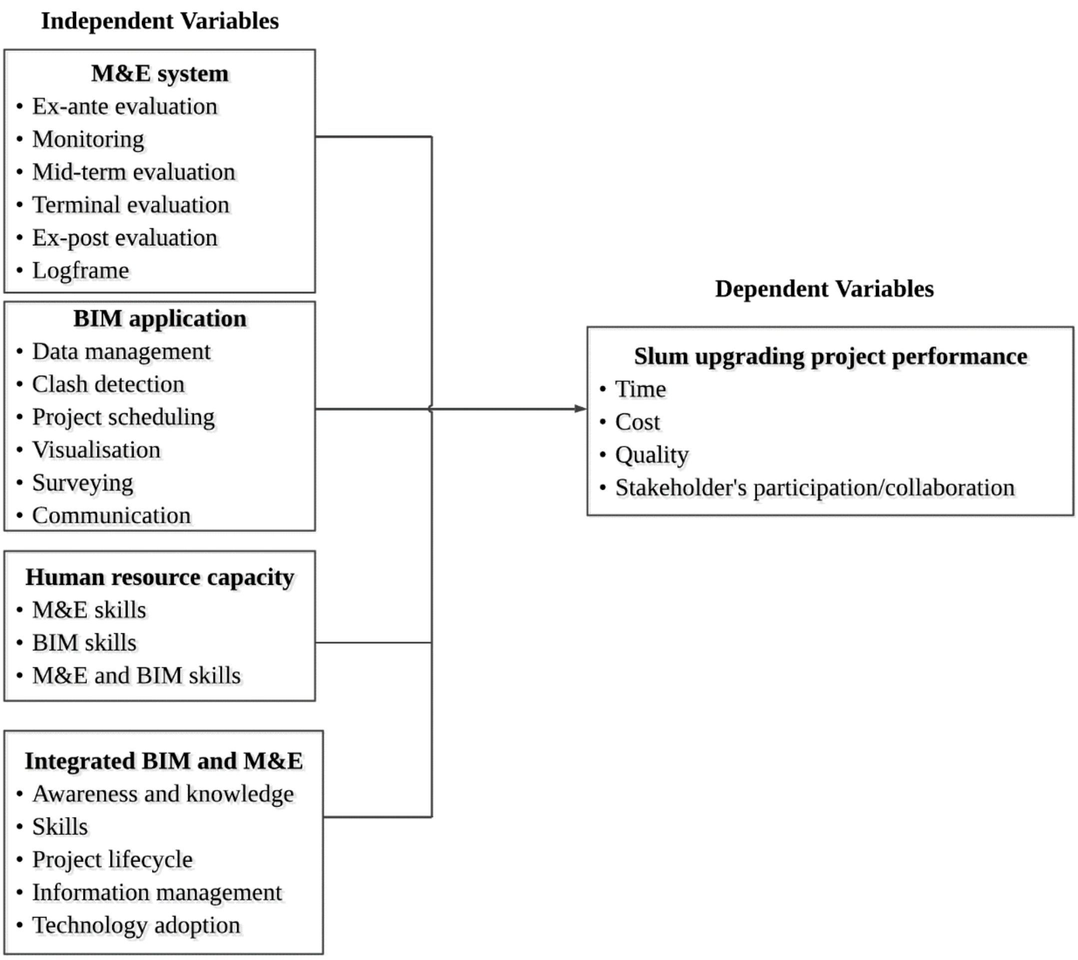

Figure 1-1: Conceptual framework showing independent and dependent variables

Source: (Researcher, 2020)

Figure 1-1 depicts the relationships between independent and dependent variables, which will be explained in the ensuing paragraph.

M&E types and planning tool and Slum upgrading performance: The link between the two variables is whether the application of M&E types and planning tool affects the performance of slum upgrading projects. Specifically, by developing and apply a logframe (independent) on a slum upgrading projects, does it lead to the delivery of a slum ugrading project on time, within budget (cost) and meet quality requirements?

BIM application and Slum upgrading performance: The link between these seeks to establish whether the conducting BIM applications on a slum upgrading project affect its performance (dependent). For example, does performing clash detection which many lead to the identification and resolution of clashes lead to time saving (time), cost saving (cost) and improve on quality of the slum upgrading projects.

Human resource capacity and Slum upgrading performance: The link between these variables seek to establish whether a professional with certain skills or experience (BIM, M&E or both) working on a slum upgrading project can influence its performance.

Integrated BIM and M&E and Slum upgrading performance: The link between these variables seek to establish whether integrating BIM and M&E concepts and applying on slum upgrading project can influence its performance.

CHAPTER 2: LITERATURE REVIEW

2.1. Introduction

The purpose of this chapter is to examine existing scholarly works about the proposed research domain with the ultimate goal of identifying knowledge gaps. The chapter commences by exploring the theoretical framework underpinning the study. This is followed by an examination of the empirical studies which focused on the identification of the relationship between the independent and dependent variables. The chapter concludes by identifying some knowledge gaps that have emerged from the literature.

2.2. Theoretical Framework

2.2.1. Theory of Change

Based on the literature, there is no universal consensus as to what constitutes the "theory of change" (MC, 2015). However, although some subtle differences exist between the various definitions, a more encompassing definition is that of the United Nations Development Programme Group, which is also focused on aid development programmes. It states "a theory of change is a method that explains how a given intervention, or set of interventions, is expected to lead to specific development change, drawing on a causal analysis based on available evidence" (UNDPG, undated). From the review of the literature, it is not clear who is (are) the proponents of the theory of change, and when the term was first used. However, the theory has been strongly linked to the works of Carol Weiss and Andrea Anderson. Carol - one of the evaluation theorists is known to have widely popularised the term (Weiss, 1995). According to Weiss (1995), the theory of change is a way to describe the set of assumptions that explain both the mini-steps that lead to the long-term goal and the connections between program activities and outcomes that occur at each step of the way. Through the works of Aspen Institute's, Andrea developed some seminal practical guidelines ‘The Community Builders’ Approach to Theory Development’ that has been considered the kernel of the theory of change (Anderson, 2005). The underpinning principle behind the theory of change is the need to specifically make sure that the goals of a particular intervention such as projects or programmes are attained (Harris et al., 2014). The theory of change is used as a lens through which the achievement of the goals of an intervention is realised. As revealed in Vogel (2012), the theory of change is quite instrumental in development studies. The theory of change has been used in the evaluation of development projects and programmes (Vogel, 2012). The theory of change has been used to identify key intervention components that may result in the greatest improvements in the health and socio-economic wellbeing of slum dwellers and highlight any potential adverse effects (Turley et al., 2013). Without explicitly stating it as theory of change, Juszczyk, Tomana & Bartoszek (2016) have used it in evaluating design change issues using emerging BIM. The theory of change is relevant in this study because it allows for a better understanding of the influence variables associated with M&E strategies and BIM on the performance of slum upgrading projects.

2.2.2. Theory of Participation and Collaboration

The theory of participation describes a move from the global and top-down strategies to more locally sensitive and inclusive methodologies (Claridge, 2004). The local sensitivity and inclusivity are related to the role of the different stakeholders especially local or community participants. The importance of the role participants in participation theory has long been articulated in Pateman’s work (Pateman, 1970) where the definition of participation is related to the number of those involved.

Pateman defines partial participation as “a process in which two or more parties influence each other in the making of decisions but the final power to decide rests with one party only” and full participation as “a process where each individual member of a decision-making body has equal power to determine the outcome of decisions” (Pateman, 1970). Based on the literature, many authors have proposed the theory of participation (Arnstein, 1969; Cogan & Sharpe, 1986). The theory by Arnstein (1969) is considered one of the classic and most influential amongst the participation theories. The theory rests on the declaration that “citizen participation is citizen power, arguing that participation cannot be without sharing and re-distributing power”. André et al. (2007) defines public participation as the engagement of persons or groups that are positively or negatively affected by, or interested in a proposed project, program, plan or policy that is subject to a decision-making process. The underpinning theory is that participation of stakeholders will cause decision-making processes to be more inclusive and, therefore, instigate ownership over development processes, which, in turn, leads to more sustainable impacts (Thomas & de Fliert, 2014). In aid development field, the theory of participation has been used to ensure the requirements of end-users are captured and integrated into projects/programmes. On the other hand, in the construction industry collaboration is often used instead of participation even though the meaning is the same. In construction, collaboration is defined as working together within a borderless team to achieve common goals delivering benefit for everyone involved through mutually beneficial alignment (Construction excellence, 2011). In collaborative projects, various participants work together remotely or in the same office or a combination of both towards the achievement of a common goal (Anumba et al., 2002). In construction practice those often cited as participants include professionals such as clients, architects, structural engineers, building service engineers, quantity surveyors, contractors, materials suppliers (Anumba et al., 2002; Zhang & Ng, 2012). Participation or collaboration has an impact on the performance of projects. Given that participation or collaboration are core concepts of M&E and BIM, the theory is relevant to this study as it is one of the parameters that has influence on the performance of slum upgrading projects.

2.3. Empirical Framework

This section will examine studies that have been conducted in the domain of slum upgrading. Specifically, the studies will focus on the factors that have the potential to influence the performance of slum upgrading project. In section 2.3.1 the application of M&E and tools and its effects on the performance of slum upgrading projects have been discussed. In section 2.3.2 the effects of the applications of BIM on the performance of slum upgrading projects have been examined. The effects of human capacity (skills) on the performance of slum upgrading projects have been examined in section 2.3.3. Lastly, in section 2.3.4 the effects of the application of integrated BIM and M&E systems on the performance of slum upgrading projects have been examined.

2.3.1. The Effects of M&E Types and Tools (Project Cycles and Logframe) on the Performance of Slum Upgrading Project

The project cycle consists of breaking the different M&E processes into manageable chunks often call phases or stages. In practice, there are 5 main phases of M&E: ex-ante, monitoring, mid-term, terminal and ex-post evaluation. The Logframe is a planning tool consisting of a matrix which provides an overview of a project’s goal, activities and anticipated results.

Adopting a system identification methodology Soman et al. (2015) used structural responses to assess the productivity and progress of the construction of viaduct for a metro rail project. The study found the method to be very effective in accurately determining the productivity and establishing the performance of the Metro rail project. In Egypt, Ragheb et al. (2012) conducted a study that revealed ex-post evaluation, logic framework and monitoring progress were effective in the monitoring of urban planning projects. Specifically, the M&E tools (ex-post evaluation, logic framework and monitoring progress) were effective in revealing the time and cost consuming procedures to collect, analyze, and report information, identifying the level of skills needed and ensuring public participation in the urban planning project.

Although the use of M&E systems in the aid development industry is quite common, it is hardly heard of in the construction industry (Callistusa & Clinton 2016; Callistusa & Clinton 2018).

The very few studies identified are Soman et al. (2015) and Ragheb et al. (2012) that focused on Metro rail project and urban planning respectively. Consequently, investigations about the influence of M&E types and tools on construction project performance are lacking. Callistusa & Clinton (2016) and Callistusa & Clinton (2018) argued that M&E techniques should be used in construction in general. Even considering slum upgrading as an aid development domain, M&E types and tools have been used with the implicit or underlying assumption that they can improve project performance. The extent to which the implemented M&S types and tools have influenced the performance of slum upgrading projects is still not known.

2.3.2. The Effects of Emerging BIM Applications on the Performance of Slum Upgrading Project

The participation of slum dwellers in upgrading projects of their communities has long been recommended by various government and international development agencies. However, despite efforts by donor agencies, many upgrading projects are still underperforming far below expectations. As argued by Njeru & Kimutai (2018), in Kenya, many slum upgrading projects have failed to meet their objectives despite strong recommendations for dwellers' participation from their government.

Effective participation requires the involvement of dwellers in the different phases of the project lifecycle. The participation includes undertaking or being actively involved in the activities of the slum upgrading projects and also exchanging information about the projects with the ultimate goal of making informed decisions about progress and outcomes. However, studies that discuss the involvement of dwellers in the different phases are limited. Most studies often talk of citizen involvement without explicitly stating their roles in each phase. Although limited in the number of phases, one of the most elaborate studies was conducted by Kihiu (2017) which only focused on 3 phases: citizens participation in: project design, capacity building in relation and the utilisation of local resources in relation to the sustainability of the projects. Furthermore, the techniques used for the involvement of dwellers have proven to be ineffective and inefficient. The common techniques can be classified into 3 categories: traditional (public hearings/meetings, surveys, interviews and questionnaires, national/local newspapers, advertising, referenda), innovative (workshops, focus groups/forums, open house on an internet webpage/website, planning for real) and ICT (e-Collaborate, e-Empower, e-Informing, e-Consulting, e-Participate, e-pertitioning, e-voting, e-polling, podcasts, wikis, blogs, surveys). The traditional and innovative approaches are limited in fostering participation because it requires physical attendance of dwellers and/or representatives during participatory meetings. Dwellers find this difficult, time consuming and find it had to sacrifice their various money income generating activities for participating in meetings.

While the ICT methods improve on the weaknesses of the preceding methods, it does not contain geometrical data necessary for visualisation and understanding of upgrading projects. Furthermore, existing methods are effective in exchanging information real-time, anytime and anywhere. Emerging BIM is excellent in fostering real-time collaboration and managing geometrical and non-geometrical data for effective exchange amongst stakeholders including dwellers. However, research of BIM applied on slum upgrading is rare, talk less on M&E. The few that exist are Braun et al. (2015), Chou & Yang (2017) and Elbeltagi et al. (2014). Braun et al. (2015) conducted a study that revealed the use BIM for monitoring onsite progress of construction works was efficient than traditional monitoring approach. Chou & Yang (2017) investigated BIM-based approaches for schedule delay analysis. The study revealed BIM was very effective in the identification of the causes of schedule delays. Elbeltagi et al. (2014)

investigated the use of BIM for estimating and monitoring construction cost of a building project. The authors revealed BIM was effective in estimation and monitoring that traditional approaches where BIM is not used. Wu et al. (2015) developed a BIM-based monitoring system for urban deep excavation projects. The study revealed BIM was effective in the monitoring of excavation projects. These studies (Wu et al., 2015; Elbeltagi et al., 2014; Chou & Yang, 2017) recommended frequent use of BIM for estimating and monitoring of projects. Despite this moderate progress of BIM research in monitoring some aspects of projects, there is scarcity of peer-reviewed literature about the same in upgrading projects.

2.3.3. The Effects of Human Resource Capacity on the Performance of Slum Upgrading Projects

Although BIM and M&E has been viewed as separate disciplines, both actually have the same goal, that of improving the performance of the construction industry. The application of these two disciplines as desperate entities has meant that professionals working in both of them do not necessarily share the same skills. BIM experts are hardly involved in the M&E of slum upgrading projects while the reverse is true. A study by Shihemi (2016) investigated the influence of human capacities in M&E on the performance of construction in Kenyan public universities. The study found that 89 respondents (94.7%) were of the view that their skills in M&E enhance performance of projects. Abanda et al. (2017) conducted a study about BIM applications and their effects on performance construction projects. The study found that when BIM is used in managing projects, it leads to cost savings, time savings and improved quality. It is important to note that these studies (Abanda et al., 2017; Shihemi, 2016) focused on general construction projects, not necessarily on slum upgrading projects. Also, these were separate studies and no studies on those with both BIM and M&E skills. Shihemi (2016) and Abanda et al. (2017) recommended the enhancement of M&E and BIM skills of professionals involved in the delivery of construction projects.

2.3.4. The Effects of Integrated BIM and M&E on the Performance of Slum Upgrading Projects

The domain of slum upgrading is cross-cutting. Firstly, the goals of most slum upgrading projects are concerned with social transformation/human development which may have social, economic and ecological impacts on a community (Crawford & Bryce 2003) and as such often considered under the development field. Secondly, as a project, it is part of the construction industry. These two disciplines seem to have influenced the way performance in slum upgrading has been assessed. While project management is a common concept in the construction industry, it is hardly the case in the aid development field (Themistocleous & Wearne, 2000). On the other hand, M&E is quite common in the aid development field and hardly discussed in the construction industry (Callistusa & Clinton 2016; Callistusa & Clinton 2018). Similar to the disparate nature of construction industry and development domain, BIM for project performance and M&E for the same has been studied and applied in isolation. For general construction practice, BIM has been hailed as a paradigm that can improve performance of the construction industry. Although the logical framework approach (LFA) widely used throughout the aid industry for project design and appraisal, has proved inadequate (Crawford & Bryce 2003), as a whole, M&E has been used to improve the performance of many development agency projects (Kamau & Mohamed, 2015). Like many others (e.g. Themistocleous & Wearne, 2000), the latter study focused on M&E applied on aid development projects. Integrating BIM and M&E has the potential in improving the performance of slum upgrading projects. However, there is paucity of peer-reviewed literature about the integration of both disciplines or some related concepts especially with regards to performance of the construction industry, talk less of slum upgrading.

2.4. Summary of the Literature Review

From the reviewed empirical literature, it is evident that different scholars have made efforts to come up with different suggestions with regards to the factors that influence the performance of projects (Shah et al., 2019). Several factors affecting project performance have received a lot of attention. However, it is from the analysis of the factors that have led to the emergence of gaps in influence of BIM and M&E as systems on the performance of slum upgrading projects which this research investigates.

2.5. Knowledge Gap

Monitoring and evaluation - Development studies versus Construction Practice: An overwhelming volume of the literature suggests M&E is well-established in the aid development discipline compared to the construction domain. Partly because of this paucity of research of M&E applications in the construction domain, Callistusa & Clinton (2016) conducted an extensive review to provide a meaning to M&E practice in construction project delivery.

Lack of or limited use of BIM in upgrading projects: Based on the literature, M&E has been applied on new construction projects. Studies about the application of BIM on existing projects in developed countries are scarce, talk less of developing countries. With regards to the upgrading projects, there is paucity of peer-reviewed literature about the use of BIM. There is also no evidence to suggest BIM has been used to complement and/or enhance the M&E of upgrading projects.

M&E in the phases of projects: In development studies, M&E largely covers the participation of end-users. On the other hand, in construction projects, the focus of monitoring is on the construction phase taking into account mostly the contributions of professionals in different tasks. Furthermore, peer-reviewed literature hardly discusses about evaluation of the construction phase compared to aid development projects where M&E is well-spread in all the delivery phases. This is explained by the different formative and summative M&E project cycles such as: ex-ante evaluation, monitoring, mid-term evaluation, terminal evaluation, terminal evaluation, ex-post evaluation. Furthermore, the Logframe tool is hardly used in construction practice.

The focus of monitoring and evaluation: Given most M&E in construction practice are focused on the construction phase, only the most important parameters from the perspective of contractors are considered. Thus, most M&E studies evaluated using BIM seldom focus on participation of end-users. Braun et al. (2015) conducted a study that revealed the use of BIM to monitor onsite progress of construction works. Chou & Yang (2017) investigated the BIM–based approaches for schedule delay analysis. Elbeltagi et al. (2014) investigated the use of BIM for estimating and monitoring construction cost of a building project. Wu et al. (2015) developed a BIM-based monitoring system for urban deep excavation projects. Despite this moderate progress of BIM research in monitoring some aspects of projects, there is scarcity of peer-reviewed literature about the same in upgrading projects.

Technical gaps: Although ICT has been used in the M&E of projects; the data used hardly include geometric data. BIM builds on this to provide the geometric and non-geometric data for M&E of projects. Furthermore, most ICTs used in practice are not linked to BIM. By linking emerging ICT and smart technologies to BIM systems, end-users can remotely contribute or participate in the delivery of projects at anytime and anywhere.

CHAPTER 3: RESEARCH DESIGN AND METHODOLOGY

3.1. Introduction

Any form of inquiry requires an appropriate, suitable and feasible research methodologies. Therefore, this chapter examines the research design and site where the study will be undertaken as well as the justifications for their selection. Furthermore, the procedure of the selection of the study sample and the data collection instruments has been discussed. Towards the end of the chapter, the methods used for the validation and determination of the reliability of the study findings have been examined.

3.2. Research Design

Research design is a framework or blueprint for data collection, measurement and analysis (Kothari & Garg, 2014). As argued in NYU (undated), a research design can be compared with a building design plan. For a building to be constructed, a detail plan is required indicating the steps to be followed, a schedule of activities and materials to be procured and used on site. Similarly, a research design is a work plan or structure put in place before data collection can commence. The ultimate goal of such a plan is to make sure that the findings obtained from implementing the designed or proposed research plan can aid in answering the initial research questions or objectives as unambiguously as possible (NYU, undated). To this end, the descriptive study was adopted as the research design for this study. A questionnaire construction was used as the main instrument for primary data collection. According to Naoum (2006), descriptive study design allows for facts about a concept and relationship(s) between them to be determined. Furthermore, given the nascent nature of BIM especially when considering integrating with M&E, quantitative research is most appropriate as it is often used in an area when much is not known about it (McCombes, 2019).

3.3. Research Site and Rationale

The sites for administering quantitative questionnaire are the Monitoring & Evaluation and BIM professionals LinkedIn groups (e.g. M&EPLG, BIM Experts) and international organisations such as the UN-Habitat, Cities Alliance, United Nations Development Programme (UNDP). Some key members of the Federation of the Urban and Rural Poor (FEDUP), UN-Habitat and Cities Alliance identified at the 1st International Conference on Sustainable Energy and Climate in African Municipalities, May 22-25, 2018, Yaoundé, Cameroon participated in the study. BIM Experts and M&EPLG have been chosen because of their expertise in BIM and M & E respectively, while international organisations have been involved in the execution, monitoring and the evaluation of slum upgrading projects.

3.4. Target Population

In this study, the target population included M&E experts who have worked on projects in Sub-Saharan Africa and BIM experts in developing countries. This is because; M&E experts who have worked in Sub-Saharan Africa understood the contextual challenges facing upgrading projects. On the other hand, in a technical field such as BIM, its experts can apply BIM in any context, so specific requirements about the area of practice are not required. This group of participants was very instrumental for questionnaire survey. Quantitatively, previous studies in Sub-Saharan Africa, both in South Africa have considered a sample size of 32 (Chimhundu, 2015) and 34 (Kiprotich, 2014) in the area of BIM. In fact, in Nigeria, Wang et al. (2015) targeted 78 participants for a BIM-related study. Given the specialist nature of the domain of BIM and M&E, 88 participants will be targeted, slightly greater than 78.

Table 3-1: Study Population

Study population	**Size**	**Region**
M&E experts in practice	44	Sub-Saharan Africa
BIM experts in practice	34	Other developing countries
M&E experts in academia	5	Sub-Saharan Africa
BIM experts in academia	5	Other developing countries
Total	88	

Source: (Researcher, 2020)

3.5. Sampling Procedures

The main sampling techniques to be used in this study are purposive, snowballing and convenience sampling.

3.5.1. Purposive, Snowballing and Convenience Sampling

According to Creswell & Clark (2011) purposive sampling allows for the identification and selection of individual participants or groups with expertise or knowledge about a study domain. It was used to identify BIM and/or M&E experts/groups with experience in upgrading projects in slum communities to participate in the questionnaire survey. The BIM experts background on LinkedIn were investigated and only those deemed competent or those with BIM experience were contacted through message boxes in LinkedIn. Similarly M&E experts contacted through message boxes in LinkedIn. Furthermore, based on identified individuals/groups, participants were advised to snowball to other potential participants within their professional groups or LinkedIn. LinkedIn provides greater ability to target data collection to an appropriate social network (Dusek, Yurova & Ruppel, 2015). According to Fricker (2016), posting surveys on forums or websites opened to members to participate is called unrestricted self-selected surveys. This is a form of convenience sampling, consequently findings from such studies cannot be generalised to a larger population (Fricker, 2016).

3.5.2. Sample Selection

For quantitative study, leading professional forums were purposively identified. Through these forums, the questionnaire was shared with members to voluntarily participate. The leading forums that were used include BIM Experts and M&EPLG. Other experts that were identified to participate in the questionnaire survey were from leading organisations in M&E such as the Federation of the Urban and Rural Poor (FEDUP), UN-Habitat and Cities Alliance. Experts from UN-Habitat and Cities Alliance were very hard to reach unless through contacts obtained through snowballing.

3.6. Sample Size

To determine the sample size, the Yamane formula was used. This is because the formula is suitable and applicable to situations where the target population is both small and large and yet representative.

The formula is:

$$n = \frac{N}{1 + N * \varepsilon^2} \qquad \text{Equation 3.1}$$

Where:

n: sample size

N: population size

ε : allowable error

In a BIM study in Tanzania, Mpangule (2016) considered confidence level 95% and margin of error 5%. Taking into account the target population of 88, the sample size is calculated as:

$$n = \frac{88}{1 + 88 * (\frac{5}{100})^2}$$

n=72

Thus, the sample size of this study is 72.

Table 3-2: Sample

Study population	**Target**	**Sample size proportion 72/88**	**Actual prospective respondents**
M&E experts in practice	44	0.818	36
BIM experts in practice	34	0.818	28
M&E experts in academia	5	0.818	4
BIM experts in academia	5	0.818	4
Total	88		**72**

[Source: (Researcher, 2020)].

3.7. Data Collection Procedures

The online structured-survey was designed using SmartSurvey and distributed to participants identified through social media forums including LinkedIn. SPSS was used for editing and analysing the data collected from the SmartSurvey.

3.8. Research Instruments

The research instrument to be used is structured questionnaire, whereby closed questions were employed. The closed type of questions allows for a standardised way of data collection from participants. The Likert scale was used in rating the different responses on the questionnaires.

3.8.1. Piloting of Research Instruments

A pilot study was conducted to test the clarity and content of the quantitative structured-survey. In other words, the pilot study was used to test how participants experience and understand the questionnaire. The participants for the pilot study were experts in M&E and BIM. In total, 8 experts, evenly distributed between M&E and BIM experts participated in the pilot study. Of these, four were from Sub-Saharan Africa and the other four from other developing countries. Of the 4 from each region, 2 were BIM experts and the other were M&E experts. The participants were contacted via LinkedIn. The pilot study findings were used to refine the questionnaire. Through the pilot study, ambiguities related to the questionnaire were identified and fixed.

3.8.2. Validity of Findings

Given that the participants for the pilot study were experts in BIM and M&E, they were used to evaluate whether the questionnaire is reliable measuring what it was designed for. This was done by performing a one-to-one mapping between the research objectives and the questions on the questionnaire before requesting for feedback from pilot study participants. The feedback was used to refine the questionnaire.

3.8.3. Reliability of Findings

For the quantitative study, an internal consistency analysis was conducted by computing Cronbach's coefficient alpha for each performance criteria identified. It has been argued by Webb et al. (2000) that the Cronbach coefficient alpha is still a dominant tool for measuring reliability and is critical for sound measurement practices. The coefficients were computed using SPSS and results presented in Appendix II. A summary of the results is presented in Table 3-3.

Table 3-3: Cronbach's Alpha for the Research Variables

Variable	Cronbach's Alpha	No of items
(M&E Types and Planning Tools)	0.855	6
BIM Application)	0.921	10
Human Resource Capacity)	0.554	4
Q5 (Integrated BIM and M&E)	0.909	8
Slum Upgrading Project Performance	0.790	4
Average	**0.8058**	

According to Creswell (2012) a reliable research instrument should have a composite Cronbach Alpha, α of at least 0.7 for all items under study. Based on Table 3-3, the composite Cronbach's coefficient is 0.8058. Thus, average reliability coefficient, α, of 0.8058 was considered acceptable. The research instrument was very reliable.

3.9. Analysis of Data and Presentation

For the quantitative data, preliminary analyses from SmartSurvey were explored. This was followed up by using SPSS to analyse feedback from closed types of questions. As argued by Boynton and Greenhalgh (2004), tables and figures are appropriate for presenting results from quantitative study. Therefore, tables were used to present the results of this study.

3.10. Ethical Considerations

This study was conducted in according to the Africa Nazarene University (ANU) research guidelines. During the data acquisition process ensuring confidentiality was imperative. This was clearly spelt out in the research participation invitation cover letter. The questionnaire ensures the respondent details are anonymous and explicitly asked in the last section as a follow up should a respondent be willing to provide further information or clarify issues that might have emerged.

CHAPTER 4: DATA ANALYSIS AND PRESENTATION OF FINDINGS

4.1. Introduction

In this chapter, the findings resulting from the analysis of the questionnaire survey will be discussed. Both the descriptive and inferential statistical techniques have been used in the analysing the data. To facilitate understanding, the findings have been presented using tables and figures and their implications also discussed.

4.2. Response Rate

As discussed in section 3.6, the estimated target population and sample size for this study are 88 and 72 respectively. However, because of the technical nature of BIM, and in order to minimise the risk of insignificant response rate, email questionnaires were purposefully sent to 200 prospective participants. Out of this, 95 replied with representing a response rate of 47.5%. However, of the 95, 5 respondents had no experience in all the 3 fields, i.e. construction, BIM and M&E and 2 other failed to attempt 2 of the 6 questions that was on the questionnaire. These 7 respondents were not considered in the analysis. Thus, the revised response rate is 40.5%.

Table 4-1: Response Rate

	No. of questionnaires returned	Target No. of respondents	Response rate (%)	Revised response rate (%)
Online (Email)		200	47.5%	44%

This response rate was greater the sample size of 72 that had been estimated in Chapter 3, which was even better for this study.

4.3. Demographic Characteristics

In this section, the demographics of the participants will be examined. The demographics have organised and presented by region and level of experience.

4.3.1. Distribution of Respondents by Regions

The researcher asked respondents where they worked. The feedback was categorised into those from Sub-Saharan Africa and other developing countries other than the former. The results have been presented in Table 4.2.

Table 4-2: Respondents by Region

	Size	**Region**	**Online (Email)**
M&E experts in practice	36	Sub-Saharan Africa	44
BIM experts in practice	28	Other developing countries	34
M&E experts in academia	4	Sub-Saharan Africa	5
BIM experts in academia	4	Other developing countries	5
Total	**72**		**88**

[Source: (Researcher, 2019)].

4.3.2. Level of Experience of Respondents

The respondents were asked to rate their level of experience in construction, BIM and M&E. The results have been presented in Table 4-3.

Table 4-3: Frequency Distribution Table of the Professional Background of Participants

		Construction			BIM			M&E		
		f	%f	Valid %f	f	%f	Valid %f	f	%f	Valid %f
Valid	Not Experienced at all	8	9.1	9.4	47	53.4	57.3	52	59.1	61.9
	Least Experience	44	50.0	51.8	30	34.1	36.6	21	23.9	25.0
	Experienced	27	30.7	31.8	4	4.5	4.9	8	9.1	9.5
	Highly Experienced	6	6.8	7.1	1	1.1	1.2	3	3.4	3.6
Missing		3	3.4		*6*	*6.8*		4	4.5	
Total		**88**	**100**	**100**	**88**	**100**	**100**	**88**	**100**	**100**

[Source: (Researcher, 2020)].

Based on Table 4-3 and using valid % frequency, 7.1%, 1.2% and 3.6% agreed they were highly experienced (i.e. Highly Experienced) in construction, BIM and M&E respectively. Also, 38.9%, 6.1% and 13.1% agreed they were experienced (i.e. “Experienced” and “Highly Experienced”) in construction, BIM and M&E. It is evident that very few respondents had BIM experience. This is not surprising, partly because of the emerging nature of BIM. Even in developed countries and despite tremendous efforts towards BIM uptake in the construction industry, its adoption is still has been facing huge challenges (Hamma-adama & Kouider, 2019).

4.4. Data Analysis and Presentation (Descriptive Statistics)

4.4.1. Results of the Effects of M&E (Project lifecycle and Logframe) on Performance of Slum Upgrading Projects in Sub-Saharan Africa

This study sought to investigate whether M&E systems have an influence on slum upgrading projects in Africa. The participants were required to rate the responses on the following scale: [1] Strongly Disagree; [2] Disagree; [3] Neutral; [4] Agree; and [5] Strongly Agree. The results have been presented on Table 4-4.

Table 4-4: Frequency Distribution Table of Effects of M&E Systems have on Slum Upgrading Projects in Africa

		Ex-ante evaluation			**Monitoring**			**Mid-term evaluation**			**Terminal evaluation**			**Ex-post evaluation**			**Logframe**		
		f	%f	Valid %f	f	%f	Valid %f	f	%f	Valid %f	f	%f	Valid %f	f	%f	Valid %f	f	%f	Valid %f
Valid	Strongly Disagree	2	2.3	2.3	3	3.4	3.4	3	3.4	3.4	7	8.0	8.0	4	4.5	4.5	3	3.4	3.4
	Disagree	5	5.7	5.7	5	5.7	5.7	6	6.8	6.8	6	6.8	6.8	9	10.2	10.2	11	12.5	12.5
	Neutral	22	25.0	25.3	16	18.2	18.4	17	19.3	19.3	17	19.3	19.3	27	30.7	30.7	31	35.2	35.2
	Agree	41	46.6	47.1	47	53.4	54.0	47	53.4	53.4	37	42.0	42.0	33	37.5	37.5	31	35.2	35.2
	Strongly Agree	17	19.3	19.5	16	18.2	18.4	15	17.0	17.0	21	23.9	23.9	15	17.0	17.0	12	13.6	13.6
Missing		1	1.1		1	1.1		0	0.0		0	0.0		0	0.0		0	0.0	
Total		**88**	**100**	**100**	**88**	**100**	**100**	**88**	**100**	**100**	**88**	**100**	**100**	**88**	**100**	**100**	**88**	**100**	**100**

[Source: (Researcher, 2020)].

Based on Table 4-4 and the valid % frequency, a high proportion of respondents agreed (i.e. Agree and Strongly Agree) that M&E systems can affect the upgrading of slums. In fact, the proportions were as follows: Ex-ante evaluation (66.6%), Monitoring (72.4%), Mid-term evaluation (70.4%), Terminal evaluation (65.9%), Ex-post evaluation (54.5%) and Logframe (48.8%). On average, 63.1% of the respondents agreed (i.e. Agree and Strongly Agree) that M&E systems can affect the performance of upgrading of slums. These results revealed a strong agreement participants of the importance of the use of M&E systems in slum upgrading despite not often thought of as an improvement tool in construction as argued by Callistusa & Clinton (2016) and Callistusa & Clinton 2018) and discussed in section 2.3.1. Furthermore these findings cannot be straightforwardly be compared with existing literature on slum upgrading as in section 2.3.1 that studies about M&E systems can affect the upgrading of slums was lacking. That notwithstanding, these findings can be compared to other similar or related field such as urban planning. The findings of this study align with those of Ragheb et al. (2012) where it was argued that M&E systems can significantly improve the performance of urban planning and its management.

Although the use of these two concepts in the aid development industry is quite common, it is hardly heard of in the construction industry (Callistusa & Clinton 2016; Callistusa & Clinton 2018).

4.4.2. Results of the Effects of Emerging BIM on the Performance of Slum Upgrading Projects in Sub-Saharan Africa

This study sought to investigate whether BIM has an effect on slum upgrading projects in Africa. The participants were required to rate the responses on the following scale: [1] Strongly Disagree; [2] Disagree; [3] Neutral; [4] Agree; and [5] Strongly Agree. The results have been presented in Table 4-5.

Table 4-5: Effects of BIM on Slum Upgrading Projects

		Speed and Accuracy			Understanding Visualisation			Clash Detection Interference Identification		
		f	**%f**	**Valid %f**	**f**	**%f**	**Valid %f**	**f**	**%f**	**Valid %f**
Valid	Strongly Disagree	4	4.5	4.8	4	4.5	4.5	1	1.1	1.1
	Disagree	2	2.3	2.4	9	10.2	10.2	5	5.7	5.7
	Neutral	26	29.5	31.0	16	18.2	18.2	15	17.0	17.0
	Agree	29	33.0	34.5	31	35.2	35.2	34	38.6	38.6
	Strongly Agree	23	26.1	27.4	28	31.8	31.8	33	37.5	37.5
Missing		4	4.5		0	0.0		0	0.0	
Total		**88**	**100**	**100**	**88**	**100**	**100**	**88**	**100**	**100**

Table 4-5 continuing…

		Project Sequencing			Cost Planning			Visualisation		
		f	**%f**	**Valid %f**	**f**	**%f**	**Valid %f**	**f**	**%f**	**Valid %f**
Valid	Strongly Disagree	1	1.1	1.1	2	2.3	2.3	2	2.3	2.3
	Disagree	4	4.5	4.6	6	6.8	6.8	1	1.1	1.1
	Neutral	17	19.3	19.5	17	19.3	19.3	19	21.6	21.8
	Agree	43	48.9	49.4	31	35.2	35.2	35	39.8	40.2
	Strongly Agree	22	25.0	25.3	32	36.4	36.4	30	34.1	34.5
Missing		1	1.1		0	0.0		1	1.1	
Total		**88**	**100**	**100**	**88**	**100**	**100**	**88**	**100**	**100**

Table 4-5 continuing…

		Clash Detection Resolution			Cost Control			Surveying		
		f	**%f**	**Valid %f**	**f**	**%f**	**Valid %f**	**f**	**%f**	**Valid %f**
Valid	Strongly Disagree	2	2.3	2.3	2	2.3	2.3	2	2.3	2.4
	Disagree	6	6.8	6.9	5	5.7	5.8	5	5.7	5.9
	Neutral	28	31.8	32.2	20	22.7	23.3	27	30.7	31.8
	Agree	35	39.8	40.2	35	39.8	40.7	34	38.6	40.0
	Strongly Agree	16	18.2	18.4	24	27.3	27.9	17	19.3	20.0
Missing		1	1.1		2	2.3		3	3.4	

Total	**88**	**100.0**	**100**	**88**	**100.0**	**100**	**88**	**100**	**100**

[Source: (Researcher, 2020)].

Table 4-5 suggests that BIM can affect the performance of slum upgrading projects. Specifically, the respondents agreed (i.e. Agree and Strongly Agree) that BIM can influence slum upgrading projects in the following ways: improving speed and accuracy (61.9%), enhancing understanding through visualisation (67%), enhancing the detection of clashes (76.1%), the development of project sequencing (74.7%), improving the development of cost plans (71.6%), improving visualisation (74.7%), enhancing the resolution of clashes (58.6%), controlling cost (68.6%) and surveying (60%). On the average, 68.1% of the respondents agreed (i.e. Agreed and Strongly Agreed) that BIM can affect the performance of slum upgrading projects. Despite BIM not commonly used in slum upgrading projects as argued in section 2.3.2, these results show that participants strongly believe its use can improve the performance of slum upgrading projects. Although not directly related to slum upgrading projects, a recent study by Khandzadi et al. (2020) revealed BIM can improve the performance of construction vis-à-vis the following key performance indicators: quality, sustainability, cost, project coordination, clash detection.

4.4.3. Results of the Evaluation of the Effects of Human Resource Capacity on the Performance of Slum Upgrading Projects in Sub-Saharan Africa

This study sought to investigate whether BIM and M&E skills (human capacity) have an effect on the performance of slum upgrading projects in Sub-Saharan Africa. The participants were required to rate the responses on the following scale: [1] Strongly Disagree; [2] Disagree; [3] Neutral; [4] Agree; and [5] Strongly Agree. The results have been presented in Table 4-6.

Table 4-6: The frequency distribution table of the effects of BIM and M&E systems on slum upgrading projects

		Traditional Construction Project Management Skills			**M&E Skills**			**BIM Skills**			**Integrated BIM and M&E Skills**		
		f	%f	Valid %f	f	%f	Valid %f	f	%f	Valid %f	f	%f	Valid %f
Valid	Strongly Disagree	14	15.9	16.1	3	3.4	3.4	2	2.3	2.3	3	3.4	3.4
	Disagree	30	34.1	34.5	27	30.7	30.7	26	29.5	29.5	4	4.5	4.5
	Neutral	25	28.4	28.7	34	38.6	38.6	39	44.3	44.3	23	26.1	26.1
	Agree	15	17.0	17.2	18	20.5	20.5	19	21.6	21.6	38	43.2	43.2
	Strongly Agree	3	3.4	3.4	6	6.8	6.8	2	2.3	2.3	20	22.7	22.7
Missing		1	1.1		0	0.0		0	0.0		0	0.0	
	Total	**88**	**100**	**100**	**88**	**100**	**100**	**88**	**100**	**100**	**88**	**100**	**100**

[Source: (Researcher, 2020)].

Based on Table 4-6, the responses reveal that the proportion of those that agreed (i.e. Agree and Strongly Agree) the following skills can affect the performance of slum upgrading projects: traditional construction project management skills (20.6%), M&E skills (27.3%), BIM skills (23.9%), BIM and M&E skills (65.9%). These results clearly show that having and using both BIM and M&E skills can positively affect the performance of slum upgrading projects. Also, it is evident that using both BIM and M&E skills separately affects the performance of slum upgrading project projects but not as much as using both. Although, not directly related to slum upgrading projects, these findings corroborate those of Kamau & Mohamed (2020) and Saka and Chan (2019a) where M&E and BIM skills have an effect on performance of projects respectively. However, a major finding from this study not found in existing literature is the fact that integrating both M&E and BIM skills can significantly improve the performance of slum upgrading projects compared to each when applied in isolation.

4.4.4. Results of the Assessment of the Effects of Integrated BIM and M&E in Maximising the Performance of Slum Upgrading Projects in Sub-Saharan Africa

This study sought to investigate whether integration of BIM and M&E strategies has an effect on the performance of slum upgrading projects in Sub-Saharan Africa. The participants were required to rate the responses on the following scale: [1] Strongly Disagree; [2] Disagree; [3] Neutral; [4] Agree; and [5] Strongly Agree. The results have been presented in Table 4-7.

Table 4-7: Integrated BIM and M&E factors

		Improve Visualisation			**Real Time Participation**			**Stakeholders and Dwellers Understanding**		
		f	%f	Valid %f	f	%f	Valid %f	f	%f	Valid %f
Valid	Strongly Disagree	4	4.5	4.6	1	1.1	1.1	3	3.4	3.4
	Disagree	1	1.1	1.1	4	4.5	4.6	2	2.3	2.3
	Neutral	16	18.2	18.4	29	33.0	33.3	17	19.3	19.3
	Agree	48	54.5	55.2	39	44.3	44.8	52	59.1	59.1
	Strongly Agree	18	20.5	20.7	14	15.9	16.1	14	15.9	15.9

Missing		1	1.1		1	1.1		0	0	
Total		**88**	**100**	**100**	**88**	**100**	**100**	**88**	**100**	**100**

Table 4-7 continuing…

		Stakeholders and Dwellers Understanding Brief			**Improve Dwellers Understanding**			**Understanding of Roles**		
		f	**%f**	**Valid %f**	**f**	**%f**	**Valid %f**	**f**	**%f**	**Valid %f**
	Strongly Disagree	3	3.4	3.4	3	3.4	3.4	1	1.1	1.1
Valid	Disagree	3	3.4	3.4	9	10.2	10.3	4	4.5	4.5
	Neutral	21	23.9	24.1	29	33.0	33.3	24	27.3	27.3
	Agree	42	47.7	48.3	34	38.6	39.1	48	54.5	54.5
	Strongly Agree	18	20.5	20.7	12	13.6	13.8	11	12.5	12.5
Missing		1	1.1		1	1.1		0	0	
Total		**88**	**100**	**100**	**88**	**100**	**100**	**88**	**100**	**100**

Table 4-7 continuing…

		Enhance Accessibility			**Enhance Project Manager Capability**		
		f	**%f**	**Valid %f**	**f**	**%f**	**Valid %f**
	Strongly Disagree	3	3.4	3.4	3	3.4	3.5
	Disagree	4	4.5	4.5	3	3.4	3.5
Valid	Neutral	15	17.0	17.0	17	19.3	19.8
	Agree	51	58.0	58.0	48	54.5	55.8
	Strongly Agree	15	17.0	17.0	15	17.0	17.4
Missing		0	0		2	2.3	
Total		**88**	**100**	**100**	**88**	**100**	**100**

[Source: (Researcher, 2020)].

The results in Table 4-7 show that by integrating BIM and M&E and applying on slum upgrading projects can significantly improve performance. Specifically, the following proportions agreed (i.e. Agree and Strong Agree) of the following factors: Improve visualisation (75.9%), real-time participation (60.9%), stakeholders and slum dwellers understanding (75%), stakeholders and slum dwellers understanding of brief (69%), improve dwellers understanding (52.5%), improve understanding of roles (67%), enhance accessibility (75%) and enhance project manager's capacity (73.2%). Thus, on average, 68.6% of the respondents agreed (i.e. Agreed and Strongly Agreed) that integrating BIM and M&E systems can influence the performance of slum upgrading projects. The findings from this study corroborates that of Kamau & Mohamed (2015) and Abanda and Tah (2017) who argued M&E and BIM improve the performance of construction projects, although the former is focused on slum upgrading projects. However, a major finding from this study not found in existing literature is the fact that integrating both M&E and BIM methods can significantly improve the performance of slum upgrading projects compared to each when applied in isolation.

4.5. Inferential Statistics

So far, in the preceding sections (section 4.1-4.4), only descriptive statics have been used. In this section, Chi-square test of independence will be used to explore the relationship between the distributions of responses to the discrete outcome variable among several independent comparison groups. In the case of this study, the independent groups to be compared are the variables in the conceptual framework of Figure 1.1 which informed the questionnaire content in Appendix II. Based on the feedback of the questionnaire survey, the responses of the different variables have been summarised and presented in Table 4-8. This is equivalent to observed frequency.

Table 4-8: Participants' Responses by Variables (Observed frequency)

Responses	M&E Systems	BIM activities	Human resources	Integrated BIM and M&E	Adoption strategy	Total
Strongly Disagree	22	20	22	21	21	106
Disagree	42	43	87	30	23	225

Neutral	130	185	121	168	145	749
Agree	236	307	90	362	320	1315
Strongly Agree	96	225	31	117	97	566
Total	526	780	351	698	606	**2961**

[Source: (Researcher, 2020)].

It is important to note that Chi-Square test of independence is only applicable to categorical variables. Five steps are pursued in order to conduct Chi-Square test of independence.

Step 1 Set up hypotheses and choose the level of significance

H_0: The variables are independent

H_1: The variables are dependent (not independent)

The level of significance chosen for this study is α=5%.

Step 2: Select the appropriate test statistic

The formula for the test statistic is:

$$\chi^2 = \sum_{i=1}^{R} \sum_{j=1}^{C} \frac{(O_{ij}-E_{ij})^2}{E_{ij}}$$ Equation 4.1

Where

O_{ij} is the observed cell count in the i^{th} row and j^{th} column of the table

E_{ij} is the expected cell count in the i^{th} row and j^{th} column of the table computed as

$$\mathbf{E_{ij}}=\frac{\text{row i total} * \text{col j total}}{\text{grand total}}$$ Equation 4.2

df=(R-1) *(C-1)

df is the degree of freedom, R is the number of rows, C is the number of columns

The condition for appropriate use of the above test statistic is that each expected frequency is at least 5 (see Pallant (2013). Table 4-8 is clearly compliant to this requirement of using Chi-square.

Step 3: Set up decision rule

In other to set a decision rule, the degree of freedom (df) and the level of significance are required. For this test, R=5, C=5, hence df= (5-1) *(5-1) =16. At a 5% level of significance, and using Appendix VI the appropriate critical value is 26.296 and the decision rule is as follows: Reject H0 if χ^2>26.296.

Step 4. Compute the appropriate test statistic

The test statistic in equation 4.2 and based on Table 4-8 (observed frequency (O_{ij})), the expected frequencies (E_{ij}) are computed and presented in Table 4-9. As an example, for cell 1, the math is as follows: 106*526/2961=18.8

Table 4-9: Participants' Responses by Variables (Expected) Frequencies

	M&E Systems	BIM activities	Human resources	Integrated BIM and M&E	Adoption strategy
Strongly Disagree	18.8	27.9	12.6	25.0	22.0
Disagree	40.0	59.3	26.7	53.0	46.0
Neutral	133.0	197.3	88.8	176.6	153.3
Agree	233.6	346.4	155.9	310.0	269.1
Strongly Agree	100.5	149.1	67.1	133.4	115.8

[Source: (Researcher, 2020)].

Using equation 4.1, Tables 4-8 and 4-9 the test statistic is computed and presented in Table 4-10. As an example, for cell 1, the math is as follows: $(18.8-22)^2/18.8$ =0.5

Table 4-10: Test Statistic computation

	M&E Systems	BIM activities	Human resources	Integrated BIM and M&E	Adoption strategy	Total
Strongly Disagree	0.5	2.2	7.0	0.64	0.05	**10.39**
Disagree	0.1	4.5	136.2	10.0	11.5	**162.3**
Neutral	0.1	0.8	11.7	0.4	0.45	**13.45**
Agree	0.02	4.5	27.9	8.7	9.6	**50.72**
Strongly Agree	0.2	38.6	19.4	2.0	3.1	**63.3**
Total	**0.92**	**50.6**	**202.2**	**21.74**	**24.7**	**300.2**

[Source: (Researcher, 2020)].

Based on Table 4-10, the value of the test statistic is:

χ^2=300.2

Step 5: Conclusion

We reject H_0 because 300.2>=26.296. We have statistically significant evidence at α=0.05 to shows that H_0 is false or that performance parameter and outcome are not independent (i.e., they are dependent or related).

CHAPTER 5: SUMMARY OF FINDINGS, DISCUSSION, CONCLUSION AND RECOMMENDATIONS

5.1. Introduction

In this chapter, a summary of the research findings, conclusions, limitations of the study and recommendations for future studies have been presented. Before engaging on the summary of the aforementioned aspects, it is imperative to revisit how the study was conducted and whether it met the research objectives. The analysis was conducted using SPSS and results presented in tables and figures format.

5.2. Summary of Main Research Findings

To this end, a number of objectives was set and appropriate methods pursued. To facilitate understanding the summary of the main research findings will be discussed in line with the research objectives of this study.

The first research objective was about the influence of M&E (project cycle and logframe) systems on performance of slum upgrading projects in Sub-Saharan Africa. The study found that on average, 63.1% of the respondents agreed (i.e. Agreed and Strongly Agreed) that M&E systems can influence the performance of slum upgrading projects.

Secondly, the study sought to investigate the influence of emerging BIM on the performance of slum upgrading projects in Sub-Saharan Africa. The study found that, on the average, 68.1% of the respondents agreed (i.e. Agreed and Strongly Agreed) that BIM can influence the performance of slum upgrading projects.

The third objective was to evaluate the influence of human resource capacity on the performance of slum upgrading projects in Sub-Saharan Africa. The study found that, 65.9%

of the respondents agreed (i.e. Agreed and Strongly Agreed) that integrating BIM and M&E skills can influence the performance of slum upgrading projects. This was by far greater than the next highest results whereby 27.3% of the respondents agreed (i.e. Agreed and Strongly Agreed) that M&E skills alone can improve the performance of slum upgrading projects.

Building and the first and second objectives, the fourth was to assess the influence of integrated BIM and M&E systems in maximising the performance of slum upgrading projects in Sub-Saharan Africa. The study found that on average 68.6% of the respondents agreed (i.e. Agreed and Strongly Agreed) that integrating BIM and M&E systems can influence the performance of slum upgrading projects.

5.3. Discussion

As discussed in section 5.2, this study revealed a number favourable outcomes with regards to various aspects of M&E and BIM vis-à-vis the performance of slum upgrading projects in Sub-Saharan Africa. The study found that the implementation of M&E and BIM on slum upgrading projects will improve their performance. This finding corroborated other studies (e.g. Kamau & Mohamed (2015) for M&E and Abanda & Tah (2017) for BIM). This study went further reveal that participants were more convinced the application of a combination BIM and M&E will improve the performance of slum upgrading projects than when BIM and M&E were/are to be implemented individually or in isolation.

5.4. Conclusion

This study aimed to investigate whether integrated BIM and M&E can influence the performance of slum upgrading projects in developing countries with focus on Sub-Saharan Africa. A quantitative research approach was adopted to achieve the aim of this study. The study concludes that the applications of BIM and M&E on slum upgrading projects can actually improve their performance. Lastly, the study also concludes that the applications of both BIM and M&E together will significantly improve the performance of slum upgrading projects than if applied individually.

5.5. Recommendations

The study revealed that there is an overwhelming consensus amongst construction, BIM and M&E experts on the need to integrate BIM and M&E for the delivery of slum upgrading projects. For example, in section 4.4, 68.6% of respondents agreed (i.e. Agree and Strongly Agree) that BIM-based construction and M&E project lifecycles should be integrated, 65.9% of the same agreed (i.e. Agree and Strongly Agree) that BIM and M&E information management techniques should be integrated. Given the emerging nature of BIM and its complexity similar to that of M&E, from a practical perspective, a major recommendation is that future studies should focus on investigating and developing an integrated BIM and M&E framework. The framework should aim at guiding professionals in using BIM and M&E in the delivering of slum upgrading projects. This study revealed that the adoption of BIM and M&E can improve the performance of slum upgrading projects. Based on this, it is imperative for governments and organisations to design policies for driving the adoption of BIM and M&E on slum upgrading projects. To ensure a gentle and effective adoption, various governments can start by making the policies voluntary before making them mandatory with time.

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APPENDICES

APPENDIX I: Letter to the Respondent

Dear Respondent,

RE: RESEARCH PROJECT

I am a postgraduate student of Africa Nazarene University pursuing Masters of Arts in Monitoring and Evaluation. As a requirement of my study, I am carrying out a survey on influence of integrated monitoring & evaluation (M&E) and Building Information Modelling (BIM) on project performance of slum upgrading projects in Sub-Saharan Africa. The success of this study will substantially depend on your willingness and co-operation to provide the information required. I kindly request you to complete this questionnaire for data gathering. The attached questionnaire is specifically designed for the purpose of this study only; and all responses will be treated in absolute confidence and anonymity.

Thank you for your cooperation.

Yours Faithfully,

Henry Abanda

APPENDIX II: Questionnaire

1. What is your level experience in the following?

	Highly experienced	**Experienced**	**Least experienced**	**Not experience at all**
Construction				
BIM				
M&E				

2. Please indicate the extent to which you agree with the following about the influence of M&E systems on slum upgrading projects in Sub-Saharan Africa. Use a scale of 1-5, where: [1] Strongly Disagree; [2] Disagree; [3] Neutral; [4] Agree; and [5] strongly Agree

	1	**2**	**3**	**4**	**5**
Ex-ante evaluation [project planning & evaluation planning]					
Monitoring (observing progress, corrective measures)					
Mid-term evaluation (Verify whether the project has been implemented smoothly and on path to achieve goals)					
Terminal evaluation (Examine whether overall project objectives have been achieved)					
Ex-post evaluation (Verify whether the outcomes that the project aimed for are continuing after a certain period.)					
Logframe (Use to plan and understand the overview of a project's goal, activities and anticipated results.)					

3. Please indicate the extent to which you agree with the following about the influence of BIM on the performance of slum upgrading projects in Sub-Saharan Africa. Use a scale of 1-5, where: [1] Strongly Disagree; [2] Disagree; [3] Neutral; [4] Agree; and [5] strongly Agree.

BIM activities	**1**	**2**	**3**	**4**	**5**
Improves speed and accuracy in data collection: Use smart devices to collect data about					

preliminary site conditions and dwellers expectations					
Enhances understanding through visualisation: Use BIM tools for visualisation of the conceptual plans to enhance understanding slum dwellers					
Clash detection: Use BIM tools to investigate areas of interference. For example, is the plumbing pipe clashing with a structural element or road kerb.					
Project sequencing: Use 4D BIM to test and rephrase the sequencing set out in the construction strategy including every aspect of on-site, off-site works, manufacturing, logistics and assembly before work start on site.					
Cost planning: Use 5D BIM to prepare the cost of the project					
Visualisation: Use BIM tools to observe the progress of upgrading projects					
Clash detection: Use BIM tools to identify and resolve clashes between different trades					
Project monitoring: Use 4D BIM to monitor the progress of project on site.					
Cost control: Use 5D BIM to monitor cost of the project					
Surveying: Use BIM apps (e.g. specialised mobile apps) in collecting project defects data and reporting to experts.					
Others, please specify					

4. Please indicate the extent to which you agree with the following about the influence of BIM and M&E on the performance of slum upgrading projects in Sub-Saharan Africa. Use a scale of 1-5, where: [1] Strongly Disagree; [2] Disagree; [3] Neutral; [4] Agree; and [5] strongly Agree

	1	**2**	**3**	**4**	**5**
Traditional project management skills are sufficient for slum upgrading projects					
M&E skills is sufficient for upgrading projects					
BIM skills is sufficient for slum upgrading projects					
BIM and M&E skills are sufficient for slum upgrading projects					
Others, please specify					

5. Please indicate the extent to which you agree with the following about the influence of integrated BIM and M&E strategies on the performance of slum upgrading projects in Sub-Saharan Africa. Use a scale of 1-5, where: [1] Strongly Disagree; [2] Disagree; [3] Neutral; [4] Agree; and [5] strongly Agree

	1	**2**	**3**	**4**	**5**
Improve visualisation					
Ensure real-time participation of stakeholders including slum dwellers from anywhere at any time in the M&E					
Improve stakeholders’ and slum dwellers’ understanding					
Improve stakeholders’ and slum dwellers’ understanding of project brief (scope, aim, objectives, budget, timeline, stakeholders)					
Improve dwellers’ understanding					
Enhance the understanding of roles which can help dwellers to channel their problems should issues emerge					
Enhance the accessibility of projects’ stakeholders to information					
Enhance project managers’ capability to identify, analyse and manage/control both errors and violation of a project/task					
Others, please specify					

APPENDIX III: Work Schedule 2019

	January		**February**		**March**		**April**		**May**		**June**
Preparing concept paper											
Proposal writing											
Proposal defense											
Data Collection											
Report and project Writing											
Defense of Final Report											

APPENDIX IV: Research Budget*

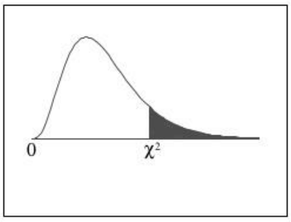
CORE ACTIVITIES	ITEMS/PARTICIPANTS	COST (£)
(i) Consolidation of literature (ii) Designing and developing research instruments	Library search Travelling expenses Typing and photocopying of research instruments	0.00 0.00 0.00
(iii) Research induction and training	Transport for researcher and two assistants	0.00
(iv) Pilot Survey	Transport for researcher and research assistants	0.00
(v) Finalizing of research instruments (Typing and photocopying)	Transport and refreshments for researcher and research assistants 30 Questionnaires for the 5 Program staff and partners	0.00 0.00
(vi) Main field data collection	Travel, accommodation and subsistence for researcher and research assistants	45
(vii) Data processing, analysis and report writing	Data processing, analysis and report writing	0.00
(viii) 10% contingency and institutional cost		0.00

Total		**45**

* The interviews will be conducted via phone while the questionnaire will be designed in SmartSurvey which will cost £45 for a period of 1 month for hosting the questionnaire. All other aspects will be conducted by the researcher without any involvement of an assistant.

APPENDIX V: Chi-Square Distribution Table

Chi-Square Distribution Table



The shaded area is equal to α for $\chi^2 = \chi^2_{\alpha}$.

df	$\chi^2_{.995}$	$\chi^2_{.990}$	$\chi^2_{.975}$	$\chi^2_{.950}$	$\chi^2_{.900}$	$\chi^2_{.100}$	$\chi^2_{.050}$	$\chi^2_{.025}$	$\chi^2_{.010}$	$\chi^2_{.005}$
1	0.000	0.000	0.001	0.004	0.016	2.706	3.841	5.024	6.635	7.879
2	0.010	0.020	0.051	0.103	0.211	4.605	5.991	7.378	9.210	10.597
3	0.072	0.115	0.216	0.352	0.584	6.251	7.815	9.348	11.345	12.838
4	0.207	0.297	0.484	0.711	1.064	7.779	9.488	11.143	13.277	14.860
5	0.412	0.554	0.831	1.145	1.610	9.236	11.070	12.833	15.086	16.750
6	0.676	0.872	1.237	1.635	2.204	10.645	12.592	14.449	16.812	18.548
7	0.989	1.239	1.690	2.167	2.833	12.017	14.067	16.013	18.475	20.278
8	1.344	1.646	2.180	2.733	3.490	13.362	15.507	17.535	20.090	21.955
9	1.735	2.088	2.700	3.325	4.168	14.684	16.919	19.023	21.666	23.589
10	2.156	2.558	3.247	3.940	4.865	15.987	18.307	20.483	23.209	25.188
11	2.603	3.053	3.816	4.575	5.578	17.275	19.675	21.920	24.725	26.757
12	3.074	3.571	4.404	5.226	6.304	18.549	21.026	23.337	26.217	28.300
13	3.565	4.107	5.009	5.892	7.042	19.812	22.362	24.736	27.688	29.819
14	4.075	4.660	5.629	6.571	7.790	21.064	23.685	26.119	29.141	31.319
15	4.601	5.229	6.262	7.261	8.547	22.307	24.996	27.488	30.578	32.801
16	5.142	5.812	6.908	7.962	9.312	23.542	26.296	28.845	32.000	34.267
17	5.697	6.408	7.564	8.672	10.085	24.769	27.587	30.191	33.409	35.718
18	6.265	7.015	8.231	9.390	10.865	25.989	28.869	31.526	34.805	37.156
19	6.844	7.633	8.907	10.117	11.651	27.204	30.144	32.852	36.191	38.582
20	7.434	8.260	9.591	10.851	12.443	28.412	31.410	34.170	37.566	39.997
21	8.034	8.897	10.283	11.591	13.240	29.615	32.671	35.479	38.932	41.401
22	8.643	9.542	10.982	12.338	14.041	30.813	33.924	36.781	40.289	42.796
23	9.260	10.196	11.689	13.091	14.848	32.007	35.172	38.076	41.638	44.181
24	9.886	10.856	12.401	13.848	15.659	33.196	36.415	39.364	42.980	45.559
25	10.520	11.524	13.120	14.611	16.473	34.382	37.652	40.646	44.314	46.928
26	11.160	12.198	13.844	15.379	17.292	35.563	38.885	41.923	45.642	48.290
27	11.808	12.879	14.573	16.151	18.114	36.741	40.113	43.195	46.963	49.645
28	12.461	13.565	15.308	16.928	18.939	37.916	41.337	44.461	48.278	50.993
29	13.121	14.256	16.047	17.708	19.768	39.087	42.557	45.722	49.588	52.336
30	13.787	14.953	16.791	18.493	20.599	40.256	43.773	46.979	50.892	53.672
40	20.707	22.164	24.433	26.509	29.051	51.805	55.758	59.342	63.691	66.766
50	27.991	29.707	32.357	34.764	37.689	63.167	67.505	71.420	76.154	79.490
60	35.534	37.485	40.482	43.188	46.459	74.397	79.082	83.298	88.379	91.952
70	43.275	45.442	48.758	51.739	55.329	85.527	90.531	95.023	100.425	104.215
80	51.172	53.540	57.153	60.391	64.278	96.578	101.879	106.629	112.329	116.321
90	59.196	61.754	65.647	69.126	73.291	107.565	113.145	118.136	124.116	128.299
100	67.328	70.065	74.222	77.929	82.358	118.498	124.342	129.561	135.807	140.169

APPENDIX VI: Research Variables

Name	Type	Width	Decimals	...	Values	Missing	Columns	Align	Measure	Role
RespID	String	8	0		None	None	8	Left	Nominal	Input
Q1_Construction	String	30	0		{1, Not Experienced at all...	7	8	Left	Nominal	Input
Q1_BIM	String	30	0		{1, Not Experienced at all...	7	8	Left	Nominal	Input
Q1_ME	String	30	0		{1, Not Experienced at all...	7	8	Left	Nominal	Input
Q2_Ex_ante_evaluation	Numeric	30	0		{1, Strongly Disagree}...	7	14	Right	Ordinal	Input
Q2_Monitoring	Numeric	30	0		{1, Strongly Disagree}...	7	8	Right	Ordinal	Input
Q2_Mid_term_evaluation	Numeric	30	0		{1, Strongly Disagree}...	7	8	Right	Ordinal	Input
Q2_Terminal_evaluation	Numeric	30	0		{1, Strongly Disagree}...	7	8	Right	Ordinal	Input
Q2_Ex_post_evaluation	Numeric	30	0		{1, Strongly Disagree}...	7	8	Right	Ordinal	Input
Q2_Logframe	Numeric	30	0		{1, Strongly Disagree}...	7	8	Right	Ordinal	Input
Q3_Speed_and_accuracy	Numeric	30	0		{1, Strongly Disagree}...	7	8	Right	Ordinal	Input
Q3_Understanding_visualisation	Numeric	30	0		{1, Strongly Disagree}...	7	8	Right	Ordinal	Input
Q3_Clash_detection_interference_identific...	Numeric	30	0		{1, Strongly Disagree}...	7	8	Right	Ordinal	Input
Q3_Project_sequencing	Numeric	30	0		{1, Strongly Disagree}...	7	8	Right	Ordinal	Input
Q3_Cost_planning	Numeric	30	0		{1, Strongly Disagree}...	7	8	Right	Ordinal	Input
Q3_Visualisation	Numeric	30	0		{1, Strongly Disagree}...	7	8	Right	Ordinal	Input
Q3_Clash_detection_resolution	Numeric	30	0		{1, Strongly Disagree}...	7	8	Right	Ordinal	Input
Q3_Project_monitoring	Numeric	30	0		{1, Strongly Disagree}...	7	8	Right	Ordinal	Input
Q3_Cost_control	Numeric	30	0		{1, Strongly Disagree}...	7	8	Right	Ordinal	Input
Q3_Surveying	Numeric	30	0		{1, Strongly Disagree}...	7	8	Right	Ordinal	Input
Q4_Traditional_project_management_skills	Numeric	30	0		{1, Strongly Disagree}...	7	8	Right	Ordinal	Input
Q4_ME_skills	Numeric	30	0		{1, Strongly Disagree}...	7	8	Right	Ordinal	Input
Q4_BIM_skills	Numeric	30	0		{1, Strongly Disagree}...	7	8	Right	Ordinal	Input
Q4_BIM_ME_skills	Numeric	30	0		{1, Strongly Disagree}...	7	8	Right	Ordinal	Input
Q5_Improve_visualisation	Numeric	30	0		{1, Strongly Disagree}...	7	8	Right	Ordinal	Input
Q5_Real_time_participation	Numeric	30	0		{1, Strongly Disagree}...	7	8	Right	Ordinal	Input
Q5_Stakeholders_and_dwellers_understa...	Numeric	30	0		{1, Strongly Disagree}...	7	15	Right	Ordinal	Input
Q5_Stakeholders_and_dwellers_understa...	Numeric	30	0		{1, Strongly Disagree}...	7	15	Right	Ordinal	Input

APPENDIX VII: Cronbach's Alpha Coefficients

Q2 (M&E Types and Planning Tools)

Case Processing Summary

		N	%
Cases	Valid	86	97.7
	Excluded[a]	2	2.3
	Total	88	100.0

a. Listwise deletion based on all variables in the procedure.

Reliability Statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.855	.859	6

Q3 (BIM Application)

Case Processing Summary

		N	%
Cases	Valid	80	90.9
	Excluded[a]	8	9.1
	Total	88	100.0

a. Listwise deletion based on all variables in the procedure.

Reliability Statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.921	.924	10

Q4 (Human Resource Capacity)

Case Processing Summary

		N	%
Cases	Valid	87	98.9
	Excluded[a]	1	1.1
	Total	88	100.0

a. Listwise deletion based on all variables in the procedure.

Reliability Statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.554	.573	4

Q5 (Integrated BIM and M&E)

Case Processing Summary

		N	%
Cases	Valid	84	95.5
	Excluded[a]	4	4.5
	Total	88	100.0

a. Listwise deletion based on all variables in the procedure.

Reliability Statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.909	.910	8

Slum Upgrading Project Performance	

Case Processing Summary

		N	%
Cases	Valid	82	93.2
	Excluded[a]	6	6.8
	Total	88	100.0

a. Listwise deletion based on all variables in the procedure.

Reliability Statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.790	.786	4

APPENDIX VIII: Research Authorisation Letter

RÉPUBLIQUE DU CAMEROUN
Paix – Travail – Patrie

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Peace – Work – Fatherland

MINISTRY OF PUBLIC WORKS

GENERAL SECRETARIAT

NATIONAL ADVANCED SCHOOL OF PUBLIC WORKS

RESEARCH PERMIT

Ref:

1st October 2019

1. Names Henry Abanda Fonbeyin
2. Nationality Cameroonian
3. Title **Influence of Monitoring & Evaluation Systems on the Performance of Slum Upgrading Projects in Sub-Saharan Africa**
4. Research shall be confined to the following region(s): Yaoundé
5. Permit validity from 1st October 2019 to 1st October 2020
6. Researcher is required to submit progress report on quarterly basis and submit all publications made after the research.

Professeur NKENG George Elambo

Nkeng

DIRECTOR

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LE DIRECTEUR