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Barriers to Technology Adoption Among Construction Project Managers in Nigeria

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Abstract

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MS, Walden University, 2014

BS, Obafemi Awolowo University, 1995

Dissertation Submitted in Partial Fulfillment

of the Requirements for the Degree of

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Abstract

Innovative technologies for construction project management are constantly emerging in the construction industry's global landscape, yet the rate of failed projects within the Nigerian construction sector due to poor coordination of construction tasks is on the rise. An unanswered question in the literature remains as to why construction project managers in Nigeria remain slow to adopt new technologies for improving decision-making processes and project success rates. The purpose of this qualitative single case study with embedded units was to understand the perceptions of construction project managers in Nigeria regarding their barriers to technology adoption. This study was framed by 2 conceptual models: Usman and Said's model of factors contributing to information and communication technology adoption in Nigerian construction firms and Waziri, Mustapha, and Idris' model of factors influencing IT adoption in Nigerian construction organizations. Semistructured interviews involving 10 participants, reflective field notes, and archival data provided information regarding the barriers to technology adoption experience of construction project managers in Nigeria. Thematic analysis of the textual data and synthesis produced 5 conceptual categories for 14 identifiable themes from the study. The conceptual categories were (a) adoption of technology, (b) culture, (c) organizational performance, (d) innovative technology, and (e) interorganizational collaborations. The findings from this study may serve as a catalyst for positive social change by challenging existing technology-avoidance behavior in the Nigerian construction industry, and opening new opportunities for improved project delivery in the Nigerian national economy.

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Chapter 1: Introduction to the Study

Although new technologies are available to improve project performance, project managers in the Nigerian construction sector avoid their adoption (Akande, Olagunju, Aremu, & Ogundepo, 2018; Ozumba & Shakantu, 2018). This technology-adoption avoidance has resulted in continued substandard evaluation and monitoring of construction project performance in the Nigerian construction industry (Afolabi, Amusan, et al., 2018; Amusan et al., 2018). Although scholars have repeatedly documented the high rate of failed projects (e.g., 66% in a recent survey) within the Nigerian construction sector, they have also continued to question why construction project managers in Nigeria remain slow to adopt new technologies for improving decision-making processes and project success rates (Afolabi, Ojelabi, et al., 2018; Hamma-Adama, Salman, & Kouider, 2018). Abandonment of failed construction projects on a mass scale constitutes one of the impediments to growth within Nigeria's economy (Adebisi, Ojo, & Alao, 2018).

As technological advancements in the construction industry progress significantly faster in other countries, researchers have reported that the Nigerian construction sector lags behind many of its developing-country counterparts regarding acceptance, usage, and adoption of these technologies (Buba, Chitumu, & Ibrahim, 2018; Fadun & Saka, 2018). Three years after Usman and Said (2014) wrote about the need for the Nigerian construction industry to adopt innovative technologies, the problem of low-level information technology (IT) utilization in the Nigerian construction industry continues (Waziri, Mustapha, & Idris, 2017). In conducting this study on the perceptions of

construction project managers in Nigeria regarding their barriers to technology adoption, I sought to support Walden's mission of driving positive social change by understanding how removing barriers to technology adoption may significantly reduce project failure rates and thereby strengthen the Nigerian public infrastructural sector and the national economy as a whole (Afolabi, Ojelabi, et al., 2018).

This chapter presents the background literature leading to the formation of the problem statement and description of the gap in the scholarly literature. The chapter is presented such that there is a logical alignment between the problem statement, purpose of the study, research question, and conceptual framework of the study. Finally, the significance of the study, assumptions, limitations, and definitions of key terms used throughout this paper are also presented.

Background of the Study

The beginning of the current millennium brought about a dramatic change in the adoption and use of technology in the global business space. Technology influences the business approach of organizations, and it is important that leaders consider technology not just as an integral part of business, but also as a matter of organization-wide concern (Omotayo, 2015). As important as technology utilization for proper planning and coordination toward improved business performance is to organizations, research has shown that the Nigerian built environment is slow in its adoption, leading to a high rate of failed and abandoned public projects. In a recent study, findings showed that Nigerian building professionals were 5 years behind their counterparts in the United States, United Kingdom, and South Africa in their awareness and adoption of building information

modelling (BIM) technology (Hamma-Adama et al., 2018). Lack of expert knowledge and infrastructure have constituted strong barriers to the adoption of BIM technology in Nigeria (Hamma-Adama et al., 2018). Even though technology is important for business growth and relationships, people who matter in an organization must buy into its adoption. Ojelabi, Afolabi, Oyeyipo, Tunji-Olayeni, and Adewale (2018) submitted that stakeholders in Nigerian built environments have not shown a significant level of readiness to adopt and integrate technology platforms for fostering business social relationships. The finding of Ojelabi et al. suggests that stakeholders' involvement and commitment are important in the decision-making process leading to technology adoption.

Critical success factor (CSF) is a management strategy for understanding, examining, and evaluating crucial things that must go well for a business to succeed (Idemudia, 2017). With respect to the Nigerian built environment, Fadun and Saka (2018) identified interactive processes such as schedule and budget updates as the key factors that drive the success of public projects. Schedule and budget updates are critical to successfully complete a project within the approved time and cost. These are complex interactive tasks that cannot be done efficiently without the utilization of appropriate technology. Fadun and Saka (2018) submitted that knowledge and application of CSF are low in the Nigerian construction industry due to technology, and as such, it is very difficult for construction professionals to establish the appropriate mechanism to control the CSF right from the planning phase of projects. In another study, Akande et al. (2018) examined project planning tools in use among construction industry professionals and

found that the use of bar chart technology ranked highest when compared to more modern technology such as Microsoft Projects and Primavera.

Technology is needed to manage changes in the scope of public projects from the planning phase and throughout the construction phase until successful delivery (Amusan et al., 2018). The goal of any project is to eliminate undue changes and, if expedient, keep the scope change within the allowable threshold. In construction parlance, a scope change becomes a variation order when the change is approved by the project manager on behalf of the project owner. As it currently stands in the Nigerian construction industry, Afolabi, Ojelabi, et al. (2018) noted that the impact of variation orders initiated by a consulting team in terms of cost overrun and delay is huge when compared to variation orders that come from other sources in a project. The use of appropriate technology will help the consulting team achieve continuous coordination of all tasks efficiently, which helps minimize changes. Apart from improper planning and poor coordination of complex tasks, Adebisi, Ojo, and Alao (2018) added that inadequate funding contributed to project failure and abandonment in Nigeria.

Leadership style influences the decision-making process and the productive outcome of decision-making efforts. Leadership is important because the complexity of projects requires a combination of technical and specialized skills for successful delivery (Ameh & Odusami, 2014). Though the authors initially noted that a high task-high relationship behavior should be the leadership standard for project managers in Nigeria, a later study revealed a combination of delegating and directing leadership styles (Buba, Chitumu, & Ibrahim, 2018).

The findings of Afolabi, Ojelabi, et al. (2018), Fadun and Saka (2018), and Hamma-Adama et al. (2018) together point to the fact that lack of technology along with use of obsolete and inappropriate technology has influenced project management practices in Nigeria, which has hindered successful public project delivery. Given that technology leads to improved business decisions and quality of service, there is a gap in the literature on why construction project managers in the Nigerian construction industry remain slow to adopt new technologies (Akande et al., 2018). Although new technologies are available to improve project delivery in the construction industry, project managers in the Nigerian construction sector avoid their adoption (Akande et al., 2018; Ozumba & Shakantu, 2018).

Problem Statement

Many construction companies in Nigeria are failing to adapt and respond to the complexity of the new technology-led business environment and tend to experience survival problems (Akande et al., 2018; Ojelabi, Afolabi, Oyeyipo, Tunji-Olayeni, & Adewale, 2018). Overall failure rates of construction project management in Nigeria (e.g., 32% in 2014) indicate problems in identifying appropriate project management practices for successful project delivery (Akande et al., 2018). Abandonment of failed construction projects on a mass scale constitutes one of the impediments to growth within Nigeria's economy (Adebisi, Ojo, & Alao, 2018). The general problem is poor coordination of complex tasks by Nigerian project managers leading to inefficient appropriate project management practices, resulting in a low rate of project completion within the nation's construction sector (Amusan et al., 2018; Oke & Aghimien, 2018).

Although new technologies are available to improve project performance, scholars have identified that project managers in the Nigerian construction sector avoid their adoption (Akande et al., 2018; Ozumba & Shakantu, 2018). This technology-adoption avoidance has resulted in continued inadequate automated evaluation and monitoring of construction project performance in the Nigerian construction industry (Afolabi, Amusan, et al., 2018; Amusan et al., 2018). Although scholars have repeatedly documented the high rate of failed projects within the Nigerian construction sector due to poor coordination of complex tasks, a deeper understanding is needed on why construction project managers in Nigeria remain slow to adopt new technologies for improving decision-making processes and project success rates (Afolabi, Ojelabi, et al., 2018; Hamma-Adama et al., 2018). The specific problem is that the barriers to technology adoption by construction project managers in Nigeria to lower the rate of failed and abandoned construction projects remain poorly understood (Muhammad et al., 2018; Onungwa & Uduma-Olugu, 2017).

Purpose of the Study

The purpose of this qualitative single case study was to understand the perceptions of construction project managers in Nigeria regarding their barriers to technology adoption. Meeting the purpose of this exploratory study may address the literature gap on why construction project managers in Nigeria remain slow to adopt new technologies for improving decision-making processes and project success rates (Afolabi, Ojelabi, et al., 2018; Hamma-Adama et al., 2018). To address this gap, in alignment with the qualitative paradigm, I conducted a single case study with embedded-units design

(Yin, 2017). Information from ten interviews a reflective field notes, and archival data were collected through multiple sources to answer the study's research question (Stake, 2010; Yin, 2017). Triangulation of data sources was used to establish the trustworthiness of my analysis and findings on the phenomena under study (Guion, Diehl, & McDonald, 2011; Merriam & Tisdell, 2015).

Research Question

How do construction project managers in Nigeria describe their barriers to technology adoption?

Conceptual Framework

There is still little known about the decision-making process to adopt a construction technology (Sepasgozar & Davis, 2018) and the influencing factors that go into acceptance or rejection of technology adoption in the construction industry in Nigeria (Muhammad et al., 2018). To this end, this study is framed by two conceptual models: Usman and Said's (2014) model of factors contributing to ICT adoption in Nigerian construction firms and Waziri et al.'s (2017) model of factors influencing IT adoption in Nigerian construction organizations. Usman and Said developed a conceptual model that captures those attributes that contribute to slow technology adoption in Nigerian construction firms, grounded in a literature review on their identified causal factors of culture, policy, and cost and how they relate to technology adoption in Nigerian construction firms. Waziri et al. developed a model of factors influencing IT adoption in Nigerian construction organizations by extending Usman and Said's conceptual model using the initial assumption that innovative technology has been a driving force behind

organizational performance through stimulation and standardization of an effective communication system among the members of organizations as well as interorganizational collaborations (García-Sánchez, García-Morales, & Martín-Rojas, 2018). Usman and Said grounded their factors contributing to ICT adoption in Nigerian construction firms model in Rogers's (1995) innovation diffusion theory, which also provided a theoretical lens through which to evaluate the effect of the three factors of culture, policy, and cost in any research related to ICT adoption.

The innovation decision-making process embedded in Rogers's (1995) diffusion of innovation theory, which helps an organization to decide whether to adopt or reject an innovative idea, is one of Rogers's significant contributions to innovation theory. Through an extensive review of the literature emanating from Nigeria, Waziri et al. (2017) developed a model of IT adoption to supplement Usman and Said's (2014) work, the model of factors influencing IT adoption in Nigerian construction organizations, which introduced new factors into the IT adoption process by construction firms: the technology, organization, and environment contexts. Findings from Waziri et al.'s study reinforced the continuing reluctance of Nigerian construction to adopt new technologies; their technology, organization, and environment (TOE) model offers a theoretical model that can be extended through empirical research to further study IT adoption within the Nigerian construction sector (Akande et al., 2018; Ozumba & Shakantu, 2018).

Nature of the Study

The nature of this study is qualitative to address the purpose of the study and provide data for the central question that drives this research drawn on a constructivist

paradigm, on the assumption that people and groups construct their own social reality (Denzin & Lincoln, 2005; Lee, 2012). A quantitative method was inappropriate for the study because quantitative research designs examine relationships, test theories, standardize reporting, and collect quantifiable data (Harkiolakis, 2017). A mixed-methods approach was not appropriate because quantitative data were not required to answer my research question (Bryman, 2017). The research problem and the nature of the study required a qualitative methodology because there was a need to explore in a brief manner a problem that is involved in a complex social process (Merriam & Tisdell, 2015). Given that the study's purpose called for a deeper understanding of the perceptions of construction project managers in Nigeria regarding their barriers to technology adoption, an exploratory single case study with embedded units (Yin, 2017) was used to meet the study goals.

The goal of qualitative research is to explore experiences from the viewpoint of people living within a specific context, and constructivists look to challenge people to be more critical of their understanding of the world and themselves while interpreting interactions between the individual and the environment (Cooper & White, 2012). Qualitative research also presents opportunities that describe how to analyze business decisions and how to explore the reasons behind various aspects of behavior within organizations—in the case of this study, the technology-avoidance behavior of construction project managers in Nigeria (Klenke, 2016). Qualitative case studies comprise an integral part of the business field, are more connected to quantitative data and methods than other qualitative designs, and generate holistic and contextual in-depth

knowledge using multiple sources of data (Eriksson & Kovalainen, 2015; Yin, 2017).

Purposeful sampling is widely used in qualitative research for the identification as well as the selection of information-rich cases that are related to the phenomenon of interest. Although there are various purposeful sampling strategies, it appears that criterion sampling should be used in the most common implementation research (Baxter & Jack, 2008). Participants for this case study were recruited using purposeful criterion and snowball sampling strategies and screened with the following inclusion criteria: adults over the age of 18; 3 years' minimum experience in the construction project management field in Nigeria; possession of knowledge regarding construction technology (Robinson, 2014).

Snowball sampling is the most common form of purposeful sampling and works by asking a few key participants who already meet the criteria for the study to refer others who may also meet the criteria (Merriam & Tisdell, 2015).

I conducted 10 in-depth face-to-face individual interviews with construction project managers in Nigeria. Schram (2006) recommended a range of five to 10 participants for a qualitative study, stating that a larger sample size may weaken a deep investigation of the phenomena under study. Data from the interview transcripts were analyzed through thematic analysis to identify themes. I triangulated the interview data themes with data from reflective field notes and archival data to support the trustworthiness of findings and make suggestions for further research (Guion et al., 2011).

Definitions

The section deals with the definitions of terms used in the study that may have multiple meanings. The terms are *project abandonment*, *project failure*, *project management*, *project manager*, *project*, *technology adoption*, and *technology*.

Project abandonment: Occurs when project owners decide to discontinue temporarily or permanently a project under construction (Amade, Ubani, Amaeshi, & Okorocha, 2015).

Project failure: The inability to complete a project in line with cost, time, and quality specification or inability of a project to satisfy the expectations of its sponsor (Nweze, 2016).

Project management: The application of knowledge, skills, tools, and techniques to project activities to meet the project requirements (Project Management Institute, 2017).

Project manager: The person assigned by the performing organization to lead the team that is responsible for achieving the project objectives (Project Management Institute, 2017).

*Projec*t: A temporary endeavor undertaken to create a unique product, service, or result (Project Management Institute, 2017).

Technology adoption: The implementation of new technologies and new methods of workplace organization with a view to enhance the quality and variety of the goods and services supplied (Ugur & Mitra, 2017). The act of selecting and deploying new technology for use by an organization.

Technology: The theoretical and practical knowledge, skills, and artifacts that can be used to develop products as well as their production and delivery system (Wahab, Rose, & Osman, 2012).

Assumptions

Assumptions are nonvalidated statements that a researcher presumes to be true for a specific purpose, such as building or extending a theory (Shungu, Ngrirande, & Ndlovu, 2014; Wargo, 2015). The assumptions are fundamental premises included in a study by the researcher for the investigation to proceed. In this study, the first assumption was that participants had sufficient knowledge, information, and understanding of the barriers to technology adoption in their organizations, as lack of understanding of the phenomenon would have made it impossible for the participants to discuss the problem for plausible solutions. The second assumption was that participants would provide honest responses and truthful information. I expected that participants would not exaggerate their responses about the technology-adoption experience in their organizations. The assumption of participants' truthfulness helped in finding solutions to the barriers confronting technology adoption. I believed that the assurance of confidentiality would enable the participants to provide truthful responses (Bloomberg & Volpe, 2018). The third assumption was that participants' decision to take part in the study was not just about helping a colleague undertaking a dissertation study but was about their genuine interest in contributing toward addressing the problem of barriers to technology adoption for curtailing failure and abandonment of public projects in Nigeria.

The fourth assumption was that the sample size adequately represented the population of the participants (project managers) working in public-projects organizations in Nigeria. This was necessary to avoid a situation in which the result of the study may have been skewed, thereby rendering the findings and recommendations from the study incapable of adequately addressing the problem of the study (Athanasiou et al., 2012). The fifth assumption was that the result of the data analysis of the semistructured interviews provided an opportunity to discover valid and reliable common themes regarding barriers to technology adoption. When the researcher removes self-bias during data collection to ensure trustworthiness of the data, themes in case study research are deemed valid and reliable. The sixth assumption was that sampling estimation bias would not occur that would disrupt the study. I prepared a reserve list of other qualified participants in accordance with the best practice recommended by Diaz de Rada (2014). The seventh assumption was that effective technology adoption enhanced successful delivery of public-sector projects. The eighth assumption was that I would not experience hindered access to documents and archival data and that all secondary data would contain accurate information for this study.

Scope and Delimitations

The specific scope of this study encompassed the perception of construction project managers regarding barriers to technology adoption in public-project organizations in Nigeria. The focus was on the decision-making process leading to technology adoption because little is known about the influencing factors that go into acceptance or rejection of technology adoption (Muhammed et al., 2018; Sepasgozar &

Davis, 2018). Usman and Said's (2014) model of factors contributing to ICT adoption in Nigerian construction firms and Waziri et al.'s (2017) model of factors influencing IT adoption in Nigerian construction organizations were the two conceptual models that guided the study. The data collection instruments for the study were interviews, reflective field notes, and archival data. The interview participants were construction project managers drawn from a population of project managers from public-project organizations that met the study's inclusion criteria. The purposeful criterion and snowball sampling strategies enableddeliberately choose settings, individuals, or activities that would lead to useful information relevant to the research question and goal (Maxwell, 2013). Reflective field notes were created in situ during field experience, whereas archival data were retrieved internally within the host organizations and data from government regulatory agencies' publications. The data were analyzed using Yin's (2017) five-stage data analysis because of the satisfactory results that qualitative scholars have achieved using the approach (Gu, 2014).

In defining the boundaries of the study, only public-project organizations located in Lagos/Abuja metropolis were included. Introducing delimitation into a study enables a researcher to make choices that can be controlled and justified, and as a result help me achieve objectivity and credibility while working within the boundaries of a study (Dika, Dibra, Brahimi, & Bezo, 2013; Nwonyuku, 2016). The choice of participants to interview was delimited to construction project managers, given the belief that they had a good understanding of technology requirements for successful project delivery. With thick description (Lincoln & Guba, 1985) and analytic generalization (Yin, 2017), this research

offered transferability, as the findings of the study are capable of being extended not only to other public project organizations outside Lagos/Abuja metropolis, but also to public–private partnership project organizations, and privately owned project organizations in Nigeria.

Limitations

Limitations are elements of a study that can affect the study outcomes, but that are not within the control of researcher (Wargo, 2015). One area of limitation is the source of data collection. For instance, when document and archival data are used, a study is limited by the information contained in the document/archival data and the quality of these data, whereas in studies in which interviews are used, though the participants have the onus to provide quality responses about their perceptions, the disposition to do exactly as expected is at the participants' discretion. Bias can potentially influence the outcome of a study (Berger, 2015), and this can emerge not only from the participants, but also from the researcher. Insider bias was not a limitation in this study, as I had no affiliation with any of the public-project organizations studied. Bias from the project managers due to their membership or affiliation with the organization may prevent them from describing experiences that may likely place the organization in a negative light, and this was addressed through a demonstration of promise of confidentiality and anonymity to the participants during participant selection. The use of criterion and snowballing sampling strategies for the study eliminated any form of convenient sampling bias from the research (Merriam & Tisdell, 2015).

Reflexivity involves a researcher self-scrutinizing the lens through which he or she views the phenomenon studied (Berger, 2015). Adopting reflexivity at every step of this research process helped in identifying and addressing biases associated with qualitative research as they emerged. Data triangulation involves converging data collected from multiple sources to achieve understanding (Lincoln & Guba, 1985) and to determine the consistency in findings (Yin, 2017). Triangulating data themes from the interviews with data from reflective field notes and archival data enabled me to support the trustworthiness of the findings (Guion et al., 2011). Additionally, the use of prolonged contact, whereby the researcher spends time in the field to understand the context and the setting of the phenomenon being studied, enhances the accuracy of findings and credibility of research.

Significance of the Study

Although few studies have examined project failures in the Nigerian construction sector, scholars have identified poor project management practice as a cause (Nweze, 2016; Obinna, 2017). No other significant study has examined the perception of construction project managers in Nigeria regarding their barriers to project management technology adoption. This study is significant because it contributes to filling the gap in the literature regarding barriers to technology adoption in the Nigerian construction industry.

Significance to Practice

The study may help advance an understanding of the barriers to technology adoption and the use of project management technology in the Nigerian public sector by

potentially extending the existing literature on failures of public projects in Nigeria related to technology adoption. Because theory is important to practice, understanding the barriers to technology adoption in the public sector in Nigeria will help stakeholders in the construction sector establish intervention strategies necessary to curtail and reduce the barriers (Frank et al., 2016). Hence, a new project management culture may begin to emerge in Nigeria that will help increase productivity, increase the chances of project success, and ensure that more public projects will be delivered on time and within the allowable budget and desired quality standard.

When institutions in a developing country devalue and undervalue local stakeholders and ethical business practices, adoption of a technological innovation that will lessen corrupt practices becomes difficult (Amavilah, 2016).This study may inform the project managers in the Nigerian construction sector about the skill necessary to circumvent corrupt practices causing multiple project failures in the Nigerian construction industry. Though this study was intended to address barriers to technology adoption in the public sector, the findings may also inform stakeholders in the private construction sector in Nigeria facing similar or related challenges (Ibem, Onyemaechi, & Ayo-Vaughan, 2018).

Significance to Theory

This study is significant because it offers an original contribution to the theoretical literature on barriers to project management technology adoption in Nigeria. While scholars have repeatedly documented the high rate of failed projects within the Nigerian construction sector due to poor coordination of complex tasks, a deeper

understanding is needed of why construction project managers in Nigeria remain slow to adopt new technologies for improving decision-making processes and project success rates (Afolabi, Ojelabi, et al., 2018; Hamma-Adama et al., 2018).

Scholars indicate that the construction industry worldwide continues to lag in technology adoption and is generally averse to change (Milliou & Petrakis, 2011; Sepasgozar & Davis, 2018). In Nigeria, risk aversion and the technology adoption gap in the construction industry are due to many reasons such as the variability of a company's expertise, the uniqueness of the product, and the nature of the industry itself (Ogwueleka & Udoudoh, 2017). These factors make the construction industry in both developed and developing countries very different compared to other industries. In the past, scholars attempted to measure factors of technology adoption decision using the theory of reasoned action (TRA) by Ajzen and Fishbein (1975). Scholars using quantitative methods have reported contradictory conclusions on how the decision to deploy a technology is a function of a variety of influences. There is still little known about the decision-making process to adopt a technology in the construction industry and the influencing factors. Furthermore, cost is often not the most important factor influencing the technology adoption decision (Sepasgozar & Davis, 2018).

Scholars have contended that other factors are likely to be critical in the adoption decision in construction industries in developing countries (Mackhaphonh & Guangshe, 2017) and should be investigated, including cultural factors; such cultural factors in Nigeria include the wider social acceptance of corrupt business practices, difficulties of changing traditional culture to collaborative culture, difficulties in maintaining a work

attitude of continuous improvement, integrity and ethics issues, and a lack of qualified personnel in the organization/project. This study may be significant to theory, given that there is still a need for theory building on how to implement decisions to adopt technology because the technology adoption process in construction and the influencing factors are not clearly understood (Sepasgozar & Davis, 2018).

Significance to Social Change

Technology can affect social change in as much as it allows existing products and practices to be transformed (Andrés et al., 2016). Unfortunately, obstacles to social change through the technological progress of African countries have reinforced corrupt business practices that keep old ways of doing business firmly in place (Amavilah, 2016). Although there have been significant variations across countries, in recent years Nigeria has risen at a faster pace in areas such as oil revenue, yet has fallen behind in promoting and supporting social change, such that inequality of both income and wealth remains widespread (Elwereflli & Benhin, 2018). This economic growth and performance picture itself remains incomplete, given the critical voices of project managers in the Nigerian construction sector that must be accounted but remain absent (Fadun & Saka, 2018).

According to a recent survey, experts in this field of study found that about 32% of construction projects in Nigeria succeeded (Akande et al., 2018). The figure constituted a failure rate of 68%. In a related survey, 4,000 failed projects were identified, and it was estimated that it would take 30 years and ₦300 billion to get the failed projects completed (Amade, Ubani, Amaeshi, & Okorocha, 2015). When failed projects are abandoned, results include unemployment of construction workers and managers,

environmental degradation, and loss of valuable economic resources. Therefore, the financial loss has long-range economic, social, and environmental implications and the loss of potential gain if the money wasted had been invested efficiently into other areas of public life (Obunwo, Chinyio, Suresh, & Adjei, 2017). When barriers to technology adoption are understood and curtailed, the rate of public project failure will reduce significantly, thereby enhancing positive social change in the Nigerian public infrastructural sector and the society as a whole. For technology adoption to succeed at the micro level of project managers, its compatibility with existing social norms and trialability within the context of existing cultural practices is imperative. Should the Nigerian government begin to include professionals from specific sectors in policy decisions that affect those industries, the outlook for positive social change can be deemed hopeful (Afolabi, Ojelabi, et al., 2018).

Summary and Transition

In Chapter 1, the specific problem was that barriers to technology adoption by construction project managers in Nigeria to lower the rate of failed and abandoned construction projects remain poorly understood (Muhammad et al., 2018; Onungwa & Uduma-Olugu, 2017). The purpose of this single case study was to understand the perceptions of construction project managers in Nigeria regarding their barriers to technology adoption. I adopted a conceptual framework based on a combination of Usman and Said's (2014) model of factors contributing to ICT adoption in Nigerian construction firms and Waziri et al.'s (2017) model of factors influencing IT adoption in Nigerian construction organizations to guide the study. The method of investigation was

qualitative using exploratory single case study with embedded units (Yin, 2017). The data for the study came from semistructured interviews, reflective field notes, and archival data, and their triangulation helped me achieve trustworthiness in the findings. I believe that the findings from the study represent a significant potential contribution to the literature on technology adoption that may enhance practice and make a positive social change.

In Chapter 2, I describe the literature search strategy that was appropriate for the study, present a review of the current literature and the conceptual framework, and provide a summary of the chapter.

Chapter 2: Literature Review

The specific problem was that barriers to technology adoption by construction project managers in Nigeria to lower the rate of failed and abandoned construction projects remain poorly understood (Muhammad et al., 2018; Onungwa & Uduma-Olugu, 2017). Many construction companies in Nigeria are failing to adapt and respond to the complexity of the new technology available within the project management and construction sectors, leading to project sustainability issues (Akande et al., 2018; Ojelabi, Afolabi, Oyeyipo, Tunji-Olayeni, & Adewale, 2018). Abandonment of failed construction projects on a mass scale constitutes one of the impediments to growth within Nigeria's economy (Adebisi, Ojo, & Alao, 2018). While scholars have repeatedly documented the high rate of failed projects within the Nigerian construction sector, a deeper understanding is needed of why construction project managers in Nigeria remain slow to adopt new technologies for improving project success rates (Afolabi, Ojelabi, et al., 2018; Hamma-Adama et al., 2018).

The purpose of this qualitative single case study was to understand the perceptions of construction project managers in Nigeria regarding their barriers to technology adoption. In Chapter 2, I state the literature search strategy in conjunction with the conceptual framework that framed the research. I present a synthesis of the body of existing scholarly research and knowledge on barriers to technology adoption by construction project managers, and specifically in the local context of Nigeria.

Literature Search Strategy

I used Google Scholar and the Walden University Library database to conduct the literature review. Within the Walden University Library, I conducted searches of ABI/INFORM Collection, ScienceDirect, Academic Search Complete, ProQuest Central, EBSCOhost, Business Source Complete, SAGE Premier, Emerald Insight, and SpringerLink. Another database that I searched for relevant articles for the study was PMI Publications and Papers retrieved from https://www.pmi.org/learning/library. I used Google and Bing search engines to uncover the sources with a focus on locating peer-reviewed journal articles relevant to the study. The strategy that I adopted for searching the literature started with the identification of important concepts of the search, keywords and related terms, and selection of appropriate databases.

I used the following key terms and a combination of search terms to find the literature: *technology adoption, ICT adoption, technology adoption theory, barriers to technology adoption.* Others were *technology adoption and project delivery, Nigerian construction industry and public project failures, project manager and successful project delivery, project leadership in Nigerian construction industry.* Terms used in the search related to the research method included *qualitative study, single case study, sampling strategy, semistructured interview,* and *case study triangulation.*

I limited the search to peer-reviewed journal articles published within the past 5 years on barriers to technology adoption in the Nigerian construction industry, including seminal works of literature and published books not too far from 5 years old. All articles were checked through Ulrich's Periodicals Directory to confirm whether the journals

were peer reviewed (Grimes & Morris, 2006). I also searched websites of public project institutions in Lagos and Abuja metropolis and obtained documents on public project failures and technology adoption.

In this literature review, I present a synthesis of prior research regarding barriers to technology adoption in the Nigerian construction industry. I also present a synthesis of scholarly literature on the causes and effects of public project failure and abandonment in Nigeria and the role of technology adoption. The literature on project management practices in the Nigerian construction industry was also reviewed from the perspective of the role of project managers as standardized by the Project Management Institute (PMI). Finally, because technology adoption cannot take place without leadership decision making, I reviewed literature on decision-making processes leading to technology adoption in the Nigerian construction industry.

Conceptual Framework

There is still little known about the process of deciding to adopt a construction technology (Sepasgozar & Davis, 2018) and the influencing factors that go into acceptance or rejection of technology adoption in the construction industry in Nigeria (Muhammad et al., 2018). To this end, this study was framed by two conceptual models: Usman and Said's (2014) model of factors contributing to ICT adoption in Nigerian construction firms and Waziri et al.'s (2017) model of factors influencing IT adoption in Nigerian construction organizations. Usman and Said developed a conceptual model that captures those attributes that contribute to slow technology adoption in Nigerian construction firms, grounded in a literature review on their identified causal factors of

culture, policy, and cost and how they relate to technology adoption in the Nigerian construction firms. Waziri et al. developed the model of factors influencing IT adoption in Nigerian construction organizations by extending Usman and Said's conceptual model using the initial assumption that innovative technology has been a driving force behind organizational performance through stimulation and standardization of an effective communication system among the members of organizations as well as interorganizational collaborations (García-Sánchez et al., 2018).

Usman and Said (2014) grounded their model of factors contributing to ICT adoption in Nigerian construction firms (see Figure 1) in Rogers's (1995) innovation diffusion theory, which provides a theoretical lens through which to evaluate the effect of the three factors of culture, policy, and cost in any research related to ICT adoption. The innovation decision-making process embedded in Rogers's (1995) diffusion of innovation theory, which helps an organization to decide whether to adopt or reject an innovative idea, is one of Rogers's significant contribution to innovation theory. While developing the diffusion of innovation theory, Rogers also took into cognizance the difference that may exist between the people and the innovation. Rogers (2003) defined diffusion within his seminal theory of diffusion as "the process by which an innovation is communicated through certain channels over time among the members of a social system" (p. 206) and concluded that the rate of adoption is affected by five factors: "(i) perceived attributes of innovation (ii) type of innovation decision (iii) communication channels (iv) nature of the social system [and] (v) extent of change agent's promotion" (p. 206). Based on the diffusion of innovation theory, Usman and Said assumed the factor

of cost constitutes a relative advantage to adopters, whereas the factors of culture and policy are to be compatible with the needs and expectations of the adopters.

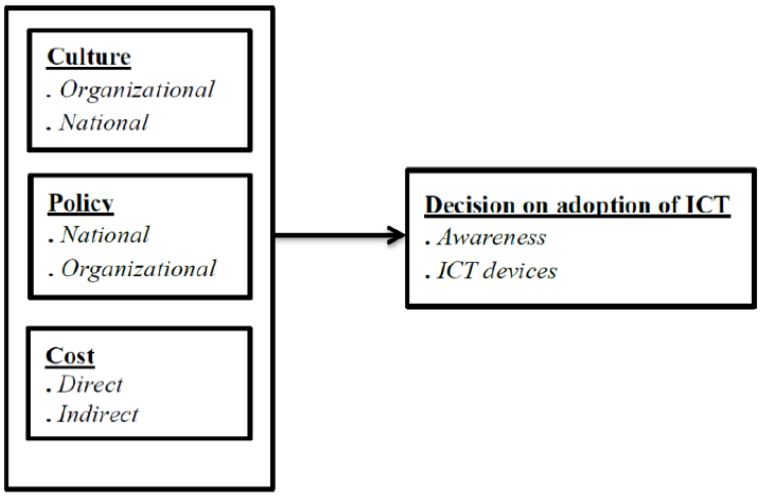

Figure 1. Model of factors contributing to ICT adoption in Nigerian construction. From "Key Factors That Affects Adoption of Technology in the Nigerian Construction Firms: A Theoretical Framework," by N. Usman and I. Said, 2014, *International Journal of Accounting, Business and Management, 2*, p. 32. Reprinted with permission.

The first factor in the model of factors contributing to ICT adoption in Nigerian construction firms (Usman & Said, 2014) is culture, which includes both organizational culture and national culture. *Organizational culture* is defined as the overall value and behavior that characterize the organization regarding its unique social and psychological environment. It is the sum of all attitudes, beliefs, customs, and written and unwritten rules that have been shared and developed over time and are valid for the organization (Phua, 2018). In relation to the diffusion of innovation, culture reflects the extent of freedom of personal expression in initiating new ideas, and it shows the extent to which freedom is allowed in decision making in the organization (Lachman, Lachman, & Butterfield, 2015).

Policy, the second factor in Usman and Said's (2014) model, consists of items that measure both national policy and organizational policy. A national policy represents a set of basic principles that guide a government toward actualizing desired national objectives, whereas an organizational policy is a set of basic principles that guide and limit the action of the organization in its pursuit of a long-term objective. Successfully identifying both national and organizational policy factors during ICT-adoption-related decision making will be of benefit to the public and private sector in the quest to adopt new technology (Karunaratne, Peiris, & Hansson, 2018). Cost, the third factor in Usman and Said's model of factors contributing to ICT adoption in Nigerian construction firms, consists of direct and indirect costs. Direct costs may include the cost of labor, material, fuel, and/or power that is directly traced to a specific cost object such as process, product, function, or project. Indirect costs apply to elements such as personnel, security, or administration that cannot be directly associated with a specific cost object. An understanding of both direct and indirect costs involved in IT adoption will facilitate a good understanding of the economic cost of IT adoption; hence, the decision to invest in a technology adoption will depend on its economic cost and financial returns (Sepasgozar & Davis, 2018).

The contribution of innovative construction outputs to the sustainable economic growth and development of a country is highly significant (Pan et al., 2018). The Nigerian construction industry is a primary stimulant of the nation's economic and social growth and accounts for about 3–8% of gross domestic product (GDP), employment of 5% of the entire country's labor force, and about 12% of production in the industrial

sector (Waziri et al., 2017). This enormous wealth creation and generation by the industry places it among the critical sectors of the country's economy. The massiveness of the industry and the interaction of its stakeholders demand an innovative running of its organizations for improved production. While technologies among the construction project managers in Nigeria have improved over the years, the adoption is generally limited to basic computer skills and the use of professional software (Adebisi, Ojo, & Alao, 2018). Rarely will project managers on construction sites in Nigeria adopt innovative and advanced IT options such as e-tendering, computerized inventory control, advanced project management, and scheduling systems, modeling and simulation technologies, or electronic data interchange (Waziri et al., 2017).

As these technological advancements in the construction industry have progressed significantly faster in other countries, Nigerian construction organizations have lagged behind many of their developing country counterparts regarding acceptance, usage, and adoption of these technologies (Buba, Chitumu, & Ibrahim, 2018; Fadun & Saka, 2018). Three years after Usman and Said (2014) wrote about the need for the Nigerian construction industry to adopt innovative technologies, the problem of the low level of IT utilization in the Nigerian construction industry continued (Waziri et al., 2017). Through an extensive review of the literature emanating from Nigeria, Waziri et al. (2017) developed a model of IT adoption to supplement Usman and Said's work, which introduced new factors into the IT adoption process by construction firms: the technology, organization, and environment contexts of the organization (see Figure 2).

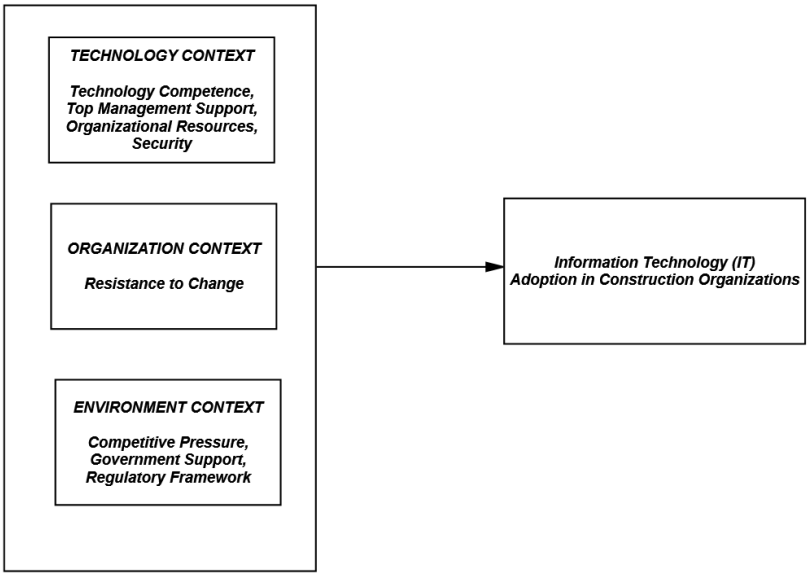

Figure 2. Model of factors influencing IT adoption in Nigerian construction. From "A Theoretical Model of Factors Influencing IT Adoption in Nigerian Construction Organizations," by A. Y. Waziri, Y. Mustapha, and K M. Idris, 2017, *International Journal of Engineering and Technology, 9,* p. 1813. Reprinted with permission.

The technology context comprises IT infrastructure competence and e-business competence, organizational size, supports from top management, technical competence, personnel with adequate skill in IT, and concerns for security. The organization context includes variables such as the firm's characteristics to effectively link structures between employees, the firm's internal communication processes, organizational culture, and organizational change processes. The environment context embraces the characteristics of the external environment such as regulation, industry structure, technology service providers, and competition (Waziri et al. 2017).

Scholars continue to recommend further inquiry into project managers' experiences in the Nigerian construction industry, including qualitative research to explore their resistance to change and to creating readiness among their employees for

successful IT adoption (Afolabi, Ojelabi, et al., 2018; Hamma-Adama et al., 2018). Findings from Waziri et al.'s (2017) study reinforced the continuing reluctance of Nigerian construction to adopt new technologies; their TOE model offers a theoretical model that can be extended through empirical research to further study IT adoption within the Nigerian construction sector (Akande et al., 2018; Ozumba & Shakantu, 2018).

Literature Review

How Technology Is Used in the Construction Industry

The construction industry is vital for the development of any nation, as the pace of physical infrastructure produced from the industry can determine the pace of economic growth (Olatunji, Oke, Aghimien, & Seidu, 2016). In Nigeria, the construction industry accounts for 3–8% of GDP (Waziri et al., 2017), and it is estimated that the industry will account for 13.2% of GDP globally by 2020 (Betts, Robinson, Blake, Burton, & Godden, 2011; PR Newswire, 2016, April 13). Hence, the contribution of the industry to the economies and wealth of a nation is enormous (Pan et al., 2018), such that it requires innovative technology to continuously drive its contribution sustainably (Ogunde, Olaolu, Afolabi, Owolabi, & Ojelabi, 2017; Tunji-Olayeni, Mosaku, Oyeyipo, & Afolabi, 2018).

The beginning of the current millennium brought about a dramatic change in the adoption and use of technology in the global business space. Technology influences the business approach of organizations, and it is important that leaders consider technology not just as an integral part of business, but also as a matter of organization-wide concern (Omotayo, 2015). Today, technology has become an organization-wide concern in every area of business such that it is risky for right-thinking leaders to ignore technology.

Technology is a driving force behind organizational performance (Waziri et al., 2017). Technology helps to improve the quality of work produced and the efficiency of construction professionals (Ozumba & Shakantu, 2018). The complexities in coordination of tasks and ambiguities associated with construction projects require that construction industry professionals adopt cutting-edge technology to overcome them for successful project delivery (Amade, Ubani, Amaeshi, & Okorocha, 2015).

The success of a construction project is determined by meeting cost, time, safety, quality, and overall value criteria as determined by the owner (Fadun & Saka, 2018). The construction manager must engage in planning, organizing, scheduling, implementing, managing, monitoring, controlling, and tracking construction projects with the aim of mitigating the effects of any occurrence or situation that could affect project success. Thus, it is critical for project managers in the construction industry to achieve these objectives through planned coordination and controlled operation of complex construction tasks and activities (Okoye, Ngwu, & Ugochukwu, 2015). Among many other factors assessed, innovative ideas and technology scored highest and significantly contributed to improved project performance (Aigbavboa, Oke, & Mojele, 2016; Sabiu & Agarwal, 2016).

The project-based nature of the construction industry, the complex communication structure, and the vast number of stakeholders and their diverse interests, coupled with the large amount of data, all require technology to achieve efficiency in managing the construction process (Holt, 2015). A construction project is characterized by thousands of individual work tasks that may be similar in nature and at times diverse

in character (Adwan & Al-Soufi, 2018). Hence, there is no one-size-fits-all technology-product-adoption approach for the industry, as each work task or group of similar tasks may require specialized technology to execute it. In construction industry, technology is used to simplify the construction process by integrating the complex interactions of all construction activities across planning, procurement, execution, and commissioning phases of construction. Although the utilization of modern technology in the construction industry has advanced in developed and industrialized nations over the years, developing nations such as Nigeria are still struggling to adopt new technology (Adebisi, Ojo, & Alao, 2018).

The construction industry in developed nations has advanced to competently using ICT technology, a platform to manage and share construction information (Martinez-Rojas, Marin, & Vila, 2016). ICT technology in use in construction industry consists of web-based, BIM-based, CAD and 3D, decision-based, tracking-based, computer-based training, knowledge and information management, simulation and analysis, video conferencing, and virtual reality applications (Adwan & Al-Soufi, 2018). BIM-based technology and other ICT applications have a profound effect on the construction process as they have greatly improved coordination among stakeholders and enhanced productivity (Sun, Jiang, Skibniewski, Man, & Shen, 2017). The use of ICT technology in construction industry has revolutionized and transformed the way projects are conceived, designed, constructed, and operated (Azhar, Khalfan, & Maqsood, 2015). Aside from ICT, other forms of technology in use in construction industry is artificial

intelligence such as remote-control trucks, excavator, drones, and robots (Bogue, 2018; Sepasgozar, Davis, Loosemore, & Bernold, 2018).

The construction industry in developed countries has also transformed from conventional building practice into industrialized building system (IBS), which has allowed construction industry to reduce waste, achieve efficiency, and remarkable productivity (Zakaria, Gajendran, Skitmore, & Brewer, 2018). With the large amount of heterogenous data involved in the planning, coordinating, and execution of construction projects, construction industry is now revolutionizing into the adoption of digitalized data phenomenon known as big data (Bilal et al., 2016). Project management technology is available for use in construction industry for automated project management practices and reporting (Aydin & Dilan, 2017; Kwak, Sadatsafavi, Walewski, & Williams, 2015).

It is evident that the emergence of new technology has rendered old technology obsolete as the world advanced toward digitalization and automated approach to industrialized processes. Technology is available for usage for construction industry professionals by way of adoption into the construction process. However, as these technological advancements in the construction industry progress significantly faster in other countries, the Nigerian construction organizations still lagged behind many of its developing country counterparts regarding acceptance, usage, and adoption of these technologies (Buba, Chitumu, & Ibrahim, 2018; Fadun & Saka, 2018).

Factors Influencing Technology Adoption in Construction

In a global construction survey, the accounting giant KPMG asked construction business leaders to report how their businesses fare on the technology adoption spectrum.

The result of the survey showed that despite a rise in project complexity and associated risk, only 8% of the respondents could be categorized as cutting-edge technology visionaries (KPMG, 2016). Over 20% said they are aggressively disrupting their business technology models, while most of the respondents said their organizations are held back by manual processes. KPMG also found out that 30% of the firms surveyed were using mobile devices to monitor projects, 33% were using robotics and automation, while 20% of the firms surveyed were yet to fully integrate project management information systems across the enterprise. The conclusion of the survey was that even though technology is available, construction industry is yet to fully embrace technology. Research has also shown that the adoption of web-based and digital technologies, especially in the Nigerian construction industry is still at its infancy (Afolabi, Oyeyipo, Ojelabi, & Amusan, 2018; Ezeokoli, Okolie, Okoye, & Belonwu, 2016).

Large projects in the construction industry typically take 20% longer to complete than scheduled and 80% budget overrun with less than 1% spending on technology R&D (Agarwal, Chandrasekaran, & Sridhar, 2016). The industry is reported to be among the least digitized sectors globally (Gandhi, Khanna, & Ramaswamy, 2016). The peculiar characteristics of construction industry, such as the uniqueness of the products, the variability of expertise and technology, and the tendency for the players in the industry to be risk-averse make the construction industry unique and very different when compared to other industries (Fadun & Saka, 2018). Thus, the decision to adopt and deploy technology in construction industry is affected by a variety of influencing factors (Nnadi, Enebe, & Ugwu, 2018).

A good number of scholars have published works on the influencing factors without taking cognizance of the decision-making process leading to technology adoption. From the TOE framework, influencing factors include readiness for change, resistance to change, and competitive and regulatory environment (Waziri et al., 2017). The interaction of culture, policy, and cost factors greatly influence the decision to adopt (Usman & Said, 2014). Other influencing factors established in the literature are technological need, technology selection and evaluation strategies, and technology negotiation strategy (Oviedo, Martelo, & Romero, 2018). Technology adoption constitutes a logical process through a specific path to reach a decision to adopt or reject. Construction companies operating under the Construction Technology Adoption Process (CTAP) follow the logical process linked to the influencing factors of the company's need, project objectives, characteristics of the adopting organization, and the characteristics of the new technology to be adopted (Sepasgozar & Davis, 2018).

There is still little known about the decision-making process to adopt a construction technology (Sepasgozar & Davis, 2018) and the influencing factors that go into acceptance or rejection of technology adoption in the construction industry in Nigeria (Muhammad et al., 2018). The decision to adopt a new technology follows logical steps and is extremely complex as it involves various interactions between vendors and customers across each phase of the decision-making process (Sepasgozar & Davis, 2018). The vendors, in this case, refer to a person or company that uses different strategies to encourage the adoption of their technologies by the customer. Customers refer to stakeholders in the construction industry who are faced with the decision to adopt

a technology under a bombardment of technological products from various vendors. Even though vendors are outside the customer's organization, they play a significantly supportive role in the adoption process that can influence the decision to adopt or reject the technology (Kamal, Bigdeli, Themistocleous, & Morabito, 2015; Ramayah, Ling, Taghizadel, & Rahman, 2016).

Critical to understanding the factors influencing technology adoption in the construction industry is a comprehensive understanding of the phases that make up the adoption decision process. The phases are technology dissemination, technology investigation, technology adoption decision, and technology implementation (Sepasgozar & Davis, 2018). Technology dissemination occurs when vendors engage in active marketing of the technology so that potential customers are aware of the new technology (Sepasgozar & Davis, 2014; Walsh, 2015). Vendors use technology exhibition and brochure to achieve dissemination. Technology dissemination brings both the vendor and the customers together, and in so doing, customers can ask and get clarification on any questions about the product, such as ease of use, perceived usefulness, and so on (Sepasgozaar, Shirowzhan, & Wang, 2017). Awareness is important in construction industry as it initiates the decision to accept or reject the adoption of a practice, process, or procedure as evidenced in scholarly literature (Sabiu & Agarwal, 2016; Nnadi, Enebe, & Ugwu 2018).

The investigation phase determines the readiness of the customer organization to adopt the technology having interacted with the vendor previously in the technology dissemination phase (Sepasgozar & Davis, 2018). This is the phase where customers put

all the information and data gathered during the dissemination phase into a context that enables them to evaluate the feasibility and viability of the technology to be adopted and select a technology that meets the needs of the organization and project objectives (Ma, Yang, & Lu, 2014; Sepasgozar & Davis, 2018). Technology readiness, in this case, is defined as the readiness of the organization and the employees to embrace the adoption of new technology (Rojas-Méndez, Parasuraman, & Papadopoulos, 2015). Apart from economic and cultural readiness (Usman & Said, 2014), the technical readiness (Waziri et al., 2017) of the organization must be assessed.

The next phase is the technology adoption decision, which deals with the adopters making sense of the analysis and substantiating the final decision to accept or reject the adoption where the vendor issues the customer organization with the contract of sale (Sepasgozar & Davis, 2018). The project manager has a critical role to play not only as an initiator of the adoption decision process with power to authorize expenditure for small purchases but will have to seek approval for larger purchases (Sepasgozar & Davis, 2018; Sepasgozar & Bernold, 2013). The implementation phase is the last phase of the adoption decision process. It involves delivery and training, commencement of operation, maintenance set up and feedback mechanism. The kind of support the adopting construction organization receives from the vendor is crucial to the continuous adoption of the technology or any other technology from the same vendor (Sepasgozar & Davis, 2018). The implementation stage helps construction organizations to develop lessons learned and create a benchmark of best practices for a future technology adoption decision process (Liu, Prajogo, & Oke, 2016).

In conclusion, first, an understanding of the technology adoption decision process matters to the adopting organization and it seems very clear that the organization cannot comprehensively understand the influencing factors without a thorough understanding of the decision-making process, how they are connected, and the key players in the process (Sepasgozar & Davis, 2018). Second, the adoption or the rejection attitude of the adopting organization must be focused on the merits of all the influencing factors and not just on the merit of few factors (Malik, Suresh, & Sharma, 2017; Sepasgozar & Davis, 2018). There is a place for readiness as no adoption can occur without an organization being technology ready. The adopting organization must jettison negative attitude to technology at individual and organizational level and embrace positive attitude to technology adoption. Technology adoption must be seen by the adopting organization as a circular process starting from technology awareness through technology investigation, technology readiness, technology adoption decision, and technology implementation and back to awareness of a new advanced technology product for the same set of tasks as it is very clear that organizations cannot afford to be out of tune with emerging technology. The tendency for organizations to be out of tune to technology occurs when there is a disengagement from the circular process, and organizations always need to keep in place a dedicated and effective R & D technology team to keep the spirit of technology adoption alive in the organization (Abubakar, Ibrahim, Kado, & Bala, 2014; Botti, 2016)

ICT in the Nigerian Construction Industry: Recent Historical Background

The construction industry in Nigerian consists of diverse professionals such as engineers, builders, architects, quantity surveyors, land surveyors, contractors, suppliers,

and geo-informatic experts among others, which require exchange of project data and information in discharging their services of achieving project objectives of time, cost, and quality to the project owners (Olubunmi, Olaniyi, & Fisayo, 2014). The large number of professional teams and the data-intensive nature of the industry requires specialized coordination of project tasks using ICT to achieve the project objectives (Bilal et al., 2016).

Historically, the Nigerian construction industry after the millennium breakthrough was still characterized majorly by the use of a traditional paper-based approach to information and communication management (Amusan et al., 2018). The report published by the International Telecommunication Union (ITU) showed that Nigeria ranked 153rd among 178 countries in global ICT ranking and 27th among 51 African countries. This result was not surprising as the industry was characterized by three major constraints: inadequate and erratic electricity supply, high cost of computer software and hardware, and insufficient jobs among the contractors operating in the industry (Gambo, 2017).

Fifteen years later, the ICT Development Index (IDI) of Nigeria was 2.60 in 2017 compared to 2.44 in 2016 while still maintaining at 143rd position among 176 countries globally and 15th position among 38 African countries (ITU, 2016; ITU, 2017). Even though the IDI went up from 2.35 in 2013 and now 2.60 in 2017, the percentage growth in IDI over the 4-year period is still low when compared with the IDI growth of other African countries. The percentage of households with computers and internet access stands at 10.56 and 15.23, respectively (ITU, 2016). Research suggested that ICT

penetration at the household level can be used to explain ICT penetration at the organizational level (Hilty & Aebischer, 2015) and as such, the statistics of ICT usage at the household level in Nigeria helps draw a background for understanding ICT penetrations in the Nigerian construction industry.

In general, industries such as banking, health, and education have achieved some level of IT adoption in Nigeria such as software development, mobile devices, cloud computing, data centers, cybersecurity, and research network (Awosan, 2014); the Nigerian construction industry is still experiencing a paradigm shift from traditional paper-based information and communication approach to a digitally based information exchange (Bilal et.al., 2016). Construction companies all over the world are growing into having in-house customized and dedicated software packages for project planning, tracking, and control locally and globally, whereas the Nigerian construction industry adoption of ICT is still generally limited to basic computer skills and general professional software such as word processing, spreadsheet, auto CAD, and internet (Adebisi, Ojo, & Alao, 2018).

Rarely will Nigeria project managers on construction sites adopt innovative and advanced IT options such as e-tendering, computerized inventory control, advanced project management, and scheduling systems, modeling and simulation technologies, or electronic data interchange (Waziri et al., 2017). The industry still lacks usage of technology platforms such as BIM for teamwork and collaboration and management of information exchange that supports operation and maintenance throughout the life cycle of projects (Lucas, 2015; Onungwa & Uduma-Olugu, 2017).

While BIM has radically transformed the way construction is done internationally (Onungwa & Uduma-Olugu, 2017), Nigerian construction industry is still at its lowest ebbs in its adoption. The result of a recent study revealed that out of the 59% of the professionals in the Nigerian construction industry that are aware of BIM technology, only 23% are using the BIM technology and the usage is still far below BIM full capability (Hamma-Adama et al., 2018). Generally, the ICT slow adoption history in Nigerian construction history accounts why many scholarly studies regarded the construction industry's failure to keep pace with ICT advancement as a major problem affecting its performance (Amusan et al., 2018; Ikediashi & Ogwueleka, 2016; Oyewobi, Ibironke, & Oladosu, 2015).

IT Adoption Issues in Today's Nigerian Construction Firms

In Nigeria, the construction industry plays a vital role in the economic development (Ejohwomu & Oshodi, 2014; Okoye, Ngwu, Ezeokoli, & Ugochukwu, 2016; Waziri et al., 2017). Construction firms in Nigeria contributed about 3–8% to Nigeria's GDP (Waziri et al., 2017). In real terms, the construction sector contribution to total GDP was 3.04% in 2017, lower than the 3.10% contribution reported in 2016 (National Bureau of Statistics, 2018). In a recent historical review of sectoral contribution to Nigerian GDP, as of 1981 the construction industry contributed 5.8% to Nigerian real GDP, nevertheless, recent development suggested that the current contribution of construction firms to Nigerian real GDP was incongruent with the historical trend three decades ago (Abubakar, Ibrahim, Kado, & Bala, 2014). This trend suggests that many

things have systemically gone astray in the construction industry in Nigeria (Chete, Adeoti, Adeyinka, & Ogundele, 2014; Ou, 2015).

In advancing the economic development objective, construction companies in Nigeria need a repositioning with technology evolution by embracing cutting edge technique in material and equipment technology, design procedures, health and safety processes, including coordination and management of complex tasks that will bring improved project outcomes, cost-efficient projects, value for money invested, safe and improved overall quality of construction projects. However, despite the increasing availability of technology, there seem to be several issues limiting Nigerian construction firms from adopting IT technology. IT adoption issues are problems, questions, complications, which constitute general ongoing concerns that technology adopters commonly face while attempting to adopt IT.

The research on IT adoption issues in the Nigerian construction industry is still emerging as there are no such scholarly papers that directly and specifically deal with the topic of IT adoption issues in Nigerian construction firms. Almost all the IT adoption issues that affect other industrial sectors in Nigeria, such as banking, manufacturing, small–medium enterprises, and so on come to play on construction industry firms as well. There are several IT technology issues mentioned in the scholarly literature but issues that are specifically relevant to construction firms in Nigeria range from lack of adequate infrastructure (Agwu & Murray, 2014, 2018; Chete, Adeoti, Adeyinka, & Ogundele, 2014), technical skill deficiency (Ejiaku, 2014; Faloye, 2014; Muhammed, Zaharaddeen, & Turaki, 2015), cost and funding constraint (Awosan, 2014; Sepasgozar & Davis, 2018;

Shaikh & Karjaluoto, 2015; Usman & Said, 2014), security concerns (Amusan et al., 2018; Ikediashi & Ogwueleka, 2016; Waziri et al., 2017), absence of enabling government policies and functioning regulatory agencies (Abubakar, Ibrahim, Kado, & Bala, 2014; Ogunde, Olaolu, Afolabi, Owolabi, & Ojelabi, 2017) to ethical concerns (Oladinrin & Ho, 2016; Ogunyemi & Laguda, 2016).

Infrastructural deficiency is real in Nigeria and is a vital technology adoption issue among Nigerian construction firms (Egoeze, Misra, Akman, & Colomo-Palacios, 2014; Mudi, Bioku, & Kolawole, 2015). Most construction firms in Nigeria lack adequate infrastructure to effectively tap into the opportunities provided by the cyberspace due to low access speed from internet providers and poor and erratic power supply from the national grid (Onyeji-Nwogu, Bazilian, & Moss, 2017; Vincent & Yusuf, 2014). The logistic performance index (LPI) is a function of the infrastructural performance of countries around the world. A review of LPI global ranking showed that Nigeria that ranked 100th position among 160 countries in 2010 with LPI score of 2.59 now ranked 110th position with an LPI score of 2.53 (The World Bank, 2018).

Lack of qualified and globally recognized IT personnel in Nigeria is an issue that is affecting IT adoption and development in Nigerian construction firms (Ejiaku, 2014; Faloye, 2014). In a period of constantly changing business environment, Nigerian construction firms are still faced with lack of adequate human resources that possess the skill to design, program, install, configure, and maintain information technology and infrastructure (Ejiaku, 2014; Muhammed, Zaharaddeen, & Turaki, 2015). The training and education necessary to support skill transfer and acquisition are not encouraging,

neither is the industry taking advantage of importation of technical equipment and technical skill from industrialized nations into Nigeria as a way of achieving acquisition of technological skill domestically (Ebong, Udoh, & Obafemi, 2014; Faloye, 2014).

Though cost is often said as not being the most important factor influencing the technology adoption decision (Sepasgozar & Davis, 2018), the cost of funding IT adoption seems to be an important issue in Nigeria and among Nigerian constructions firms (Awosan, 2014; Shaikh & Karjaluoto, 2015; Usman & Said, 2014). The lending rate from banking institutions in Nigeria has never been static and generally high, ranging from 16% to 26% and varies from banks to banks. Apart from the high lending rate, there is a consensus that construction firms face delays from their clients to make payments as and when due for certified work done (Anny, Anthony, & Kehinde, 2015). The fluctuating high lending rate, when combined with delay payments, creates cash flow forecast constraints thereby affecting true knowledge of the economic cost of IT adoption (Usman & Said, 2014).

The adoption of technology with respect to security concerns involves hackers, cyber fraud, virus attacks, and spyware infections (Waziri et al., 2017). A recent study concluded that the fear of insecurity is the main reason some users of IT in Nigeria declined the use of online facilities (Tarhini, Mgbemena, Trab, & Masa'Deh, 2015). The fear of hackers limits the interest of foreign service providers to invest in internet technology in Nigeria (Muhammed, Zaharaddeen, & Turaki, 2015). Consequently, security issues limit the confidence that construction firms have on IT adoption and usage.

The absence of enabling government policies and functioning regulatory agencies remains one of the major issues affecting IT adoption among construction firms in Nigeria (Abubakar, Ibrahim, Kado, & Bala, 2014; Ogunde, Olaolu, Afolabi, Owolabi, & Ojelabi, 2017). There is inconsistency in the area of policy formulation and implementation which affects construction entrepreneurs working hard to survive in the difficult business terrain (Ogunde, Olaolu, Afolabi, Owolabi, & Ojelabi, 2017). The existing government policies lack attractions for IT adoption among construction firms to take full advantage of cutting edge and disruptive technology (Abubakar, Ibrahim, Kado, & Bala, 2014). As of today, there are many regulatory agencies such as National Office for Technological Acquisition (NOTA), National Information Technology Development (NITD), and Nigerian Computer Society (NCS) and most often there are controversies as to which regulatory agency has the purview to register IT contractors (Agbata, 2018). The unique nature of construction industry with respect to IT adoption requires industry-specific policy and regulation.

The ethics of technology adoption are the moral and professional principles guiding the adoption, implementation, distribution, and use of technological products and outputs. The existence of codes of ethical conduct in most organizations does not seem to impact positively ethical behaviors in construction organizations (Oladinrin & Ho, 2016). There appeared to be a high incidence of unethical behavior in the industry, the most common being dishonesty of employees (Ogunyemi & Laguda, 2016). Loyalty, trust, and confidentiality of information are ethical factors that users of technology need to comply with. Generally, the big issue of IT adoption with respect to

ethics is that technology advances exponentially compared to the rate at which ethical codes are updated in organizations, resulting in a wide regulatory gap between technology and ethics (Wadhwa, 2014).

Project Failures and Abandonment in Nigerian Construction Industry

Project failure is the inability to complete a project in line with cost, time, and quality specification or the inability of a project to satisfy the expectations of its sponsor (Nweze, 2016). Many authors have contributed to the scholarly literature on project failure and abandonment in the Nigerian construction industry. A synthesis of the literature showed that most of the writers agreed on the four elements of cost, time, quality, and satisfaction as essential in the definition of project failure (Nweze, 2016; Ogunmola, 2015); however, only few of the writers distinguished project failure from project abandonment (Amade et al., 2015). A project is considered a failure when the criteria for assessing the success of cost, time, quality, and stakeholder satisfaction are not met at the time of project delivery. Project abandonment occurs when the sponsors decide to temporarily or permanently discontinue a project under development (Amade et al., 2015; Doraisamy, Akasah, & Yunus, 2014; Ezenekwe & Uzonwanne, 2017).

Many factors have been attributed by scholars for the failure of projects in Nigeria such as economic recession (Olanrewaju, Idiake, & Oyewobi, 2018), non-minimization of completion time originally scheduled for a project (Adamu, Aromolaran, & Aitsebaomo, 2018), poor knowledge of lesson learned and its application to construction project delivery in Nigeria (Ononuju, Amade, Amaeshi, Adu, & Iringe-koko, 2019), lack of sufficient attention to risk management (Akinbile, Ofuyatano, & Agboola, 2018), poor

attention to integration of sustainability into projects (Aghimien, Adegbembo, Aghimien, & Awodele, 2018), and institutional errors and corruption (Nweze, 2016; Ogunmola, 2015), however factors related to project management practices ranked first (Amade et al., 2015).

The overall failure of construction project management in Nigeria in 2014 of 32% indicates problems in appropriate project management practices for successful project delivery (Akande et al., 2018). Project management is the systematic application of knowledge, skills, tools, and techniques to project activities to meet the project requirements (Project Management Institute, 2017). An appropriate project management practice involves a total application of the nine knowledge areas (scope, schedule, cost, quality, resource, communication, risk, procurement, and stakeholder management) to projects and their integration using an appropriate project management plan (Abdul Rasid, Wan Ismail, Mohammad, & Long, 2014; Kerzner, 2018b).

Though a recent study established significant relationship between application of project management technique and project successful delivery (Onifade, Oluwaseyi, & Ibrahim, 2017), scholars were at congruence in their key findings about project management practices in the Nigerian construction industry such as limited knowledge and utilization of modern project planning tools and techniques (Akande et al., 2018), lack of sound project management practice (Fagbenle et al., 2018), non-institutionalization of project management practice (Ogunde et al., 2017), and lack of project management knowledge (Ugwu & Attah, 2016) as significant predictors of project failure.

Though it has been established that project success is contingent upon appropriate project management practices, research also established that the application of project management best practices in the Nigerian construction industry is hindered by poor leadership (Fagbenle et al., 2018), low level of client involvement in the decision making (Ugwu & Attah, 2016), non-involvement of stakeholders especially the end users (Ekung, Okonkwo, & Odesola, 2014; Nnadi, Enebe, & Ugwu, 2018; Ochieng, Ugonna, Matipa, & Shah, 2018), and low level of project management software adoption (Akande et al., 2018; Ibem, Aduwo, Ayo-Vaughan, & Tunji-Olayeni, 2018; Michael, Austine, & Abdulahi, 2018).

The abandonment of failed construction projects on a mass scale constitutes one of the impediments to growth within Nigeria's economy (Adebisi, Ojo, & Alao, 2018). A recent study estimated that it would take the nation about ₦300 billion and 30 years to resuscitate 4000 failed and abandoned projects (Amade, Ubani, Amaeshi, & Okorocha, 2015). Abandoned projects result in costly, risky, and undesirable consequences on the project's overall success, thereby impacting on the economic projections of the nation's states and the nation at large (Ezenekwe & Uzonwanne, 2017). Scholars in this field revealed that abandoned projects have a wide range of social, economic, and environmental implications to growth and development such as poor state of living standard, wastage of valuable resources, loss of promising job opportunities, decrease in economic activities, loss of potential revenue to government, while domestic and foreign loans become more difficult to obtain to finance other future projects (Doraisamy,

Akasah, & Yunus, 2014; Mac-Baranga, 2017; Obunwo, Chinyio, Suresh, & Adjei, 2017; Ojo & Aroge, 2016).

Poor coordination of complex tasks by Nigerian project managers leads to inefficient appropriate project management practices resulting in a low rate of project completion within the nation's construction sector (Amusan et al., 2018; Oke & Aghimien, 2018). The unique characteristics of project activities in the construction industry, the large amount of diverse data, and the complex communication structure require the adoption of technology to manage and integrate the construction process efficiently across the planning, procurement, construction, controlling, and commissioning phases of projects (Adwan & Al-Soufi, 2018; Holt, 2015; Mikalef, Pappas, Krogstie, & Giannakos, 2018). However, professionals in the Nigerian construction industry poorly coordinate these complex tasks resulting in delays due to rework and low rate of project completion (Eze & Idiake, 2018).

Although new technologies are available to improve project performance, scholars have identified that project managers in the Nigerian construction sector avoid their adoption (Akande et al., 2018; Ozumba & Shakantu, 2018). Whereas the adoption and utilization of cutting-edge technology have advanced among project managers in developed countries, project managers in the Nigerian construction industry are still generally about five years behind in the adoption spectrum of new technology (Adebisi, Ojo, & Alao, 2018; Hamma-Adama et al., 2018). Project management practices deal with the use of proven traditional practices that are widely applied as well as innovative practices that are emerging in the project management profession (Kerzner & Kerzner,

2017; Project Management Institute, 2017); project managers in the Nigerian construction industry are yet to fully adopt and embrace innovative technology such as BIM (Ahmed, 2018; Hamma-Adama et al., 2018), virtual team (Odubiyi & Oke, 2016; Zuofa & Ochieng, 2017), project management platform (Afolabi, Fagbenle, & Mosaku, 2017; Michael, Austine, & Abdulahi, 2018).

This technology adoption avoidance in the Nigerian construction industry has resulted in continued inadequate automated evaluation and monitoring of construction project performance (Afolabi, Amusan, et al., 2018; Amusan et al., 2018). As technology is changing rapidly from mechanization to automation and robotics in industrialized countries (Kamaruddin, Mohammad, & Mahbub, 2016), so must project managers in the Nigerian construction industry become aggressive in embracing new technology for monitoring and evaluation of project performance in order to remain competitive and dominant in the current business terrain (Ikediashi & Ogwueleka, 2016). Project performance is measured and evaluated relative to the set success criterion for cost, time, and quality (Amandin & Kule, 2016). However, the task of monitoring and evaluating project performance using an automated approach has not been given serious attention and appears to be sidelined among project managers in the Nigerian construction industry (Ogunde, Joshua, Amusan, & Akuete, 2017) leading to delay in the issuance of project reports and ineffective reporting (Ejohwomu, Oshodi, & Lam, 2017). Project management related factors significantly affect the level of a contractor's project performance (Mir & Pinnington, 2014; Olanipekun, Nunayon, & Olugboyega, 2017).

Project Management Practices in Nigerian Construction Industry

Project management is the systematic application of knowledge, skills, tools, and techniques to project activities to achieve project objectives (Nweze, 2016; PMI, 2017). Project objectives involve delivering the project on time, within cost and quality standard while addressing the interests of stakeholders (Ogunmola, 2015; PMI, 2017). Project management practice covers the integration of nine project areas of scope, schedule, cost, quality, resource, communication, risk, procurement, and stakeholder interest (PMI, 2017) and starts with the development of the project charter and project management plan. The project charter is a statement that describes the scope and objectives of the project and identifies the main stakeholders and the people participating in the project and states the authority of the project manager. The project management plan is an approved working document that contains summary plans for the nine project areas and details out the methodology and action steps the project will take to plan, execute, coordinate, monitor, control, and close the project (Abdul Rasid, Wan Ismail, Mohammad, & Long, 2014; Kerzner, 2018b).

Best practice is an industry's acceptable way proven to effectively accomplish a desired result and since the project management plan dictates the direction a project will take, hence, having a project management plan in place constitutes a best practice for successful project delivery (Kerzner, 2018b). The application of project management best practices leads to project performance (Ogunde, Joshua, Amusan, & Akuete, 2017). Scholars have assessed project management practices in Nigeria and found that project management practice in Nigeria does not conform to international best practices

(Ekundayo, Jewell, & Awodele, 2013; Igwe & Ude, 2018). They identified risk assessment, monitoring and evaluation, institutional frameworks, public procurement strategy, infrastructure for public project management, and stakeholder engagement, and executive project management philosophy as areas where project management practices in Nigeria are lagging. For example, a recent study assessed the risk management maturity level of construction organizations in Nigeria as novice (Salawu & Abdullah, 2015).

Project management maturity is the position in which the company finds itself regarding the project management processes, and which helps explain the processes that the organization will need to develop to reach a desired future (Souza & Gomes, 2015). There is a dearth of research that specifically assessed the overall project management maturity level of construction industry, however a similar and related study indicated that the project management maturity level in the construction industry of developing nations is still at the low level, an informal practice of project management processes (Pawar, Deshmukh, & Chavan, 2016) or a basic project management practice (Kerzner, 2018a) as shown in Figure 3. This current state of the Nigerian construction industry's project management maturity is incapable of addressing all the essential knowledge areas in project management and as such, weak procurement strategy, weak stakeholders' relationship, and poor leadership potential have been identified as the major factors for the unsound project management practice in Nigeria (Shuaib & Davison, 2018).

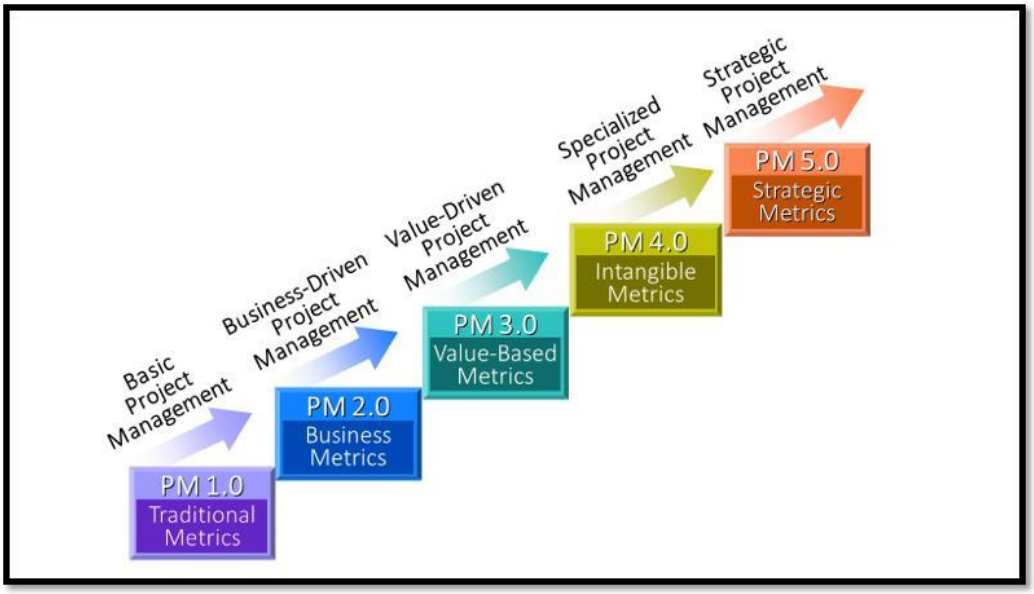

Figure 3. Levels of project management maturity. From *The Future of Project Management: A White Paper* (p. 10), by H. Kerzner, 2018 (https://www.iil.com). Reprinted with permission.

Also, in contrast with widely accepted executive project management practice in developed countries, the stakeholders' traditional approach to the project management procurement is still widely used in the Nigerian construction industry and this hinders the maturation of project management skills and practice (Ekundayo, Jewell, & Awodele, 2013; Igwe & Ude, 2018). Hence, the adoption of project management practice in Nigeria does not totally guarantee project success (Mafimisebi, 2016). Factors militating against the adoption of executive project management structure include the traditional culture of stakeholders, skill shortages, unfavorable policies, and absence of regulatory body (Akande et al., 2018; Ekundayo, Jewell, & Awodele, 2013). Technology adoption leads to improved project performance (Aigbavboa, Oke, & Mojele, 2016; Sabiu & Agarwal,

2016). As technology adoption advances so does project management maturity level, which in turn leads to improvement in project performance (Katane & Dube, 2017).

Sustainable Construction Practices in Nigeria

Sustainability is defined as the developments that meet the needs of the present generation without compromising the ability of future generations to meet their own needs (Brundtland, 1987). The concept of sustainable construction, also known as green buildings, deals with the design and construction of resource-efficient buildings in accordance with environmentally friendly principles (Ragheb, El-Shimy, & Ragheb, 2016). Sustainable construction practice aims at achieving improved well-being as it is done with the mind of achieving harmony with humanity and the environment. Though sustainability has social, economic, and environmental dimensions, the environmental aspects of sustainability are more generally pronounced in construction projects (Marcelino-Sadaba, Gonzalez-Jaen, & Perez-Ezcurdia, 2015).

Scholars have documented varying reports about the state of sustainable construction practice in Nigeria. Findings reveal that most construction organizations do not have any sustainability strategies in place due to their low level of awareness (Tunji-Olayeni et al., 2018). Owners of construction organizations are aware of sustainability but are yet to fully embrace a holistic sustainable construction practice (Zuofa & Ochieng, 2016); construction organizations and professionals in Nigeria and other West African countries still follow the conventional methods of construction (Ogungbile & Oke, 2019).

Sustainable construction practices in the Nigerian construction industry lack advocacy for public awareness as many stakeholders are yet to be aware of the benefits such as savings in utility cost, savings in maintenance cost, and high value ratings that sustainable construction offers (Ogungbile & Oke, 2019). The implementation of sustainable construction practice in Nigeria faces some barriers: lack of expert knowledge in sustainable construction (Akadiri, 2015; Zuofa & Ochieng, 2016), finance and lack of institutions of higher learning offering sustainability courses (Olanipekun, 2015), lack of the procurement strategy (Ogungbile & Oke, 2019; Zuofa & Ochieng, 2016), lack of demand and affordability (Davies & Davies, 2017), culture and insecurity of lives (Ogungbile & Oke, 2019), technology (Isa, Dodo, Ojobo, & Alkali, 2016; Ogungbile & Oke, 2019). Whereas the project management maturity level in Nigeria's construction industry is at *Level 1-Basic Project Management* (see Fig. 3), this level is two steps below *Level 3-Value Driven Project Management* at which sustainable practice is supported (Kerzner, 2018a).

The Project Manager and Technology Adoption in Nigeria's Construction Sector

Scholars have offered several definitions of project managers; the head of project governance (Muller, 2017), the leader of a project team (Harrison & Lock, 2017), as agents of change management (Bourne, 2015; Balogun, Bartunek, & Do, 2015; Lines, Sullivan, Smithwick, & Mischung, 2015; Carnall, 2018) and a person responsible for the success of projects in terms of cost and technical performance (Igwe & Ude, 2018). According to Project Management Institute's definition, and as adopted for this study, a project manager is a person assigned by the performing organization to lead the team that

is responsible for achieving the project objectives (Project Management Institute, 2017). There are two things that come out of all the definitions of project managers offered by scholars. First, a project manager is appointed and assigned by the project owners or sponsors. Second, a project manager is the leader of the project team. Research has also shown that it is difficult to separate the purpose of project management from the principal role of project manager (Harrison & Lock, 2017).

A project manager dictates the direction for the project and stays informed about the current industry trends such as product and technology, process improvement, and sustainability strategies (PMI, 2017). Project managers basically have a role that covers technical dimensions such as scope, schedules, resource allocation, baseline budget, and status report as well as social–cultural dimensions such as leadership, problem solving, teamwork, negotiation, politics, and stakeholders' interest (Larson, Gray, Danlin, Honig, & Bacarini, 2014). The project manager's approach to the social cultural dimension of project management is contingent upon the location of the project (Igwe & Ude, 2018; Larson, Gray, Danlin, Honig, & Bacarini, 2014). Project managers, as drivers of project performance, need to be good in three areas of competencies to be able to successfully play their role. These are technical project management skills, strategic business management skills, and leadership skills (PMI, 2017). People skills are crucial for project managers as they need these to develop and manage teams (Ramazani & Jergeas, 2015). Project managers live a life of change, from project to project, from stakeholder to stakeholder, from team to team, and from technology to technology (Davison, 2017). A recent study recommended that project managers in the Nigerian construction industry

need to engage in continuous professional development to stay abreast with latest project management strategies (Ogunde, Joshua, Amusan, & Akuete, 2017).

The literature on project managers' leadership profile revealed no significant relationship exists between the project leaders' professional background and their leadership effectiveness and concluded that any of the built environment professionals can be appointed as project team leader (Ameh & Odusami, 2014). With this finding, the leadership status of project managers in the Nigerian construction industry is being questioned, unlike in developed countries, where the executive project management practice gives credence and empowers the project manager as the overall project leader (Inuwa & Kunya, 2015; Shuaib & Davison, 2018).

In a study of projects' failure curtailing factors, project management and project manager's related factors scored highest in relative importance index over contractor, client, environment, procurement, and design team related factors (Amade et al., 2015). Despite a clear understanding of the importance of project management practices and effective project managers to project performance in the Nigerian construction industry, the rate of project failure and abandonment is worrisome and of great concern (Adebisi, Ojo, & Alao, 2018). However, research has shown paucity in the application of project planning tools and techniques in the Nigerian construction industry (Ahmad & Namala, 2015). Technology leads to automation and improved business decision (Kamaruddin, Mohammad, & Mahbub, 2016), the lack of technology and the use of obsolete and inappropriate technology for the execution of construction projects in Nigeria hindered

project managers' effectiveness towards successful project delivery (Fadun & Saka, 2018; Hamma-Adama et al., 2018).

Many factors have been offered in the literature as influencing technology adoption, which are categorized into technology, organizational, environmental related factors (Waziri et al., 2017), and sociocultural related factors (Ojoko, Osman, Rahman, & Bakhary, 2018). Technology related factors include feature of the new technology to be adopted with regard to its ability to meet the needs of the project and the organizational objective (Sepasgozar & Davis, 2018), difficulty in demonstrating the evidence of benefits an organization will derive from adopting technology (Aduwo, Ibem, Uwakonye, Tunji-Olayeni, & Ayo-Vaughan, 2016), and deficiency in the technical skill required to support the use of the technology (Ejiaku, 2014; Faloye, 2014; Muhammed, Zaharaddeen, & Turaki, 2015).

Organizational related factors include internal policy and bureaucratic procedure inherent in the decision-making process towards technology adoption (Usman & Said, 2014), criteria for evaluating the technology with respect to project objectives and needs (Oviedo, Martelo, & Romero, 2018; Sepasgozar & Davis, 2018), the readiness of the members of the adopting organization to accept and embrace a change from the old ways of doing things (Waziri et al., 2017), and high investment cost associated with adoption of new technology (Aduwo, Ibem, Uwakonye, Tunji-Olayeni, & Ayo-Vaughan, 2016).

Environmental factors are factors external to the adopting organization and of which the adopting organization has little or no control. These include lack of effective government policies and dysfunctional regulatory environment (Waziri et al., 2017;

Abubakar, Ibrahim, Kado, & Bala, 2014; Ogunde, Olaolu, Afolabi, Owolabi, & Ojelabi, 2017), a general state of infrastructural deficiency (Agwu & Murray, 2014, 2018; Chete, Adeoti, Adeyinka, & Ogundele, 2014), and constraints of sourcing fund for technology investment within the domestic banking environment (Awosan, 2014; Sepasgozar & Davis, 2018; Shaikh & Karjaluoto, 2015; Usman & Said, 2014). Sociocultural factors include the general state of cyber insecurities in developing countries (Amusan et al., 2018; Ikediashi & Ogwueleka, 2016; Waziri et al., 2017) combined with tendencies of people in the workplace to conform to unethical practices during technology utilization (Oladinrin & Ho, 2016; Ogunyemi & Laguda, 2016)

Although scholars have repeatedly documented the high rate of failed projects within the Nigerian construction sector due to poor coordination of complex tasks (Afolabi, Ojelabi, et al., 2018; Hamma-Adama et al., 2018), a deeper understanding of the barriers confronting construction project managers in Nigeria to adopt new technologies for improving decision-making processes to lower the rate of failed and abandoned construction projects remains poorly understood (Muhammad et al., 2018; Onungwa & Uduma-Olugu, 2017). Project management is a discipline that is widely recognized and globally adopted within the construction industry, and despite the advancements in project management discipline globally the traditional project management structure, typical of the nonexecutive project management structure that has been proved ineffective, is still widely in use in the Nigerian construction industry (Ekundayo, Jewell, & Awodele, 2013; Tunji-Olayeni, Mosaku, Fagbenle, & Amusan, 2016). The traditional project management structure makes a project manager a project

coordinator rather than a project leader to pursue new technology adoption, a task that cannot be accomplished without full corresponding executive power and authority (Ekundayo, Jewell, & Awodele, 2013; Igwe & Ude, 2018).

Summary and Conclusions

The literature review entailed a synthesis of knowledge and critical analysis on technology adoption in the construction industry, the role of project managers in the technology adoption process, and the causes and consequences of failure to adopt technology in the construction industry in Nigeria. Abandonment of failed construction projects on a mass scale has become a barrier to economic growth for Nigeria. Poor coordination of complex tasks by Nigerian project managers has led to inefficient project management practices resulting in a low rate of project completion. Although new technologies are available to improve project performance, scholars have identified that project managers in the Nigerian construction sector avoid their adoption, an action resulting in continued inadequate construction project performance in the Nigerian construction industry. Scholars have repeatedly recommended further empirical research to better understand barriers to technology adoption by construction project managers in Nigeria with the goal of lowering the rate of failed and abandoned construction projects.

In Chapter 3, I present the methodology for the qualitative case study designed to achieve the purpose of the study and offer data to answer the central research question. I also present the sampling rationale and approach and the data collection approach. Lastly, the logic for the study and primacy for the data collection and analysis are also discussed.

Chapter 3: Research Method

The purpose of this qualitative single case study was to understand the perceptions of construction project managers in Nigeria regarding their barriers to technology adoption. To address this purpose, and aligning with the qualitative paradigm, this study utilized a single case study with embedded units design (Yin, 2017). Scholars have repeatedly documented the need for empirical research to gain a deeper understanding on why construction project managers in Nigeria remain slow to adopt new technologies for improving decision-making processes and project success rates (Afolabi, Ojelabi, et al., 2018; Hamma-Adama et al., 2018). This study is important, as it investigated the underresearched area of barriers to technology adoption and use of project management technology in the Nigerian public sector. When barriers to technology adoption are better understood, the rate of public-project failure may be lowered, resulting in possible positive social change for the communities served by the Nigerian public infrastructural sector (Afolabi, Ojelabi, et al., 2018).

This chapter provides detailed information on the research method and rationale for conducting a qualitative case study. The central research question (CRQ) guiding this empirical investigation is presented with the participant selection strategy, data collection strategies and data analysis, the role of the researcher, ethical considerations, and a summary of the main points of Chapter 3.

Research Design and Rationale

The research question drives the research strategy (Browne & Keeley, 2014; Onwuegbuzie & Leech, 2004) and is crucial to understanding the problem to be studied

(Morgan, Pullon, Macdonald, McKinlay, & Gray, 2017). Hence, it is important that a researcher identify the right question for a study. Consistent with the purpose of this study, the CRQ was as follows: How do construction project managers in Nigeria describe their barriers to technology adoption?

The failure and abandonment of construction projects on a mass scale in the Nigerian construction industry constitute an impediment to economic growth (Adebisi, Ojo, & Alao, 2018). The overall project failure of 32% as of 2014 in the Nigerian construction industry suggests problems in project management practices for successful project delivery (Akande et al., 2018). The application of project management practices leads to improved project performance (Ogunde, Joshua, Amusan, & Akuete, 2017), and despite a clear understanding of the relevance of improved project management practices to achieve project performance in the Nigerian construction industry, the rate of project failure and abandonment seems unabated (Adebisi, Ojo, & Alao, 2018).

Technology brings automation in business decision making (Kamaruddin, Mohammad, & Mahbub, 2016), drives improved project performance (Aigbavboa, Oke, & Mojele, 2016; Sabiu & Agarwal, 2016), and leads to efficiency of construction professionals and improvement in the quality of work (Ozumba & Shakantu, 2018; Waziri et al., 2017). A project manager is the leader of the project team and is responsible for dictating the direction for the success of the project (PMI, 2017). However, lack of technology or the application of inappropriate technology limits a project manager's effectiveness for successful project delivery (Fadun & Saka, 2018; Hamma-Adama et al., 2018).

Findings from the literature indicated paucity in technology adoption among project managers in the Nigerian construction industry, with about 5 years' lag in their adoption spectrum on new technology when compared to project managers in developed countries (Adebisi, Ojo, & Alao, 2018; Ahmad & Namala, 2015; Hamma-Adama et al., 2018). Although new technology is available to improve project performance, project managers in the Nigerian construction sector avoid its adoption (Akande et al., 2018; Ozumba & Shakantu, 2018). Barriers can deter or slow technology adoption in the construction industry (Fang, 2016; Olawumi, Chan, Wong, & Chan, 2018). Sepasgozar & Davis, 2018). The specific barriers that make construction project managers in Nigeria remain slow to adopt technology to lower the rate of project failure and abandonment are yet to be properly understood (Muhammad et al., 2018; Onungwa & Uduma-Olugu, 2017). Technology adoption induces social change (Andrés et al., 2016; Lakshmanan, 2018). A deep understanding of the perception of construction project managers in Nigeria regarding their barriers to technology adoption may help to improve the project success rate and may support the advancement of positive social change (Xiahou, Tang, Yuan, Chang, Liu, & Li, 2018).

I found the qualitative method appropriate for this study because of its alignment with the purpose of the study, which was to understand the perceptions of construction project managers in Nigeria regarding their barriers to technology adoption. The quantitative method was not appropriate for this study, as it deals with testing theories and correlating relationships using quantifiable data (Harkiolakis, 2017; Kumar, 2019) and does not allow for the development of an in-depth understanding of participants'

perspectives, experiences, and knowledge about the research question (Merriam & Tisdell, 2016). A mixed method combining both qualitative and quantifiable data was inappropriate because quantitative data were not required to answer my research question (Brannen, 2017; Bryman, 2017). The qualitative method is descriptive (Bryman, 2014) and helps a researcher to seek an understanding of how a problem under study works in the real world (Burkholder, Gary, Cox, & Crawford, 2016; Robson & McCartan, 2016). With the qualitative method, a researcher can generate data about a human group in a natural setting, analyze data inductively, extract meaning from participants, and interpret the meaning of findings (Stake, 2010).

The research design for this study was qualitative single case study. I chose case study over other qualitative designs such as ethnography, grounded theory, phenomenology, and narrative because a case study design helps a researcher understand the case, what it is, how it works, and how it interacts with its real-world contextual environment (Yin, 2017). A case study focuses on why and how questions about a contemporary set of events in their natural setting over which the researcher has little or no control (Baran & Jones, 2016; Yin, 2017). With an explorative single case study, I was able to explore in depth the decision-making process and the barriers leading to technology avoidance behavior of project managers in a single public project organization in Nigeria (Easterby-Smith, Thorpe, & Jackson, 2012).

Role of the Researcher

In this research, my role was to interview construction project managers in the Nigerian construction industry about their experience of the barriers confronting them in

relation to technology adoption. In this research, I was not a participant but rather a researcher who investigated the question related to my study, and as such, I had no personal relationship with any of the participants and did not have any power or control over them as they each shared their personal and professional experience to achieve the purpose of the study. As a qualitative researcher, my positionality in this study was not of a participant but rather an observer, a recorder, and an analyst of the qualitative data (Chesebro & Borisoff, 2007).

Though I was not a participant in the study, as a qualitative researcher, I represented the primary instrument through which the data were collected and mediated in the conduct of the research (Denzin & Lincoln, 2003; Lofland, Snow, Anderson, & Lofland, 2006; Mills, Durepos, & Wiebe, 2010; Sutton & Austin, 2015) and considered myself as a vital part of the research process and inquiry (Ravitch & Carl, 2015) in every stage of the study from planning, collection of data, analysis of data, and reporting of findings (Sanjari, Bahramnezhad, Fomani, Shoghi, & Cheraghi, 2014). I ensured that the method of data collection was not just reliable, but also verifiable, and that the data-gathering instrument yielded accurate results. I created field notes and kept a log of data collection activities in the course of the study that helped me achieve validity (Kumar, 2019; Ledford & Gast, 2018).

Researchers generally have the responsibility of protecting all participants in a study from potentially harmful consequences because of their participation in the exercise (Sanjari, Bahramnezhad, Fomani, Shoghi, & Cheraghi, 2014). I communicated the protection of privacy to the participants in writing after they had shown interest to

participate in the study. The use of pseudonyms in referencing the participants in this study has helped me maintain anonymity for participants and keep their information confidential throughout the course of the study and after the study (Petrova, Dewing, & Camilleri, 2016; Orcher, 2016).

The positionality of a researcher as the instrument of research may introduce subtle research bias (Jafar, 2018). A qualitative researcher is expected to get immersed in his or her study, suggesting that the "positionality of the researcher is located … always 'inside' the research study" (Cuthill, 2015, p. 63); hence, researchers must be reflexive of their positionality and come up with an active approach to identify and tackle likely bias (Liong, 2015). The potential research bias in this study was mitigated through faithful attention to methodological rigor (Ravitch & Carl, 2015) and participants' validation method (Rubin & Rubin, 2012). Additionally, the potential for sample selection bias was mitigated through faithful attention to the implementation of the sample selection criteria set up for the study (Certo, Busenbark, Woo, & Semadeni, 2016; Sarstedt, Bengart, Shaltoni, & Lehmann, 2018). In this study, there were no potentials for conflict of interest due to insider bias, as I had no affiliation or relationship with the project managers that were interviewed, nor the organizations to which they belonged (McCoy & Emanuel, 2017).

By keeping a log of all research activities and conducting reflexivity using Berger's (2015) approach, I tracked and controlled the potentials for research and personal bias to enhance the accuracy of the research process and findings. Berger's approach to reflexivity involves prolonged engagement of participants and repeated

review of interview responses. The use of a semistructured interview approach helped eliminate personal positioning, as the participants were able to add insights that I might not have thought about previously (Drew, 2014). There were no incentives for the participants, as participation in the study was voluntary, and the participants were told that they had the liberty to withdraw from the study at any time. However, when participants agreed to voluntarily participate in research that had high potential to proffer solutions to mass-scale project failures and abandonment in the Nigerian construction industry, they were more likely to have a feeling of intrinsic satisfaction and a sense of pride that came with their participation in such research (Stunkel & Grady, 2011).

Methodology

An exploratory qualitative single case study with embedded units (Yin, 2017) was adopted to gain a deeper understanding of the perception of construction project managers in the Nigerian construction industry regarding their barriers to technology adoption, which helped to address the gap concerning why construction project managers are slow to adopt new technologies for improving decision-making processes and project success rates (Afolabi, et al., 2018; Hamma-Adama et al., 2018). An exploratory case study investigates a problem that has not been studied more clearly and in which a detailed preliminary investigation is lacking (Maslach, 2017). Yin (2017) suggested that case study research should have propositions to direct attention to the core thing to be examined within the scope of the study, though such propositions may not be necessary when dealing with exploratory design, provided that the purpose of the study is clearly articulated and stated.

A core value of using a qualitative research method is the ability of a researcher to explore in depth a subject grounded in a conceptual framework (Collins & Cooper, 2014). A single case study allowed me to focus on a case and explore it in depth, rather than on multiple cases, to achieve a holistic real-world perspective (Yin, 2017). A single case study places emphasis on an intensive investigation and analysis of a unit embedded in a case (Hancock & Algozzine, 2016; Yazan, 2015, Yin, 2017), which will lead a researcher to achieve a significant contribution to knowledge by confirming, challenging, or extending a theory (Yin, 2017).

Mills (2014) observed that across the literature, researchers have described case study as both a method and a methodology. A method is a set of procedures and techniques employed in a study, whereas a methodology is the lens through which a researcher views and makes decisions about a study (Harrison, Birks, Franklin & Mills, 2017; Mills, 2014). As noted by Harrison et al. (2017), case study researchers emphasized that an overarching methodology will help shape a case study design and that multiple sources of data and methods can be used (Merriam & Grenier; 2019; Yin, 2017). Reviewing different types of evidence and outlining the research findings while using a qualitative approach enable researchers to assess a particular case from various perspectives, relying on the data available (Stake, 1995). A single case study investigating a social phenomenon can involve individuals living within a particular social context as embedded units of study (Yin, 2017). The unit of analysis, which in a case study may be a person, event, entity, or other unit of analysis (Noor, 2008), was the construction project manager in Nigeria.

Purposeful sampling is widely used in qualitative research for the identification as well as the selection of information-rich cases that are related to the phenomenon of interest, and there are various purposeful sampling strategies (Palinkas et al., 2015). Participants for this case study were recruited using a purposeful and snowball sampling strategy and screened with the following inclusion criteria: adults over the age of 18 years; 3 years' minimum experience in the construction project management field in Nigeria; and possession of knowledge regarding construction technology (Robinson, 2014). The exclusion criteria for the sample applied to individuals who did not meet all of the above inclusion criteria. Snowball sampling is the most common form of purposeful sampling and works by asking a few key participants who already meet the criteria for a study to refer others who may also meet the criteria but may be hard to find within the sample population (Merriam & Tisdell, 2015). I conducted 10 in-depth face-to-face individual interviews with construction industry managers. Schram (2006) recommended a range of five to 10 participants for a qualitative study, stating that a larger sample size may weaken a deep investigation of the phenomena under study.

Because case studies do not involve experimental controls or manipulation, the research design was suitable for this study in order to gain a deeper understanding of the perceptions of construction project managers in Nigeria regarding their barriers to technology adoption. To address this gap in the literature and the research problem, qualitative data were collected from multiple sources, including interviews, reflective journaling notes, and archival data, to support the trustworthiness of findings and make suggestions for further research (Guion et al., 2011). The data-collection process met the

case study criteria by developing an appropriate participant selection logic (Yin, 2017).

Participant Selection Logic

The target population of this case study consisted of construction project managers in Nigeria. I sent my email address and a recruitment letter on LinkedIn to my professional network to solicited potential participants who met the study's inclusion criteria. The sampling strategy for this study included purposeful criterion and snowball techniques. The sampling strategy was purposeful because it helped me select participants who would provide rich information relevant to the research questions (Maxwell, 2013; Palinkas et al., 2015). Snowball sampling is the most common form of purposeful sampling and works by asking a few key participants who already meet the criteria for the study to refer others who may also meet the criteria (Merriam & Tisdell, 2015). Snowball sampling helps in creating a chain of participants based on referrals who may be good sources, given the focus of the inquiry (Ravitch & Carl, 2015), thus enabling the researcher to access hidden and quality participants who ordinarily might be difficult to identify using other sampling strategies (Noore, 2008). Though snowball sampling has been questioned because of the tendency of participants to refer others who share similar characteristics or outlooks, varying the initial set of participants within the boundaries of the inclusion criteria led to the generation of samples that were not skewed excessively in one direction (Etikan, Alkassim, & Abubakar, 2016).

Participants for this case study were recruited and screened with the following inclusion criteria: adults over the age of 18 years; 3 years' minimum experience in the construction project management field in Nigeria; and possession of knowledge regarding

construction technology (Robinson, 2014). The exclusion criteria for the sample applied to participants who did not meet all of the above inclusion criteria. I conducted 10 in-depth face-to-face individual interviews with construction project managers in Nigeria. Schram (2006) recommended a range of five to 10 participants for a qualitative study, stating that a larger sample size may weaken a deep investigation of the phenomena under study. The participant selection logic of this study followed that of similar studies in the business and management subject area that were grounded in Yin's (2017) interpretation of participant recruitment for case studies, such as those of Brown (2017) on airport managers, Hamlett (2014) on manufacturing managers, and Neubert (2016) on tech firm owners.

The specific procedures of how to identify, contact, and recruit the participants were accomplished through purposeful selection of the construction project managers. I identified the initial set of participants that referred other participants through a thorough search and review of the profiles of construction project managers pooled from the LinkedIn website (https://www.linkedin.com/). Another recruitment source was through network sampling using direct contact through my professional network. I carried out a review of the professional profiles of the construction project managers that are active on LinkedIn and pre-screened the construction project managers that met the inclusion criteria. I then e-mailed the pre-screened participants and sought their interest to participate in the study. I engaged in a preliminary chat with the participants that favorably responded to further determine their suitability and knowledge of construction technology and adoption in the Nigerian construction industry. A consent form was

delivered electronically to the participants who finally met the inclusion criteria and showed interest to voluntarily participate in the research.

Data saturation occurs when additional data from the participants will no longer yield any new themes (Houghton, Casey, Shaw, & Murphy, 2013). Mason (2010) noted data saturation as a point of diminishing returns for qualitative samples. In this study, though a range of sample size was proposed, the choice of number of actual participants was guided by the achievement of data saturation. The number of participants is flexible as the fieldwork progresses until the full advantage of an in-depth study is reached for the issues being researched (Stake, 2010). A single point sample size is unnecessary in qualitative research because a single point sample size may be either too small or too large to reach theoretical saturation (Sandelowski, 1995). Data saturation relies on the type of data source and integration of the research question (Suri, 2011). Although the proposed sample size was five to 10 participants, data saturation was used in conjunction with the number of participants to determine when to stop the interview process. The emphasis on data saturation was necessary because failure to reach saturation would adversely affect the validity of the research (Fusch & Ness, 2015).

Instrumentation

The goal of utilizing specific instrumentation in a case study is to collect data from multiple sources and provide sufficient data collection instruments to answer the research question (Yin, 2017). In consideration of the various forms of questions developed that related to the research topic, it was important to examine all of the responses along with the characteristics and selection of participants in the data analysis

process. Thus, it was important to gather instrumentation protocols that align with the purpose of the study and contribute original data to the study's conceptual framework. Carefully choosing the appropriate instrumentation produced themes that supported insights that emerged from studying the perceptions of construction project managers in Nigeria regarding their barriers to technology adoption. Three sources of data were utilized throughout this study: (a) a semistructured interview protocol (see Appendix C) whose items have been designed and standardized by previous researchers, (b) archival data in the form of government reports (Yin, 2017), and (c) reflective field notes (Merriam & Tisdell, 2015), which were kept by throughout the entire data collection process.

The interview protocol. This study's interview guide (see Appendix C) involved semistructured questions grounded by the two conceptual models framing this study: Usman and Said's (2014) model of factors contributing to ICT adoption in Nigerian construction firms and Waziri et al.'s (2017) model of factors influencing IT adoption in Nigerian construction organizations. Usman and Said developed a conceptual model that captures those attributes that contribute to slow technology adoption in Nigerian construction firms, grounded in a literature review on their identified causal factors of culture, policy, and cost. Waziri et al. developed the model of factors influencing IT adoption in Nigerian construction organizations by extending Usman and Said's model using the initial assumption that innovative technology has been a driving force behind organizational performance through stimulation of an effective communication system

among the members of organizations as well as interorganizational collaborations (García-Sánchez et al., 2018).

An open-ended interview technique improved and increased my capability to understand a phenomenon or occurrences through the subject's point of view (Kvale, 1995). Hence, in the case of this study, interviews were valuable in gaining an in-depth understanding of the perceptions of construction project managers in Nigeria regarding their barriers to technology adoption. Each section, as well as eliciting facts, used prompts to facilitate conversations around the facts, such as "Can you give me an example of that?" and "Please tell me more about that." While asking probe questions, generic questions encouraged in-depth examples and details of actions from participants. In asking about specific details, probes were customized to the specific dialogue with participants (Merriam & Tisdell, 2015).

I reflected back to my understanding of what participants said to ensure accuracy and clarity. This process minimized potential interviewer-induced bias and provided participants with opportunities to correct any inaccuracies in the transcripts. This interview protocol was successfully field-tested by two subject matter experts (SMEs) for proper alignment with the purpose of the study and found that the interview questions provided answers for the central research question: Prof. Nicholas Harkiolakis, an SME in the fields of technology adoption and project management and currently on the faculty at New England College in Henniker, New Hampshire, USA and at Ecole des Ponts Business School in Paris, France; and Dr. Darren Allen, Senior Project Manager in the

construction industry based in both the United Arab Emirates and the United Kingdom and an SME in construction project management for developing economies.

Archival data. Triangulation is an analytic technique and a central aspect of case-study research design utilized during fieldwork in addition to later data analysis (Yin, 2017). Triangulating plays a vital role during the qualitative research process; it is regarded as a methodological technique for corroborating or conflicting ideas and data (Guion et al., 2011). I triangulated the results of the qualitative interviews with archival documents. The archival documents included government reports from the construction industry in Nigeria, and media reports from the domestic and foreign press documenting issues that were identified in the raw data from the interviews. I also reviewed databases of updated issues pertaining to construction project management in Nigeria. I utilized these three sources of archival data for methodological triangulation to answer the research question and add credibility and trustworthiness to the study results. This method was used in similar studies such as that of Komodromos (2014) and Neubert (2016), in which a multiple case study design used archival data to triangulate interview data in order to answer the study's research questions.

Reflective field notes. How observation is used in research depends on the research question and the paradigm supporting a qualitative investigation. This study was grounded in the interpretivist paradigms and thus used unstructured observation in the form of reflective field notes as a source of data collection (Merriam & Tisdell, 2015). Reflective field notes obtained from online data sources—the semistructured interviews carried out via Skype, in this case—are the third instrument used for data collection from

the participants of this study (Merriam & Tisdell, 2015). Skype was useful in upholding a highly unbiased atmosphere and averting personal reflexivity by depriving the interview interaction of contextual information. By allowing me to reach participants in distant locations, Skype additionally aided the process of replication (Janghorban, Roudsari, & Taghipour, 2014).

Interactions, interviews, and introspection constitute online data collection, which is also referred to as netnography (Kozinets, 2017; Merriam & Tisdell, 2015). Because most, if not all, online data collection interactions are recorded and saved as they occur, reflective field notes were much more important than observational field notes in this case study's design. During my Skype interviews, I recorded participants' observations regarding pretexts, subtexts, personal emotions, and contingencies that took place over the course of time online through these reflective field notes from online data collection (Yin, 2017). Reflective field notes often provide key insights into how online social interactions may detect the reasons behind the cultural values of the participants, rather than offer the more typical recording or description of them (Kozinets, 2017).

I developed netnographic field notes prompts that I utilized as triangulation prompts during the data analysis process, a common practice in a study driven by a qualitative study purpose and research methods (Kozinets, 2017). This method was used in similar studies such as that of Neubert (2016), in which a multiple case study design using case study observational research methods is used to explore the research questions within real-world settings where the reflective field notes launch a sequential order of data collection, data analysis, and synthesis (Yin, 2017).

The strength of this study's instrumentation was dependent on the matter of transferability. Transferability is comparable to external validity, as both concepts refer to which results of one study can be valuable in other settings (Merriam & Tisdell, 2015). Transferability ultimately encourages further future research, and it is conceivable that the conclusions from this research will be appropriate to individuals beyond the participant group (see Klenke, 2016; Shenton, 2004).

Procedures for Recruitment, Participation, and Data Collection

I initiated the recruitment process for the study using an e-mail that I sent to solicit for potential participants through my social network on LinkedIn. The use of social media such as Facebook, LinkedIn, Instagram, and Twitter as a recruitment tool for human research is increasing and is no longer a strange practice in research (Gelinas, Pierce, Winkler, Cohen, Lynch, & Bierer, 2017). Social media is defined as internet-based applications where users can construct a public or semipublic profile and create and maintain a list of other users ('friends') with whom they may share content and participate in social interactions and networking (Boyd & Ellison 2008; Kaplan & Haenlein 2010). When compared with traditional recruitment methods such as flyers, newspaper adverts, letters, e-mails, and word of mouth that are slow and expensive, social media enhances more visibility and are cheaper and faster (Whitaker, Stevelink, & Fear, 2017).

As prospective participants showed interest in the study, as expected, I received emails from them for additional information with respect to the study and the process that will lead to their participation. The participants recruited were project managers who met

the criteria set out in the Participant Selection Logic. Participants were project managers who possessed knowledge of construction technology and had a minimum of 3 years' experience in public project constructions in the Nigerian construction industry. The first set of potential participants was screened in line with the set criteria, and participants that met the criteria were considered as core to initiate the snowball selection process and were asked to refer other potential participants. I informed the participants that the LinkedIn platform was for recruitment purpose only and that after the recruitment process was completed, data and information would no longer be shared through the platform so as not to jeopardize the privacy of the participants.

After the Institutional Review Board (IRB) approved the application for the interview, I requested for the contact information such as phone number, e-mail address, and Skype address, including best time to contact by phone that the participants preferred to be used for the study and sent a recruitment letter to each of the participants through e-mail. I e-mailed the recruitment letters with the informed consent and demographic forms as an attachment to the e-mail. To ensure privacy of the participants' key demographic information, the demographic form was silent on participant's exact age with the participant having the option to state their age within a range. I used the informed consent form to explain in sufficient detail, the nature and purpose of the study, the risk and benefits of being a participant in the study, and the potential positive social change that the study will bring to the society. I used the Informed Consent form to explain to the participants that participation was voluntary and that they could withdraw at will their participation from the study at any time. The participants were also informed in the

consent form about how their privacy will be guaranteed and secured through confidentiality and anonymity processes that integrated into the research process. Having debriefed the participants with the above in the consent form, I then requested the participants to express their consent to participate in the study by signing the consent form or respond, “I consent” and return the signed form using my e-mail designated for the study. The return of the signed consent form marked the beginning of the participant’s interview process. I then prepared an interview timeline using Microsoft Project software that scheduled the day and time each participant agreed to be conveniently available for the interview.

In understanding how construction project managers described their barriers to technology adoption, I developed a set of semistructured interview questions grounded in the conceptual framework literature review. The Skype interview took place in a safe, quiet, and relaxed setting that was free from distractions as the interviews were being recorded to enhance generation of excellently audible and clear data during the interview (Hope, 2017; Ighadalo, 2018). For this study, I established five to 10 participants for the interview based on Schram’s (2006) recommendation that a large sample size may weaken deep investigation of the phenomenon being studied. Data organization and analysis process commenced as participants were being interviewed and the process continued until data saturation was reached. Data saturation occurs ‘‘when gathering fresh data no longer sparks new theoretical insights, nor reveals new properties of the researcher’s core theoretical categories’’ (Charmaz, 2006, p. 113). In plain language, this is when every interview question has been exhausted to a point that the participants begin

to give the same answers and further interview results in the emergence of the same themes (Crosby et al., 2017) meaning that new data are no longer necessary (Yin, 2017).

The interview time was between 40 and 60 minutes. As I conducted the interview with Skype based on the agreed timeline, I recorded the interview through digital devices, complemented with the use of Microsoft software to write down participants' responses and take observational notes. I attentively listened to the participants' responses to the prepared semistructured questions while at the same time recognized when to throw in probing questions when necessary. Probing questions help to dig through the mud to discover the gold (Rubin & Rubin, 2011; Wheeler & Massey, 2018). I was unable to achieve the required number of participants before data collection began, and the process of participants' solicitation through snowball technique continued until enough participants were recruited to achieve data saturation. There was only one follow up interview after the first interview was completed due to inaudible interruptions. I e-mailed a transcribed copy of the participant's responses to each participant and requested the participant to review, scrutinize, and authenticate their responses as being the participant's original contribution to the research during the interview. In line with best practice for qualitative research, transcribed data are being kept confidential and will be destroyed after five years.

I compared multiple sources of evidence to strengthen the trustworthiness of the data results (Merriam & Tisdell, 2015; Yin, 2017). I triangulated the results of the qualitative interviews with reflective field notes and archival documents. The archival documents included reports on technology adoption for public projects service delivery in

the Nigerian construction industry. Sources of archival documents identified for this study were websites of public project delivery institutions in Nigeria. The observational notes taken during the Skype interview focused on the participants regarding each participant's pretexts, subtexts, personal emotions, and contingencies that took place over the course of the online interview (Yin, 2017). I applied reflectivity to the observational notes taken during the Skype interview and arrived at reflective field notes, which help me discover useful insight about the participants' nonverbal responses that occurred during the interview (Kozinets, 2017).

Data Analysis Plan

Qualitative data analysis deals with turning written data such as interviews, field notes, and archival documents into findings and conclusions. Case study data analysis is the process of examining, categorizing, tabulating, testing, and converging case study evidence to produce empirically based findings (Yin, 2017). The most common problem researchers encounter in qualitative studies is being confronted with a huge amount of data that has piled up unanalyzed during the data collection period (Maxwell, 2013). The interweaving of data collection and data analysis process increases research rigor (Miles, Huberman, & Saldana, 2014). Hence, in this study, and as the research proceeded, I conducted both data collection and data analysis concurrently.

I began the process of data analysis by reviewing and examining the data to determine what was worth investigating by reading through the interview transcribed data and other documents that were to be analyzed (Maxwell, 2013), determining and following a specific analytical technique appropriate for the data, coding the interview

data and interpreting the findings (Miles et al., 2014). The analysis of data allowed me to identify emerging themes and patterns that helped offer an explanation to the central research question of how construction project managers in Nigeria described their barriers to technology adoption. When the emerging themes were categorized, findings emerged that helped me achieve a deep understanding of the slow adoption of technology and the technology avoidance attitude of construction project managers in the Nigerian construction industry. Also, another important task that I did before data analysis began was to prepare a detailed description of the research setting.

The research setting is a physical, social, and cultural site in which a researcher conducts a study and studies the participants in their natural setting (Given, 2008). I prepared a detail description of the research setting before data analysis began, and this assisted me in sense or meaning making during the interpretation of the findings (Merriam & Tisdell, 2015). Documentation and understanding of the conditions under which a study occurs boost the repeatability or reproducibility of the study if the study is to be conducted by another researcher under similar setting (Goodman, Fanelli, & Ioannidis, 2016). I developed the codes that were grounded in the conceptual framework. I connected the result of the data analysis with the central research question and drew conclusions in such a way that anyone can check with clarity, the entire research process that led to the conclusion.

Data analysis needs to be approached with rigor when applying any of the five analytical techniques—pattern matching, explanation building, time series analysis, logic models, and cross case synthesis for case study research (Yin, 2017). In this study, I

applied rigor and adopted pattern matching logic that addressed the “how” of my case study. Pattern matching occurs when the predicted pattern is compared with the empirical pattern. I predicted the findings of the study through deduction of key propositions that emerged from the literature review and my knowledge of technology adoption in the course of reviewing the literature. The empirically based pattern is the pattern of the findings revealed from the result of data analysis.

The goal of pattern matching is to examine the extent the empirically based pattern matches or deviates from the predicted pattern. Yin (2017) mentioned that if the empirical and the predicted pattern appear to be similar, it indicates acceptability of the original explanation which helps strengthen the internal validity of the case study. If the empirically based pattern and the predicted pattern do not match, then there are rivals and the researcher must offer explanation to address the rival. In this study and in accordance with Yin’s procedure for pattern matching, I compared the empirically based pattern with the predicted pattern, examined the extent of the matching, offered rival explanation where necessary, interpreted the result, and drew conclusions. Thematic analysis is the core process of pattern matching and offers an effective and reliable approach for data in qualitative study (Gu, 2014; Kikuchi et al., 2014).

In qualitative inquiry, a code is a researcher’s generated construct that is symbolically assigned to capture the summative, or the essence of every statement in the transcript of data (Vogt, Vogt, Gardner, & Haeffele, 2014). Code could be a word or summative short phrase assigned to individual datum in data to initiate the analytic process of qualitative research (Miles et al., 2014; Ravitch & Carl, 2015; Saldaña, 2015).

After each of the participants had been served with a copy of their transcript for validation, I started with the initial review of data and began the coding. I carried out two cycles of coding, the pre-codes and the actual code. The pre-coding provided the basis for coding and allowed comparison of the pre-code with the code, and once the codes had been determined, I rolled over the codes into categories for thematic analysis. Saldaña (2015) mentioned that coding is a cyclical act and it is rarely possible to arrive at perfect codes during the first cycle. I carried out the coding activities using Microsoft Excel template. Basit (2003) noted; "coding and analysis are not synonymous, though coding is a crucial aspect of analysis" (p. 145).

I developed the splitting up or categorizing of common codes, phrases, and words within the participants' responses using manual coding. My intention was to use the cross-case synthesis analysis strategy (see Yin, 2017). In addition, I applied content analysis techniques for primary data. I first identified codes in the main content through information coming from in-depth interviews, and then created categories from the identified codes. I continued with the content analysis from primary and secondary data using a pattern-matching technique followed with triangulation by exploring patterns of similarity or difference among themes generated by the analysis (Yin, 2017).

The identified themes represented recognized patterns, reasonable and practicable agenda of the researcher, commonalities as well as the research question (Yin, 2017). I classified several themes using coding analysis that recognizes similar relationships within several cases with codes that connect data collections and combines themes across a few methodologies such as journals, interviews, and discussions (Ravitch & Carl, 2015;

Saldana, 2016). The triangulation of data collection sources ensured rigor in the evaluation of data collected and which in turn improved the overall quality of the study (Yin, 2017). Attitude is usually passed across using signs that are conveyed verbally, with their body language and so on (Stake, 2010). I recorded these signs in several ways to enhance the development of context-based reports of unspoken character which allowed for a more comprehensive memory (Ravitch & Carl, 2016). I shared records of electronically transcribed research participants' responses individually with the respective participants to examine and verify the accuracy of interpretation and assess the researcher's reflexivity and perspective (Berger, 2015; Merriam & Tisdell, 2015).

The next step was the interpretation of the data analysis. This involved comparing various themes that emerged from the analysis of the data generated through multiple sources (interview, field notes, and archival data) and comparing the findings with the theoretical proposition generated from the literature review. Yin (2017) noted that the strength of case study findings rests in its ability to be generalized to the theoretical propositions established from the literature. To this end, and because this study was framed by two conceptual models, Usman and Said's (2014) model of factors contributing to ICT adoption in Nigerian construction firms and Waziri et al.'s (2017) model of factors influencing IT adoption in Nigerian construction organizations, the alignment of these conceptual frameworks to the overall findings from the case study research was essential in interpreting the result to arrive at a deep understating of how construction project managers in the Nigerian construction industry described their barriers to technology adoption.

Also, comparing the findings with the findings from similar studies helped me in validating the findings of the study. Discrepant cases are data that are out of congruence with the pattern or explanation that are emerging from the data analysis (Walsh, Holton, Bailyn, Fernandez, Levina, & Glaser, 2015). Analyzing, interpreting, and reporting discrepant cases is necessary as it may help the researcher broaden, revise, or confirm the patterns emerging from the data analysis and further enhance the study's credibility. Reporting the case study is the final step of a case study research (Yin, 2017). I reported the outcome of the case study by using thick descriptive narratives and presented to my research audience a holistic picture of barriers that confront construction project managers in the Nigerian construction industry towards adopting technology.

Issues of Trustworthiness

Trustworthiness in qualitative research is the extent to which a researcher demonstrates confidence in their findings. This suggests that the sources and the methods that the researcher applied to produce the findings must be trustworthy, using a set of four criteria. The criteria are credibility, transferability, dependability, and confirmability (Guba, 1981; Lincoln & Guba, 1985). Although Guba and Lincoln (1994) later added authenticity, this criterion is yet to enjoy wider acceptability among qualitative researchers.

Credibility

The credibility of a study is the confidence in the truth of the study and the findings (Lincoln & Guba, 1985) and is considered the most important criterion (Polit & Beck, 2014). Credibility requires that a researcher demonstrates with rigor that the

findings being presented represent the true picture of the phenomenon (Shenton, 2004). The concept of credibility is analogous to internal validity in quantitative research (Connelly, 2016). According to Lincoln and Guba (1985), triangulation, pronged engagement, peer debriefing, and member checking are the techniques for establishing the credibility of a study. In this study, I used triangulation, prolonged engagement, and member checking to achieve a credible study.

Triangulation of data. Triangulation of data is the process of achieving consistency in findings by converging data from multiple sources (Yin, 2017). The use of multiple sources of evidence strengthens the quality of case study data because by converging data from multiple sources, any weakness inherent in a single source would be overcome. With triangulation of data, a researcher can arrive at a case study report that is well developed, rich, and comprehensive (Lincoln & Guba, 1985).

The four common forms of triangulation are methodical triangulation, data triangulation, investigator triangulation, and theoretical triangulation (Denzin, 1970, 2009). Methodical triangulation occurs to ensure consistency of findings by using different data collection methods, whereas data triangulation occurs to ensure consistency in findings using different data sources within the same method (Denzin, 1970, 2009; Lincoln & Guba, 1985). Investigator triangulation takes place when multiple researchers or analysts are involved in a single study, whereas the inclusion of a range of different theories to frame a study is referred to as theoretical triangulation (Denzin, 1970, 2009; Lincoln & Guba, 1985). To this end, and by my adoption of two different conceptual models for this study, Usman and Said's (2014) model of factors contributing to ICT

adoption in Nigerian construction firms and Waziri et al.'s (2017) model of factors influencing IT adoption in Nigerian construction organizations, there was an element of theoretical triangulation already integrated into the study *ab initio*. In this study, in addition to theoretical triangulation, I used methodical triangulation to triangulate data obtained through Skype interview method with reflective data obtained from the field observation method and data obtained from the archives to support the trustworthiness of findings and make suggestions for further research (Guion et al., 2011; Houghton et al., 2013; Rohrbeck & Gemunden, 2011).

Prolonged engagement. This approach involves spending some good time in the field, enough to arrive at a comprehensive understanding of the setting, both social and cultural, under which a phenomenon is being studied, including the participants involved in the study (Lincoln & Guba, 1985). With prolonged engagement, I developed an in-depth understanding of barriers to technology adoption by construction project managers in the Nigerian construction industry including the decision-making process towards adoption. Prolonged contact enhances credibility and trust for the study as the researcher becomes immersed in the study so will the context and the setting that generated the findings become clearer and more appreciated (Lincoln & Guba, 1985).

Member checking. This approach is also known as participant validation. This strategy can be technical, and it includes asking the participants to check, review, verify, and confirm the accuracy of their statements as shown in the interview transcript and by so doing helps the researcher to establish validity (Lincoln & Guba, 1985; Tong, Chapman, Israni, Gordon, & Craig, 2013). Member checking helped me understand the

true and actual perception of the participant during the interview. I did not encounter any problem with member checking as all the participants were able to recapture verbatim what they said and how they said their views during the interview.

Transferability

Transferability is the extent the findings of a study are transferable to other contexts or settings and participants (Burkholder et al., 2016; Korstjens & Moser, 2018). According to Shenton (2004), the researcher needs to provide enough details of the context and setting encountered during the fieldwork so that another researcher can assess whether the prevailing environment is similar to other settings. The concept of transferability is analogous to external validity in quantitative research (Connelly, 2016; Yin, 2017). The assurance of transferability was critical to my study so that findings from the study on technology adoption barriers among project managers in the Nigerian construction industry could be used to discuss technology adoption barriers with project managers in other sectors of the Nigerian economy or with project managers in the construction industries of other developing African countries. In this study, I established transferability using thick description.

Thick description. The basic idea of thick description was first introduced by the philosopher Gilbert Ryle (Ryle, 1949). In the 1970s, it was established as a qualitative method for investigating implicit social practices in their specific contexts by the anthropologist Clifford Geertz (Geertz, 1973). Since then, thick description has become a well-established concept and practice in qualitative empirical approach (Stokes, Cheraghi-Sohi, Kristensen, & Sutton, 2016**).** In thick description, a researcher gives a

detailed account of fieldwork and constructs patterns of social and cultural experience (Holloway, 1997), which provide a reference point for users of the report that are transferable to other times, settings, and people (Sergi & Hallin, 2011). In this study, I achieved transferability through thick description of the entire research process, the method, the participants and their context, the settings, data samples, and the sampling method (Houghton et al., 2013; Korstjens & Moser, 2018).

Dependability

Dependability is the consistency of the findings over time when the entire research process leading to the findings is replicated by other researchers (Billups, 2014; Korstjens & Moser, 2018). Dependability is important to the trustworthiness of the study because the research audiences are interested in knowing if other researchers were to look over the data, they will arrive at similar findings and conclusions about the data. As a qualitative study, the procedure for data collection, analysis, interpretation leading to the findings must be reliable and dependable. In this study, I used audit inquiry technique to establish dependability.

Audit inquiry. An audit inquiry involves a detailed account of the research process from data collection to the research findings. I first ensured that all the interview transcripts produced from the digital recorder were accurate representations of the participants' responses during the interview before coding. I achieved this by listening to the participants' interview responses several times and comparing with the transcripts and sending out the participant's transcript for their validation. I presented a detailed account of how data were collected, categorized, themed, and interpreted including the decisions

that I made in the process to arrive at the findings. I reviewed the report several times to ascertain that I had not missed anything in the study. Also, I engaged a researcher who is not involved in the research to examine the data process and the findings independently with the aim of evaluating the accuracy, and this helped me achieve dependability. The audit did not prompt for collection of additional data for stronger findings (Lincoln & Guba, 1985).

Confirmability

Confirmability is the last criterion in establishing the trustworthiness of a research study. The intent of confirmability criterion is to verify that the research findings are derived from the participants' narratives and other sources of data for the study rather than the researcher's biases, motivation, or interest (Lincoln & Guba, 1985). Confirmability deals with the neutrality, impartiality, and the precision of the data and is also connected to dependability because both dependability and confirmability can be established at the same time (Gibson, Benson, & Brand, 2013; Houghton et al., 2013; Walker 2012). In this study, I achieved confirmability using audit trail and reflexivity (Lincoln & Guba, 1985).

Reflexivity. Reflexivity is about self-awareness and analytic attention to the researcher's role during the conduct of qualitative research (Lambert, Jomeen, & McSherry, 2010; Palaganas, Sanchez, Molintas, Visitacion, & Caricativo, 2017). Through the practice of reflexivity, I was aware of my contribution to the construction of meanings from the lived experiences of the participants throughout the research process (Ackerly & True, 2010; Denzin & Lincoln, 2011). In this study, I maintained a reflexive

journal notebook on my preconception and values and how they affected my research decisions in all phases of the study (Korstjens & Moser, 2018).

Ethical Procedures

As part of the requirement to achieve and maintain ethical practices in the conduct of research works, Walden University requires all doctoral students to obtain approval from Walden University's IRB before data collection can commence. In this study, I complied with every IRB requirement necessary to gain access to the participants and the data for the study. The IRB ensures that participants involved in the study of human subjects are protected from being harmed or injured in any way during a study (Jacob & Ferguson, 2012). I applied to IRB and kept a record of my application approval number issued by the IRB. With this approval, I accessed the research site, reached out to the participants, and collected the data.

Participants' participation in any research involving human subjects is voluntary, and a researcher is under obligation to achieve this through informed consent. The informed consent is a procedure by which a participant in a study, having understood the research information, the process, and its risk, can voluntarily indicate willingness to participate as a participant in the study. I completed the Informed Consent Form and forwarded it to each of the participants to sign and return the signed Informed Consent Form to me electronically via an e-mail address designated for the research. The informed consent form served as an opportunity for the participants to ask me any questions and to receive clarification from me on any issues that bothered them about the research and its process.

Yin (2017) recommended that the conduct of a study must follow the highest ethical standard, and the researcher must take full responsibility for the scholarship, professionalism, and the appropriateness of the methodology adopted for the research. Research ethics include all aspects of research design ranging from research goals, research question, validity, and methods (Maxwell, 2013). Also, originality and referencing scholarly work of others appropriately to avoid plagiarism is an aspect of ethical obligation that a researcher must observe and comply. I developed trust relationship with the participants and addressed participants' privacy and the confidentiality of the views and perceptions that they expressed in the study (Palys & Lowman, 2012).

Here is a highlighted list of the ethical actions I took to comply with the ethics of conducting human subject research:

1. I did not engage in the use of pressure or undue influence or undue motivation, such as offering things of value such as to get the participants involvement in the research.
2. Participation was totally voluntary, and the participants were informed of their rights to withdraw unconditionally and at any time from the study.
3. I addressed anonymity by randomly allocating pseudo names in place of participants' actual names during data collection and analysis.
4. During audit inquiry, I provided a pseudonymous copy of the report to the external researcher to keep the identity of the participants totally secured.

5. I addressed confidentiality by signing off on consent letters with a promissory guarantee to individual participants that their personal information and identities will be protected from the public. To ensure the privacy of the participants' key demographic information, I designed a demographic form that gave participants the option to specify their age within a range.
6. I addressed the ethics of respect to participants by involving the participants while scheduling the interview. The participants dictated the interview date and times most convenient for them.
7. I addressed the ethics of no psychological harm to the participants by being psychologically meticulous while asking probing questions. I did not probe participants' personal life experience but probed participants' professional life experience to bring depth to the study.
8. I informed the participants of the interview protocol and the data collection devices such as Skype and voice recorder before they were used and asked them to express their concerns, if any.
9. I obtained approval from the IRB before data collection began.
10. I asked the participants to validate their responses as recorded in the transcript before data processing began.
11. I let the participants have access to a copy of the research paper before it will be published for them to confirm that their privacy was truly covered in the report,

12. I dealt with less of hard files of data but more of electronic files. Where hard files are involved such as interview notes, print photographs, audio, or video files, I securely locked them away in a cabinet that is only accessible by me. All electronic files are password protected and encrypted.
13. I will erase, incinerate, and destroy all data, both hard and soft copies, collected after 7 years and inform the participants accordingly.

Summary

In Chapter 3 of this study, I adopted a qualitative single case design over other qualitative designs such as ethnography, grounded theory, phenomenology, and narratives and substantiated the rationale for the adoption of the research design. As a qualitative researcher, my positionality as the instrument of the research and my role as an observer, a recorder, and an analyst of the qualitative data rather than as a participant in the study was discussed. I also identified potentials for some research biases that may creep into the study and discussed how such biases were mitigated using reflexivity.

I grounded the single case design into an appropriate methodology for the selection and recruitment of participants using a criterion-based snowball strategy and the collection of research data from multiple sources (interview, archival data, and reflective field notes). An interview protocol grounded in the two conceptual models framing the study—Usman and Said's (2014) model of factors contributing to ICT adoption in Nigerian construction firms and Waziri et al.'s (2017) model of factors influencing IT adoption in Nigerian construction organizations—was field-tested by two subject matter experts (SMEs) and established as having proper alignment with the purpose of the study.

The procedure for thematic analysis of the field data to produce empirically based findings and how the findings were interpreted using pattern matching was presented. The issues of credibility, transferability, dependability, and confirmability were addressed to support the overall trustworthiness of the study. I also discussed and highlighted ethical actions necessary to achieve all the ethics of conducting research involving human subjects mandated by IRB. Going forward, Chapter 4 deals with the detailed description of the research setting, demographics, actual data collected from the field, their analysis, the results, and the presentation of evidence that support the trustworthiness of the study.

Chapter 4: Results

The purpose of this qualitative single case study was to understand the perceptions of construction project managers in Nigeria regarding their barriers to technology adoption. Meeting the purpose of this exploratory study may address the literature gap concerning why construction project managers in Nigeria remain slow to adopt new technologies for improving decision-making processes and project success rates. The specific problem that I researched in this study was that barriers to technology adoption by construction project managers in Nigeria to lower the rate of failed and abandoned construction projects remain poorly understood. I used 12 semistructured interview questions designed to provide answers to the central research question of how construction project managers in Nigeria described their barriers to technology adoption.

The findings generated from the semistructured interview data, when triangulated with archival data and reflective field notes, provided deep insight into technology-adoption barriers among construction project managers in Nigeria. When barriers to technology adoption are understood, the Nigerian government is more likely to begin to include professionals from specific sectors in the technology policy decisions that affect those industries, the rate of public project failure will begin to reduce, and the outlook for positive social change may be deemed hopeful. In this chapter of the study, I describe the research setting, participant demographics, data collection procedures, data analysis procedures, and evidence of trustworthiness, in addition to presenting the results of the study. I conclude the chapter with a summary and transition to Chapter 5.

Research Setting

I first identified potential participants for the study via the LinkedIn professional networking platform and reviewed potential participants' profiles to assess whether they met the three inclusion criteria: adult over the age of 18 years; 3 years' minimum experience in the construction project management field in Nigeria; and possession of knowledge regarding construction technology. After I had prequalified participants as meeting the three inclusion criteria, I contacted them via email to solicit their voluntary interest in participating in the study and explained the procedure for the interview, the interview method, and the interview duration. Once a participant showed interest, I sent out the Recruitment Letter (Appendix A) and the Informed Consent Form. The recruitment letter had a section for validating the potential participant's eligibility to participate based on the three inclusion criteria set up for the study. After I received the signed consent form, I set up an interview date and time that was most convenient for the participant.

I started with four potential participants originally sourced from the LinkedIn platform. Three of them agreed to participate, whereas one declined due to lack of time and a busy schedule. The potential participant who declined due to lack of time offered to be interviewed through e-mail. I apologized to the participant because the e-mail method proposed did not align with my data collection method and strategies. The three participants who accepted to be interviewed became the primary source for the other seven participants recruited through a snowballing technique.

I proceeded with the interview and collected recorded interview data for the single case study from the 10 construction project managers in Nigeria I recruited, using the Skype telecommunication platform with the consent of the participants. Each of the interviews was planned to last 40–60 minutes, in which I sought to gather information-rich conversational evidence on the 12 semistructured interview questions designed and pre-tested for the study. After the interviews were completed, I noted that the shortest interview duration was 42 minutes, and the longest was 64 minutes, and there had been no evidence of fatigue from any of the participants throughout the interview time. I experienced a situation in which at the end of a question and before proceeding to the next interview question, participants wanted to know if I was satisfied with their response. I let the participants know that I was just an investigative researcher and that I had no preformed answers or anticipated responses. Moreover, I explained that a qualitative interview is all about participants' experiences of the phenomenon being investigated I also let all the participants know that the deeper they went into describing their experience in response to each of the questions, the better my chance of arriving at information-rich case study evidence for the study.

All of the interviews were conducted in privately chosen settings of the participants, and there was no evidence of prolonged interruptions, especially for participants living with their immediate nuclear families. In order to achieve an uninterrupted interview experience due to power and internet instability in Nigeria, some of the participants voluntarily decided to have their interviews conducted during night hours in their homes or during weekend day hours in their offices. Out of the 10

interviews conducted, one was later repeated with the participant due to an inaudible audio recording. The participant voluntarily agreed to repeat the interview. The repeat interview was done at the participant's most convenient date and time, and there was no inducement. All of the participants recruited had main offices in Abuja and Lagos and branches across capital cities of the three geo ethnic groups in Nigeria. I wrote down reflective field notes during the interviews.

Demographics

The demographic composition of the 10 participants is presented in Table 1. I assigned the participants unique pseudonyms from P1 through P10 to conceal their identity and maintain confidentiality in line with the ethics of human subject research. At the time of the interview, 60% of the participants occupied senior project manager positions while 40% were in project manager positions. In terms of educational achievement, 50% were holders of Bachelor of Science degrees, 30% had Master of Science degrees, and 20% held doctoral degrees. Forty percent of the population sample had construction technology experience of 6-10 years, 30% had experience of 16-20 years, and 30% had 21-25 years of experience. From the data in Table 1, relying on the Pew Research Center (2019) generational age classification, I determined that 40% of the research population sample were Millennials and 60% fell within the Generation X age group. None of the participants were within the infant or elderly age categories. There were no vulnerable participants, as required by Walden's IRB. There were no female project management practitioner participants recruited in this study, not because there are no female project managers practicing in the Nigerian construction industry, but because

the only female project manager who was referred for the study through the snowball technique declined to be interviewed after many attempts due to her busy schedule. Fifty percent of the participants had an architectural technology background, 30% had a quantity surveying background, and 20% had a building technology background.

Table 1

Participants' Demographics and Characteristics

Participant	Professional background	Level of education	Current title	Gender	Years of experience	Age in years
P1	Architecture	Master of Science	Snr. project manager	Male	16-20	46-50
P2	Architecture	Bachelor of Science	Project manager	Male	6-10	31-35
P3	Quantity surveying	Doctor of Philosophy	Snr. project manager	Male	21-25	41-45
P4	Building technology	Bachelor of Science	Project manager	Male	6-10	31-35
P5	Architecture	Bachelor of Science	Snr. project manager	Male	21-25	41-45
P6	Quantity surveying	Doctor of Philosophy	Snr. project manager	Male	21-25	41-45
P7	Architecture	Master of Science	Snr. project manager	Male	16-20	46-50
P8	Quantity surveying	Bachelor of Science	Snr. project manager	Male	16-20	41-45
P9	Architecture	Master of Science	Project manager	Male	6-10	31-35
P10	Building technology	Bachelor of Science	Project manager	Male	6-10	31-35

Data Collection

I started the process of participants' identification, recruitment, and data collection after I received IRB approval. My IRB approval number was **6-20-19-0172689**. I collected interviewed data from 10 participants who met the criteria for inclusion in this case study. I first identified potential participants for the study via the LinkedIn professional networking platform and reviewed potential participants' profiles

to assess whether they met the three inclusion criteria: adult over the age of 18 years; 3 years' minimum experience in the construction project management field in Nigeria; and possession of knowledge regarding construction technology. After I had pre-qualified the participants as meeting the three inclusion criteria, I contacted them via email to solicit their voluntary interest to participate in the study and explained the procedure for the interview, the interview method, and the interview duration. Once a participant showed interest, I sent out the recruitment letter and the Informed Consent Form. The recruitment letter had a section for validating the potential participant's eligibility to participate based on the three inclusion criteria set up for the study. After I received the signed consent form, I set up an interview date and time that was most convenient for the participant.

The data-collection techniques that I used for this study involved semistructured interviews, reflective field notes, and archival data. I started with five potential participants originally identified from the LinkedIn professional platform. Four of them agreed to participate, whereas one potential participant declined due to lack of time in a busy schedule. The potential participant who declined due to lack of time offered to be interviewed through e-mail. I apologized to the participant that the e-mail method proposed did not align with my data collection method and strategies. I started the interview with four participants I recruited through the LinkedIn professional platform, and they became the primary source for the additional six participants I recruited through snowballing technique.

Interviews

Each interview started with an expression of appreciation to the participant, followed by a brief overview of the study. Sixty percent of the participants had their interview conducted in the comfort of their home on a weekday, with most of these interviews occurring at night, whereas 40% of the participants had their interviews conducted in their offices during weekend days, mostly in the morning. None of the participants had their interview scheduled within their official working hours. I used the Interview Protocol (see Appendix B) to guide the interview, and this ensured consistency in interview process and conduct across the 10 participants. In some cases, and when prompted, I used probes and follow-up questions to arrive at an information-rich explanation. The entire interview process took 23 days to complete across all 10 participants (i.e., approximately two and a half days to identify participants, receive consent, schedule an interview, follow up, and conduct the interview). The actual average time for the interviews was 53 minutes; the planned average time was 50 minutes.

I conducted all of the interviews with Skype, recorded the interviews with a free Skype call recorder (http://voipcallrecording.com), and engaged the services of Rev Transcription Services for the transcription. After the transcription, I listened to the audio multiple times, made corrections, and added reflective field notes. The transcribed data were sent to the participants to confirm that the transcription of their interview responses represented their views during the interview. All 10 participants validated their interview responses; two of the participants made minor changes that did not significantly alter the contents of the transcription. After receiving the validated transcribed data from each of

the participants, I erased participants' names, applied pseudonyms, and organized each of the participants' transcribed data in ascending order of pseudonyms (P1, P2, P3, …, P10) across each interview question into a single Microsoft Word document. Overall, there were 106 pages of validated transcribed interview data, which was an average of approximately 11 pages per participant, or an average of one page per participant per semistructured interview question. At the count of 10 participants planned for the study, I found that I had reached data saturation because no new additional interview data emerged after Interview 6. There were no hard copies for any of the transcribed data nor any pieces of information that could link the participants' names with their pseudonyms. All data were electronically saved on my personal computer and were fully encrypted with a password. I did not encounter any unusual circumstances during the collection of these data.

Reflective Field Notes and Journaling

After receiving my IRB approval on June 20, 2019, I kept reflective field notes with me, where I drafted my plan for the processes of recruiting participants, progress feedback, and record of any contextual information relevant to the phenomenon under study. I used the reflective field notes throughout the interviewing process to record my thoughts, emotions, and reflections on the participants' nonverbal cues such as emotions and behaviors. The reflective notes were also used to capture participants' reactions and responses during the recruitment process, data collection process, tones, and attitude during the interview. During data analysis, the reflective field notes provided the

opportunity for me to mirror participants' responses in the context of their sentiment (Merriam & Grenier, 2019).

During the interview, I wrote down some observations and reconfirmed the observations by repeatedly listening to the interview audio recordings (Merriam & Grenier, 2019). I continued with the reflection from one interview to the other, which helped me establish patterns and themes within and across data. I observed participants' passions in assertively expressing their knowledge, experience, and perception of barriers to technology adoption by construction project managers in Nigeria.

Transcript Review

After each interview, I completed the interview data transcription and forwarded a copy of the transcript to the individual participant through email for data source triangulation. The process of asking participants to check and validate transcribed data is known as *member checking*. I did this to assure the accuracy of the content and underlying social behavior, which helped confirm the overall accuracy of the interview data. Member checking helped to improve the accuracy and credibility of this research, as any thoughts that participants felt were not clearly expressed were cleared and corrected as appropriate (Yin, 2017). Generally, a small number of changes were made, but the changes did not have an impact on the content or the meaning. However, the changes were incorporated into the participants' original responses to satisfy the participants.

All of the participants' responses to the interview transcripts were returned to me within 72 hours. Eight of the participants confirmed the content as consonant with the interview, while the remaining two participants confirmed their responses with minor

changes that did not impact the content or meaning. I compiled all of the verified transcribed data into a secured file and stored the data in accordance with the data security plan established for the study in Chapter 3. I used the confirmed transcribed data for manual hand coding and data analysis.

Data Analysis

I began data analysis after completing the member-checking process for the transcribed data with all of the participants. I adopted a descriptive coding strategy recommended by Saldana (2016) to assign meaning to segments of raw data collected for this study and used the emerging words from the descriptive coding for categorization and thematic analysis. The raw data transcribed and confirmed through the member-checking process presented a detailed account of the experience of the construction project managers in the Nigerian construction industry regarding their barriers to technology adoption.

Because coding drives data collection in a case study design (Saldana, 2016), reshaping of analysis for this study led to the emergence of themes regarding the perceptions of construction project managers in Nigeria regarding their barriers to technology adoption. Considering that case study involves in-depth, futuristic, and holistic investigation into all aspects of the case and provides industry-related data that are not anticipated by literature (Yin, 2017), this study provided detailed information on the unexplored area of barriers to technology adoption from within the Nigerian construction industry and provided a comprehensive understanding of the phenomenon under study in this single case study design with the participants being the embedded

units within the case. Because the inductive approach is used in qualitative research to generate or broaden theory and allow themes to emerge from data (Saunders et al., 2018), I used the inductive approach as part of my analysis strategy for this study, which allowed for themes to emerge.

Knowing that thematic analysis emphasizes identifying, examining, and taking record of meaningful patterns within data, and propelled by systemized raw data coding process (Yin, 2017), I applied thematic analysis for this study to examine meanings and provide description of the social reality of construction project managers in Nigeria regarding their barriers to technology adoption. The set of techniques I deployed while analyzing textual data towards developing themes that can be used to answer the study's central research question determines the accuracy of thematic analysis. The processes of recording, transcription, member checking, and categorizing of participants' similar thoughts using keywords and deeply rooted sentiments help validate the accuracy of the data base for this study (Yin, 2017).

Manual hand coding through a systematic process framed in the descriptive coding method was used in the thematic analysis for this study (Saldana, 2016). I adopted the descriptive coding method (Saldana, 2016) to assign meanings to segments of raw data, which led to the emergence of lists of words, phrases, or both for indexing and data categorization. The use of Microsoft Excel software aided me in the manual hand-coding of the participants' transcribed interview responses. The coding of words and or phrases combined with data triangulation brought about a substantial recognition of patterns,

while deep attention to similarities and differences in the pattern improved upon the dependability for the study (Yin, 2017).

I adopted the *ground up* data analysis strategy (Yin, 2017) and generated codes from the transcribed data using the inductive analysis approach recommended by Boyatzis (1998). Inductive analysis involves coding the data without attempting to make the data fit into a preexisting coding frame or the researcher's analytic preconceptions. As in this study, a thematic analysis is considered data-driven when the codes are generated inductively (Braun et al., 2019). While utilizing thematic analysis, I carefully searched for themes important to the depiction of the phenomenon, which involved a meticulous process of identifying themes through readings and good understanding of the data (Yin, 2017).

I categorized common codes, phrases, and words within the participants' responses (Yin, 2017) and applied content analysis techniques for primary data. The first step I took was to identify codes in the main content of the in-depth interviews and then create categories from the identified codes. (Yin, 2017). As soon as data entry began, I highlighted the key words and phrases relevant to answer the interview questions. This thematic analysis was carried out through a careful recognition, identification, and recording of emerging patterns from the interview discussion. I highlighted and extricated all words and phrases which I considered pertinent to answer the study's central research questions from the participant's transcribed interview. I assigned codes to the extricated and evaluated data segments and recorded the codes against each interview question. Codes were further accrued into themes by identifying and distinguishing similarities

(Yin, 2017). The final coding categories and themes for this single case study are further presented and described below to exemplify the coding process for each coding category and theme.

Though the use of manual descriptive coding is laborious, it helped me delve much deeper into the data (Cronin, 2014) with a deeper contextual understanding of the data (Finfgeld-Connett, 2013). As a novice researcher, I found the descriptive manual coding method more effective and suitable to use for my data analysis than Computer Assisted Qualitative Data Analysis Software (CAQDAS). The data analysis considered all the archival data obtained from government reports on technology adoption in Nigeria. This data analysis was structured in accordance with Yin's (2017) five phases of analysis-assemble, collect, interpret, disassemble, and conclude the data. The sources of data were through interviews, reflective field notes. This methodological triangulation enhanced the dependability of the results.

The five coding categories are based on the conceptual framework, and the 14 themes gleaned from the thematic analysis and areas are listed below.

Themes for adoption of technology

1. policy
2. costs
3. commitment to change

Themes for causal factors of culture for slow technology adoption

1. company culture
2. ethnic culture

Themes for organizational performance

1. below industry standards
2. influenced by low technology adoption
3. lack of younger, tech-savvy professionals

Themes for innovative technology

1. lack of adequate financial investment
2. lack of appropriate technology training
3. low access to latest technology due to government policy

Themes for interorganizational collaborations

1. communication system issues
2. team collaboration emerges with technology adoption
3. empower project managers to lead

The five conceptual coding categories are grounded in the study's conceptual framework. This includes two conceptual models: Usman and Said's (2014) model of factors contributing to ICT adoption in Nigerian construction firms and Waziri et al.'s (2017) model of factors influencing IT adoption in Nigerian construction organizations. Usman and Said developed a conceptual model that captures those attributes that contribute to slow technology adoption in Nigerian construction firms, grounded in a literature review on their identified causal factors of culture, policy, and cost and how they relate to technology adoption in the Nigerian construction firms. Waziri et al. developed the model of factors influencing IT adoption in Nigerian construction organizations by extending Usman and Said's conceptual model using the initial

assumption that innovative technology has been a driving force behind organizational performance through stimulation and standardization of an effective communication system among the members of organizations as well as interorganizational collaborations.

Usman and Said (2014) grounded their factors contributing to ICT adoption in Nigerian construction firms model (see Figure 1) in Rogers's innovation diffusion theory (1995) which also provided a theoretical lens through which to evaluate the effect of the three factors of culture, policy, and cost in any research related to ICT adoption. Waziri et al. (2017) developed a model of IT adoption to supplement Usman and Said's work, the model of factors influencing IT adoption in Nigerian construction organizations, which introduced new factors into the IT adoption process by construction firms: the technology, organization, and environment contexts. Findings from Waziri et al.'s study reinforced the continuing reluctance of Nigerian construction to adopt new technologies; their model offers a theoretical model that can be extended through empirical research to further study IT adoption within the Nigerian construction sector (Akande et al., 2018; Ozumba & Shakantu, 2018).

Presenting case study research findings can be done in different styles according to the purpose of the work, the kind of analysis undertaken, and the intended readership. In this case the personation of category and themes is by participant quotes considering that one of the goals of the research was to give voice to a previously unheard population through this purposive sample (Corden & Sainsbury, 2006). The following is a description of the finalized coding categories and themes of this single case study with

embedded units, along with respective examples of participant quotations (Table 2) to represent each of those categories and themes.

Table 2

Coding Category and Theme Examples

Participant	Interview excerpt	Category	Theme
P3	"So, everything about the law to make people appreciate and accept and allow for the adoption of technology is fine. It's okay. Then we you bring it down to industry level it would take me back to the question of government policy, industry-specific policy. One thing is to say it, another is to have the will power to actually direct people to do it and do it the right way"	Adoption of technology	1) Policy; 3) Commitment to change
P1	"Because they have an existing structure, it means that they have to in a way phase out those ones, and then get a replacement which on cost aspect is not that easy as it's more expensive. Cost is a significant factor causing the low adoptions of technology in Nigeria. And most organizations are unable to do that. The cost of the structural aspect, the rearrangement that has to take place before a new technology will come in"	Adoption of technology	2) Costs
P7	"The third one is commitment. You need to once you are aware and you are willing to change you should just commit to the decision you have taken because when you say you are aware, and you want to change, and you are not committed, you must walk towards it. It's like when my organization had to move from Iso 9000 (2008) Iso 9001 (2015). The year that we changed to Iso 9001 (2015) was the year that we were told	Adoption of technology	3) Commitment to change

(*table continues*)

Participant	Interview excerpt	Category	Theme
	by September next year the Iso 9000 (2008) would become obsolete and so if you are not Iso 9001 certified, then you must start from beginning. Immediately, that compelled us to radically made the change. So, something must push people you must commit. If you don't do it, you will lose your certification. In that aspect. So, if something is not compelling people, they won't commit"		
P5	"We can't compare Nigeria to the advanced world. In the advanced world, it is part of their system and part of the management whereas here it just something so strange to us. As time goes on, we believe there would be room for improvement. I can't say we are 100% up to date but if I may rate my company technology adoption, I will say we are in the range of sixty, sixty-five percent"	Culture	1) Company culture
P7	"Well I don't see anything in place in terms of ethnic culture influencing adoption of technology in Nigeria at all, I don't. The only influence ethnic culture have now is in terms of design. The kind of building design that we do in Nigeria. That is, you know we have local architecture. I know there is Hausa architecture. When you design for a Hausa man as there is a way you need to incorporate their belief into the design. When you design in the western part of Nigeria, there is a way you do your design. So, I think it's only in terms of design but maybe in terms of managing projects, maybe in a way because you need to acknowledge the culture of people when you go to their rural areas to manage projects so you need to recognize their belief. But in terms of adopting technology, it doesn't. The path hasn't crossed"	Culture	2) Ethnic culture

(*table continues*)

Participant	Interview excerpt	Category	Theme
P8	"You have to bear something in mind, because you know the riverine areas are somehow a very terrible terrain to work and the ethnic of those people there, if you want to work there apart from the cost of project you have to set aside the cost of settling the community people in that area. In this aspect ethnic culture may affect project management practice and execution"	Culture	2) Ethnic culture
P1	"The state of technology is still relatively low in terms of adoption. And that will translate into how efficient the organization of construction project to be undertaken here. So, at times we see the management were forced to pending or delay the renewal, and thus automatically translate into slowing down the pace of work that is being undertaken"	Organizational performance	1) Below industry standards; 2) Influenced by low technology adoption
P8	"Like I said earlier, that the old professionals, the elderly ones they have been used to their own old way of doing things. They are not ready to change and is causing serious problem. These are the people that are supposed to make policies, that are supposed to advise governments, based on their experience in the field. But because they know that their old ways of doing this before, they are used to that, they don't want to improve from that it makes it difficult for them to even advise government properly. So, I can say that is the primary barrier. Some of them still using pen and drawing board instead of software's and are not ready to improve. simply because you see most of the elderly professional in the project management industry are used with their old system of doing things. They find it difficult to develop	Organizational performance	3) Lack of younger, tech-savvy professionals

(*table continues*)

Participant	Interview excerpt	Category	Theme
	themselves in terms of technology advancement. And to now adopt other means is difficult just because of the belief and the kind of attachment they have with the old method of doing things. But in the area of the young professionals, at least they are trying to adopt some of this technology. You can take for example now. All this highly professionals in my organization, even to use computers is hard. It is the young ones that are just starting now, that are now using all the computers, use some software"		
P1	"In terms of the low adoption, we have a lot of factors mitigate on it which is more with financial considerations. Considering the capital inflow, most organization have challenge on rolling out this new technology"	Innovative technology	1) Lack of adequate financial investment
P8	"I must be sincere with you. Like I said earlier, I work with the state government. On their side, they are putting little or no efforts in making some new technology available to project managers. The new technology that we have, that we are adopting now are being made available by the professionals' staffs by themselves. We do acquire some skill, but it is in our personal money we use to go for trainings. But on the part of the government, they only have policies. But they don't implement those policies. Here, everything is in the hands of individuals to train and develop themselves technology wise"	Innovative technology	2) Lack of appropriate technology training
P2	When you talk of construction equipment and method or the necessary equipment methods as expected or us, to be using, they are not readily made available because	Innovative technology	3) Low access to latest technology due to government policy

(*table continues*)

Participant	Interview excerpt	Category	Theme
	you know, we are still depending on the European country or the Western country for all this technology. Because of the level of our technology, we are still buying them, and they are very costly. They are very expensive, and their adoption depends on many factors. Also, government policy is affecting the technology we can adopt. Not that we don't know the right thing but is very difficult to do the right thing. Government has to wake up. All this burden supposes to rest on the shoulder of the government, they have to make the right policy and be on their toes. What government is doing towards technology adoption is not encouraging, is still not enough. For example, when it comes to housing development, government supposed to bring all professionals in the construction industry together to develop how modern and new technology can be used to provide affordable housing units to address housing needs for low income, middle income, and high-income earners. They can use this as a case study to provide homes for government workers and this will help organizations to follow like a blueprint of what they want for the industry"		
P1	"There must be a fore-knowledge agreement on the critical need of technology to be deployed for use. If it is not critical it may not be adopted and because others also must understand that software for them to deploy it in the first place because communication is about a give and take thing. It's a two-way thing. It cannot be a one-way direction. I think something like that which has to do with management perception on to the	Interorganizational collaborations	1) Communication system issues

(*table continues*)

Participant	Interview excerpt	Category	Theme
	critical need. When there is break in communication there is going to be a kind of delay in the project implementation"		
P1	"May I just briefly state that the little I know about project management software is basically that there is software that help project managers and they seem to collaborate and meet goals. So, the project manager sits at the top. He is not the only one that is managing the project. There are other engineers, architects and the likes that worked on this project, synergizing with the contractor on site. This will help to collaborate and then meet goals on time while managing resources and cost. The function may include task distribution. The time tracking, budgeting and resource planning, team collaboration and the like. Because without agreement, you cannot meet every need. Often, it's beyond the scope of a project manager working on site as a project manager and as a coordinator on site at the same time"	Interorganizational collaborations	2) Team collaboration emerges with technology adoption
P1	"Well, the way I look at it is in two folds. First, if it happens that the project architect happens to be the project manager on which happens most times, it's easy for him to request for the adoption of new technology. Why? Because he is the same person that he's using his own software to generate the information that is required for the efficient implementation of the project. And then put it into use, the project management software that will help him in his work. For a situation where there is different headship... most times, they are different depending on the scope of the project. The project manager is different from the project consultant architect. And at that point,	Interorganizational collaborations	3) Empower project managers to lead

(*table continues*)

Participant	Interview excerpt	Category	Theme
	different headship exists. A project manager will sit at top what has to do with management aspect. While the technical aspect is being shared by the architect because that's where the information dissemination on the actual implementation of the project lies"		
P10	"One of the challenges we are facing most is that law relating to construction industry in Nigeria is too weak in the sense that it accommodates anybody to practice as project managers. Due process must be followed in making sure that each professional play their roles as assigned on the project. For example, if you are a builder you play your role as a builder, if you are a quantity surveyor you play your role as a quantity surveyor, if you are a structural engineer you play your role as structural engineer, likewise architect. This is not so in other countries. This is one of the major challenges we are facing in adopting new technology in the construction industry"	Interorganizational collaborations	3) Empower project managers to lead

Description of the 14 Themes

Policy. This term refers to a blueprint or set of basic principles adopted by an organization to guide and limit the action of the organization in its pursuit of a long-term objective.

Costs. This term refers to the price that an organization has to pay to acquire new technology adoption. It is a combination of both direct and indirect cost associated with

the acquisition of new technology that the organization must bear towards technology adoption.

Commitment to change. This term refers to a mindset that individually and collectively binds everyone involved in a change effort to accept, embrace, and be devoted to a course of action deemed necessary to effect the change initiative successfully.

Company culture. This term refers to the overall value and behavior that characterized a company regarding its unique social and psychological environment. It is the sum of all attitudes, beliefs, customs, and written and unwritten rules that have been shared and developed over time and are valid for the organization (Phua, 2018).

Ethnic culture. This term refers to the culture of a people in a given geopolitical zone with regard to their heritage, religion, and custom, which determines their attitude towards the adoption of new technology.

Below industry standards. This term refers to a state of organizational performance regarding technology adoption that is considered to have fallen short of the minimum requirement generally acceptable to the construction industry.

Influenced by low technology adoption. This term refers to the influence low adoption of technology has on organizational performance. The aim of technology adoption is to drive improved project performance. The low adoption of technology consequently influenced low organizational performance.

Lack of younger, tech-savvy professionals. This term refers to the absence of young project managers that are proficient in the use and application of technology-based solutions to project management practices.

Lack of adequate financial investment. This term refers to the inability of construction organizations to engage in the act of planning, committing, and investing a dedicated capital into technology adoption endeavor with the expectation of driving the growth of the business through innovative technology.

Lack of appropriate technology training. This term refers to the inability of construction companies in the Nigerian construction industry to create and establish internal and external platforms through which project managers undergo training to update their skills in the awareness and use of new technology for project management applications and practices.

Low access to latest technology due to government policy. This refers to government related policy factors that create an environment inhibiting or limiting direct access to the acquisition and use of technology by project managers in the Nigerian construction industry.

Communication system issues. This refers to channels of communication and factors limiting timely and appropriate dissemination of information on emerging technology and trends among project managers and other stakeholders.

Team collaboration emerges with technology adoption. This refers to the unfolding or emergence of teamwork, creative thinking and collective participation

approach towards the achievement of project objectives facilitated by the adoption of technology by all project team members.

Empower project managers to lead. This refers to the emergence of a project management environment among team members that permits genuine and professional project management practices on projects in which project managers can act and exercise their authority as project managers unencumbered.

Evidence of Trustworthiness

Credibility

Credibility is the confidence the researcher has in the truth of the study, the findings, and the implementation of the strategies for validating the trustworthiness of the data (Lincoln & Guba, 1985; Merriam & Tisdell, 2015). Most often, credibility is assessed based on whether the research findings represent a convincing conceptual exposition of the data (Korstjens & Moser, 2018). I reached a firm conclusion for this study following the method and procedure established for assuring and ensuring credibility as established by seminal methodology scholars (Stake, 2013; Yin, 2017).

First, after the participants were enlightened about their voluntary choice of participation and their confidentiality regarding the study, I achieved conversational and in-depth revealing responses from the participants as they were being interviewed in a comfortable atmosphere at the location of their choice for the interview. Second, the credibility for this study was achieved using member checking strategy as the interview transcript for each participant was reviewed and corrected by the respective participant (Merriam & Tisdell, 2015). Third, prolonged engagement, saturation, consistency, digital

recording, and audit trail that I deployed enhanced data conclusion credibility (Cooper & White, 2012; Yin, 2017). Fourth, ensuring the inclusion of participants that truly met the inclusion criteria, adult over the age of 18, 3 years minimum experience in the construction project management field in Nigeria, and having knowledge regarding construction technology, also helped to improve the credibility of the study (Merriam & Tisdell, 2015; Yin, 2017). Also, cross case synthesis used to identify and pinpoint similarities, differences, and redundancies helped in ensuring rigor and further strengthens the study's credibility. Finally, the credibility of the findings of this study was further strengthened through the use of Skype interviews triangulated with records of nonverbal cues, reflective field notes, and archival data.

Transferability

In qualitative study, transferability is used to explain the degree to which a research can be transferred or replicated to other contexts (Korstjens & Moser, 2018; Yin, 2017) and as such, the researcher is expected to provide evidence that makes the study replicable for those seeking to replicate the study using a different context. In achieving transferability, first, I detailed a thick description of the context, the setting, and method adopted for the research in the research design to help any researcher seeking to replicate this study within a different context in the future to make reasonable judgment that will aid and ease the transferability (Morse, 2015). Second, the interview questions were generated from the literature on the two conceptual frameworks that undergirded the study and were arrived at while having in mind the necessity for a high probability of transferability. Finally, the use of LinkedIn professional platform to recruit participants

for the study and Skype for the participants' interview for this study provided sustained unbiased atmosphere (Yin, 2017), allowed ease of access to distant prospective participants (Seitz, 2016), and aided the replication process (Janghorban, Roudsari, & Taghipour, 2014).

Dependability

In qualitative research, dependability is the consistency and repeatability of research findings over time by other researchers and is often considered a measure of the standard with which the study is administered, scrutinized, and presented ((Billups, 2014; Korstjens & Moser, 2018; Yin, 2017). First, I adopted audit inquiry and documented a detailed and comprehensive account of the research process from data collection to the research findings, which eased the study replication, thereby aiding the dependability of the study. Second, having verified and ascertained that the transcripts produced from the digital recorder were an accurate representation of the participants' responses during the interview through multiple and repeated listening to the audio transcripts and participants' validation of responses and before coding commenced, I carefully documented the semistructured interview questions (Appendix B, Interview Protocol) from which the responses were generated alongside other multiple sources used to triangulate themes.

Third, reiterating participants' inclusion criteria in the recruitment letter (Appendix A) and further confirmation at the beginning of the interview from participants gave credence to the dependability of the findings. Fourth, the successful field testing of the interview protocol used in generating the interview transcribed data

for proper alignment with the purpose of the study and the central research question by two subject matter experts (SMEs): Prof. Nicholas Harkiolakis, an SME in the fields of technology adoption and project management and currently on the faculty at New England College in Henniker, New Hampshire, USA and at Ecole des Ponts Business School in Paris, France; and Dr. Darren Allen, Senior Project Manager in the construction industry based in both the United Arab Emirates and the United Kingdom and an SME in construction project management for developing economies also enhanced the study's dependability (Barusch, Gringeri & George, 2011).

Confirmability

In qualitative research, the researcher uses tests of confirmability to verify that the research findings are derived solely from the participants' narratives and other sources of data (Stake, 2013). The intent of a confirmability test is to understand at what point, if at all, a researcher's bias could creep into the study and to what extent it could have motivated the findings (Ravintch & Carl, 2016). Scholars believed that both dependability and confirmability can be achieved at the same time using the same method and approach (Gibson, Benson, & Brand, 2013; Houghton et al., 2013; Walker, 2012).

First, in ensuring confirmability, I deployed design instruments that I did not manipulate tby being consciously aware of my positionality as an instrument of the research. Second, Dr. Janet Durgin being the methodology expert of my dissertation committee and serving as the external auditor for my study audited the study process to ensure alignment between the collected data, data analysis, research findings, interpretation, and recommendation. Finally, the use of reflective field notes throughout

the study through which I recorded and reviewed my observations and interpretations to eliminate researcher's bias helped in upholding the study's confirmability (Morse, 2015).

Study Results

In this single case study with embedded units research, a specific purpose and research question guided the study (Yin, 2017). Meeting the purpose of this exploratory study may address the literature gap on why construction project managers in Nigeria remain slow to adopt new technologies for improving decision-making processes and project success rates (Afolabi, Ojelabi, et al., 2018; Hamma-Adama et al., 2018). I was able to answer the following central research question: How do construction project managers in Nigeria describe their barriers to technology adoption? by interviewing construction project managers in Nigeria regarding their perception of the barriers to technology adoption,

This case study revealed Nigerian construction project managers 'perception on this topic, and patterns and themes developed from the raw data collected from the interviews and subsequent data analysis. The identification of these patterns and themes took place through thematic analysis of the textual data. The process involved comparing various themes that emerged from the analysis of the data generated through multiple sources (interview, field notes, and archival data) and comparing the findings with the theoretical proposition generated from the literature review.

Yin (2017) noted that the strength of a case study findings rests in its ability to be generalized to the theoretical propositions established from the literature. To this end, and given that this study was framed by two conceptual models, Usman and Said's (2014)

model of factors contributing to ICT adoption in Nigerian construction firms and Waziri et al.'s (2017) model of factors influencing IT adoption in Nigerian construction organizations, the alignment of these conceptual frameworks to the overall findings was essential in interpreting the results to arrive at a deep understating of how construction project managers in the Nigerian construction industry described their barriers to technology adoption.

Also, comparing the findings with findings from similar studies helped me in validating the findings of the study. Discrepant cases are data that are out of congruence with the pattern or explanation that are emerging from the data analysis (Walsh, Holton, Bailyn, Fernandez, Levina, & Glaser, 2015). Analyzing, interpreting, and reporting discrepant cases is necessary as it may help the researcher broaden, revise, or confirm the patterns emerging from the data analysis and further enhance the study's credibility. Reporting the case study is the final step of a case study research (Yin, 2017). I reported the outcome of the case study by using thick descriptive narratives and presented to my research audience a holistic picture of barriers that confront construction project managers in the Nigerian construction industry towards adopting technology. No discrepant data were significant or reached data saturation in order to influence the study findings.

The data analysis reflected all of the data collected and comprised interviews, field notes, member-checked transcriptions, and findings presented in the seminal literature (Yin, 2017). I used a thematic analysis recommended by Yin (2017) to categorize data from my qualitative research, in order to gain a deeper understanding of

the study participants' views, behaviors, or qualities in a natural setting to answer the central research question (Yin, 2017). Because there is no one procedure in the literature on how to develop a rigorous and relevant thematic analysis, the discussion of a thematic analysis should provide a logical, coherent, concise, non-repetitive, and unassuming account of the data within the identified themes (Boyatzis, 1998; Yin, 2017). Data analysis of case study data needs to be approached with rigor when applying any of the five analytical techniques—pattern matching, explanation building, time series analysis, logic models, and cross case synthesis—for case study research (Yin, 2017). In this study, I applied rigor and adopted pattern matching logic that addressed the "how" of my case study research question. Pattern matching occurs when the predicted pattern is compared with the empirical pattern. I predicted the findings of the study through deduction of key propositions that emerged from the literature review and my knowledge of technology adoption in the course of reviewing the literature. The empirically based pattern is the pattern of the findings revealed from the result of data analysis.

In the remainder of this section, the 14 themes that emerged from the thematic analysis are defined through a summative statement delineated from the participants' responses to the interview questions. To support the summative statement on each theme, I include representative direct quotes from the participants that defined the complex views grounding each theme. The themes were relevant to the purpose of the study and directly relate to the research question. Table 2 shows the relationship between the participants' responses and the emergent coded themes.

All the responses listed below under each theme are a direct quote from the participants' perspective to provide contextual, detail-rich data and enhance confirmability. Each of the interview responses was carefully analyzed with self-reflection represented through my reflective journal notes while out in the field during data collection. During the data analysis process, the process of turning written data into findings and conclusions, I used triangulation of findings to ensure that the results emerged from participant-driven experiences and not my own predisposition.

Themes From the Thematic Analysis

Policy. This term refers to a blueprint or set of basic principles adopted by an organization to guide and limit the action of the organization in its pursuit of a long-term objective. The absence of enabling government policies and functioning regulatory agencies remains one of the major issues affecting IT adoption among construction firms in Nigeria (Ogunde et al., 2017). The study participants eluded to inconsistency in the area of policy formulation and implementation which affect construction entrepreneurs working financially hard to survive in the Nigerian business terrain. According to participants, existing government policies detract IT adoption among construction firms to take full advantage of cutting edge and disruptive technology (Abubakar, Ibrahim, Kado, & Bala, 2014). The unique nature of the Nigerian construction industry with respect to IT adoption requires industry-specific policy and regulation. Participant responses include:

Participant 3: "I think the only need of the government, or the only thing we always look for from the government is right policy direction. That's all everybody is

looking for. Policy direction in the economy, in the construction, in the manufacturing, everybody is looking for the right policy direction. Because a good policy direction will actually boost that sector, a wrong policy direction with actually break that sector down. There is little or no policy direction in the construction industry".

Participant 7: "So, I think government needs to lead or set the parameter so that people can key into things. If not, people will not commit to buying software for better project delivery".

Participant 10: "Most of this technology are not produced in our country, we import them. One of the barriers is government policy on custom fees and the cost of clearing at the port of entry. The fees and clearing cost are higher in Nigeria and is not encouraging adoption of new technology for the efficient delivery of construction projects".

Costs. This term refers to the price that an organization has to pay to acquire new technology adoption. It is a combination of both direct and indirect cost associated with the acquisition of new technology that the organization must bear towards technology adoption. The participants' perceptions are that cost is a barrier and plays a significant role in technology adoption among project managers in the Nigerian construction industry. According to the participants, the kind of technology to be adopted is a function of the many cost elements involved in the adoption and the expectation of the adopters in terms of the value and financial returns that will come forth after the technology has been adopted and put to use (Sepasgozar & Davis, 2018). These are the participants' responses that addressed cost in technology adoption.

Participant 6: “You know it takes costs to acquire new technology, so costs to some extent is a barrier, but at the same time such cost must give value for money at the end. If the initial capital can be laid, you know, to get the new technology, eventually value would be experienced via efficient delivery of project with respect to time, cost, and quality. What I mean is that for now we are getting the expected results. Even though it's not a perfect kind of technology. And if we now get a new technology, and vis-a-vis the performances of the technologies and their costs, so that will now inform us on what to go for in the nearest future. We need a better technology but at reduced costs with higher value”.

Participant 7: “Costs play an important role in deploying technology within the organization, because from costs for training staff, costs for procurement of software, costs for infrastructure, deployment and costs for deployment itself. Creating the infrastructure and deploying the infrastructure, all these are elements of cost. So, cost is highly significant in ensuring that technology is really deployed within the organization, so cost is an important element”.

Participant 10: “Costs play a vital role on the technology that is provided. It reflects on the cost of the construction; it increases the cost of the construction charged to the clients. Also, cost makes us to acquire technology that is within our capacity and as time goes and as company progresses, we acquire more”.

Commitment to change. This term refers to a mindset that individually and collectively binds everyone involved in a change effort to accept, embrace, and be devoted to a course of action deemed necessary to effect the change initiative

successfully. The absence of commitment to change towards technology adoption by members of the organization affects technology adoption, and it is important that for technology adoption to be successful, every stakeholder that matters in the organization must buy into its adoption (Ojelabi, Afolabi, Oyeyipo, Tunji-Olayeni, & Adewale (2018). Participants' perception reiterated that showing awareness of new technology and the readiness to adopt new technology is not enough unless the organization and its people are genuinely committed to the adoption. The current level of commitment to technology adoption is low and not encouraging, and there is need to make people understand the usefulness of the technology. According to the participants, organizational commitment to change influences how members of the organization will understand the usefulness of the technology vis a viz its adoption (Wahab, Umar, & Shamsuddin, 2015). Participants responses on commitment to change include:

Participant 2: "I have made mentioned of something like this before and that is our tradition and culture. We don't want to change; we are too rigid. Even no matter how educated we are, all the traditions and customs affect our approach towards adoption of modern technology. They know they can work but they don't want to put it to work, because they don't want to take risk. These are the factors".

Participant 3: "And again, I have seen also where a company is willing to invest in technology, but the people are not willing to accept that they change. So, I think also I will come to you from a point of view that there wasn't more information on why the technologies is an improvement to what they have been doing. Do you understand? People need to know, why do you think your new system will improve my job? I've been

on this job for 25 years. I've never had an issue using this technology or using this strategy. Why do you want to suddenly change the strategy and how do you think this will make me work more better? They need to know the benefit of using it before they can actually accept it. They need to know how it will specifically impact their job".

Company culture. This term refers to the overall value and behavior that characterized a company regarding its unique social and psychological environment. It is the sum of all attitudes, beliefs, customs, and written and unwritten rules that have been shared and developed over time and are valid for the organization (Phua, 2018). The slow adoption of technology in the Nigerian construction industry has become a practice posing difficulties in changing this traditional culture to collaborative culture of technology adoption and in maintaining a work attitude of continuous improvement (Mackhaphonh & Guangshe, 2017). The participants noted that a culture of slow adoption of new technology among project managers in the Nigerian construction industry has become ingrained in the traditional project management philosophy, thus a good culture of technology adoption is something that is still alien to project management practices in the Nigerian construction industry; hence company culture is a major barrier that is critical for a deep understanding during the technology adoption decision-making process.

Participant 1: "Go on the streets, there are streetlights and the streetlights say stop and you ignore it. You understand, it has to do with culture, attitude of the people and I believe it has to do with how educationally advance and how they understand the need for the technology".

Participant 3: “The truth is, you can't give what you don't have. That is just the real deal about life. We belong to a place where people believe that if we've done it this way for 10 years and it’s been working for us why do you want us to practically switch the way we do things? We've been doing it this way so let's continue doing it this way. Well I think I won't look at it from ethnicity point of view directly because I see no direct correlation between ethnicity and technology. I'll look at it from educational background, I'll look at it from company culture. Those will have an influence on how you accept technology as a person, as a project manager”.

Ethnic culture. This term refers to the culture of a people in a given geopolitical zone with regard to their heritage, religion, and custom which determines their attitude towards the adoption of new technology. Research recently showed that pattern of technology adoption varies across cultural dissimilarities (Beretta, Fontana, Guerzoni & Jordan, 2018). The participants for this study recognized and agreed that technology adoption varies across geopolitical zones in Nigeria. Although some ethnic culture is receptive to the adoption and acquisition of new technology, some culture is averse to its adoption.

Participant 4: “This is major, like we have contemporary architecture, we have our local architecture. You understand, so, if you're bringing in contemporary architecture, some ethnic culture may not accept it. So, it will take to educate the indigenes about what they will gain. I could remember one time, while I was doing one project in Jan Lingo, Taraba state, there was no network in the place. When the network provider enter the place and they want to provide a network to the community, the

kinsmen summoned the network provider and cautioned him not to install the network and said we are not against this thing you are bringing but we are looking at our culture. Our children are very obedient. Our children are very respectful. But if you install this technology, it may sway our children into fornication, lies, stealing and the rest of that. So, there is a contradiction. They don't want to receive it. It takes the network provider to educate the people, to say, okay, this is what you will gain. So majorly, if you are bringing in new technology, some culture and ethnics may counter it, based on their own personal opinions. East also has some element of ethnic culture with respect to technology. Southwest is ready to accept any technology. Thus, across the geo-political zone liker North and southeast and South-South out there is difficulty in trading off ethnic belief and cultural belief to the technology you are bringing in".

Participant 5: "Our cultural belief as well. Cultural belief is also a factor because they're some tribes that they will tell you, "All these things that they're doing on the internet is rubbish." They don't believe internet, sorry, technology has gone a long way in making things so easier. Some tribes don't believe. They still believe in doing things in the manual. This cultural and religious belief sometimes affects teleconferencing as a way of collaborating with project team. It's something I've experienced very well".

Overall, participants' perception regarding culture is that while company culture has a direct link with technology adoption, ethnic culture indirectly influences technology adoption through educational exposure of the ethnic community.

Below industry standards. This term refers to a state of organizational performance regarding technology adoption that is considered to have fallen short of the

minimum requirement generally acceptable to the construction industry. Technology drives project management maturity, and in the Nigerian construction industry the project management maturity is very low (Pawar, Deshmukh, & Chavan, 2016) due to low level of technology adoption. Generally, the slow technology adoption history in the Nigerian construction industry accounts why many scholarly studies regarded the construction industry's failure to keep pace with ICT advancement as a major problem affecting its performance (Amusan et al., 2018; Ikediashi & Ogwueleka, 2016; Oyewobi, Ibironke, & Oladosu, 2015). The participants in this study noted the adoption of sub-standard technology in project management practices and its resulting effect on organizational performance:

Participant 4: "Owing to the complexity of the technology, what they put in place is not to the standard but at least it makes us compete favorably to achieve at least average result".

Participant 9: "What they have made available is not up to the standard, it's below standard of what they're supposed to make available. For example, the availability of up to date project management software and equipment technology for efficient work is not there".

Influenced by low technology adoption. This term refers to the influence low adoption of technology has on organizational performance. The aim of technology adoption is to drive improved project performance. As organizations in the Nigerian construction industry adopt new and cutting-edge technology so does the construction industry project management maturity which in turn improves project performance

(Aigbavboa, Oke, & Mojele, 2016; Sabiu & Agarwal, 2016; Katane & Dube, 2017) The findings of a recent study show that technology adoption and acquisition have a significant positive influence on organizational innovation which in turn positively impact organizational performance (Sirisomboonsuk, Gu, Cao & Burns, 2018). Low adoption of technology negatively affects organizational performance as noted by the following participants:

Participant 1: "So, at times we see the management were forced to pending or delay the renewal, and thus automatically translate into slowing down the pace of work that is being undertaken".

Participant 3: "And what software did you apply to each of those project constraints priority to your project. How successful were they? Did they fail did they succeed? So, if you match the software you have used in a particular system to the project you've actually implemented in the particular timeframe, you should be able to know which was successful, which was not successful. I think the success rate of the project will tell you the success rate of the software. Which is knowledge of previous performance and lessons learned kind of a thing. If you attend conferences and seminars and hear presentations on the new technologies in the market, you find yourselves so surprised that you have not actually heard of them or actually have an idea what that is. So, we are still kind of backward. I think we should have been doing better by now in terms of adopting technologies".

Lack of younger, tech-savvy professionals. This term refers to the absence of young project managers that are proficient in the use and application of technology-based

solutions to project management practices. A recent theoretical model of technology acceptance noted that the adoption rates of older adults is lower compared to the younger adult (Mitzner, Savla, Boot, Sharit, Charness, Czaja, & Rogers, 2018). Generally, the overall perception of the participants connotes that the technology adoption propensity of organizations is more likely to vary according to the composition of the generational age group of project management professional individuals in the organization as noted below:

Participant 1: “Well, let me look at this from this angle. You know that when you are young, there is that youthful exuberance. And then even the mental capacity as to how you absorb new technology is faster than when you're in advanced state. At that advanced state. There are a lot of factors for which at that point the person plays more of a managerial role and not more of the actual use of this technology”.

Participant 7: “If I take it from the internal, there are staff that are savvy when it comes to using modeling or 3D expressions and 3D image to express the views of things. It is not an organization-wide thing, do you understand? We have individuals that are savvy in that line and some are not savvy in that line. So, it's giving a competitive edge amongst staff. You can see where government too will be challenged. Because government need to train its staff to be that savvy before they can now vet whatever the practitioners are submitting for approval. If government can start from that level alone, it will compel a shift”.

Lack of adequate financial investment. This term refers to the inability of construction organizations to engage in the act of planning, committing, and investing a dedicated capital into technology adoption endeavor with the expectation of driving the

growth of the business through innovative technology. The cost of technology adoption is huge so is the financial investment. The Nigerian construction industry is faced with challenges that render financing investment into technology adoption difficult due to the constraints posed by high cost of sourcing fund for financing technology investment (Aduwo, Ibem, Uwakonye, Tunji-Olayeni, & Ayo-Vaughan, 2016; Awosan, 2014; Sepasgozar & Davis, 2018;) and dysfunctional financial regulatory environment (Abubakar, Ibrahim, Kado, & Bala, 2014; Ogunde, Olaolu, Afolabi, Owolabi, & Ojelabi, 2017). The following participants explained their perceptions regarding lack of adequate financial investment to procure innovative technology in the Nigerian construction industry as follows:

Participant 3: "We can't say it is helping us in terms of tracking our costs and maybe that is the reason they have not really invested so much money into buying the software. But if they should invest money in buying the software, they would be able to make much, much profit at the end of the project. So, cost limit the technology my company can make available for our usage on projects. It scares the company. Like I think that, for instance there was a software I saw for two thousand pounds for you to actually buy the software, but you will be paying an annual subscription of I think, maybe another 200 pounds or thereabout. So, the cost of purchases, the cost of licenses, the cost of system upgrade and the cost of training. So, if we put that four concepts together it is something that makes it quite difficult for project managers or project owners, or company owners to consider such investment".

Participant 7: “So financial capability is a major barrier in adopting this new thing in Nigeria. Because I told you a little while ago that I was at a seminar where the auto desk vendor said a single user is almost one million naira while a multiple user that is cloud based is about almost three million naira. And you have to pay it annually. So, paying for technology, paying to get yourself to that level so that you can practice internationally, is so much expensive to us in Nigeria. And that is one of the major, major barriers. It's even a major barrier. It's a major barrier. In Nigeria you ask a contractor I want to give you an advance payment of ten billion Naira go and bring a bank bond of ten billion, bringing a bank bond of ten billion demands that you have to keep ten billion collateral with the banks. But the Nigerian contractors don’t have ten billion because they can't raise such money”.

Lack of appropriate technology training. This term refers to the inability of construction companies in the Nigerian construction industry to create and establish internal and external platforms through which project managers undergo training to update their skills in the awareness and use of new technology for project management applications and practices. The implementation phase of the adoption decision process involves delivery of the adopted technology, training, commencement of operation, maintenance set up, and feedback mechanism. The kind of support the adopting construction organization receives from the vendor is crucial to the effective and efficient use of the technology (Sepasgozar & Davis, 2018). However, the Nigerian construction industry is lacking in the areas of expert personnel needed to engage the users in the training and education necessary to acquire the skill to use the technology expertly which

is resulting in technical skill deficiency (Ebong, Udoh, & Obafemi, 2014; Muhammed, Zaharaddeen, & Turaki, 2015). The participants' perception regarding lack of appropriate technology training is reflected as follows:

Participant 3: "We need people with innovative and creative ideas to think through how to efficiently use some of these systems. Most companies have a good system in place but there are no creative ideas on how of maximize the benefits of those systems. So, we just need people to sit down and think on how best to maximize the benefit of a system they have in place".

Participant 4: "The main barrier here is education, training and retraining. Most times we want it, but no one to train, we want it urgently, you just get information about it, you want to start it, you have not trained about it, you have no knowledge about what you even want to do. And the staffs are not being equipped with more knowledge about the innovation or the technology. I think that is the major barrier, training".

Low access to latest technology due to government policy. This refers to government related policy factors that create an environment inhibiting or limiting direct access to the acquisition and use of technology by project managers in the Nigerian construction industry. The government across all levels does not have in place enabling policies and functioning regulatory agencies directly responsible for technology adoption which has become one of the major barriers affecting access to technology adoption (Ogunde, Olaolu, Afolabi, Owolabi, & Ojelabi, 2017) as noted by the participants:

Participant 2: “Also, government policy is affecting the technology we can adopt. Not that we don’t know the right thing, but it is very difficult to do the right thing”.

Participant 4: “A secondary barrier is accessibility. How do you access this tech, you are aware of, like I told you government policy sometime regulates what can be imported, so you have to find out how does the government allow it? How do you go about it? I think all those things must be put into consideration and thereby, it makes the accessibility sometimes very difficult. You cannot assess it. You are aware, you have gotten information, you are ready for it, but you cannot assess it. Apart from government policy availability is also another factor. For example, maybe at the time of getting to know about the new technology, it may not be available to reach out to all constructional companies going after it. Again transportation barrier in a sense can also be a factor for you to clear it from the port of entry due to government policy in terms of permit and custom control may sometimes takes another many years to clear, and I think another one is the cost efficiency. Do you have enough fund? You may not have enough fund to assess this technology”.

Communication system issues. This refers to channels of communication and factors limiting timely and appropriate dissemination of information on emerging technology and trends among project managers and other stakeholders. Communication is one of the key knowledge modules in project management practices (PMI, 2017), hence the complex communication structure associated with construction projects requires adoption of technology to integrate and manage projects efficiently (Adwan &

Al-Soufi, 2018; Mikalef, Pappas, Krogstie, & Giannakos, 2018). The channel through which technology information is communicated predicts its adoption (Rogers, 2003, p. 2006); however, the participants noted that an effective communication system for interorganizational collaboration on technology adoption has not yet been standardized among members of organizations in the Nigerian construction industry (García-Sánchez, García-Morales, & Martín-Rojas, 2018):

Participant 3: "I will just put that one into communication system integration. There is this fragmented way of working in my company which I think is not good for any project manager to have in regards of what is happening on the project".

Participant 4: "The second barrier is lack of information system. How does the information circulate? How the information of new technology, the circulation of the information, like I told you, I said in my organization what the company owner does is to put more fund into the information system, so that you have to even know, this is what is now trending. This is what is in vogue, so that you can now adopt it. So majorly the information system, it's not given the right attention until it come too close to your doorstep, and you think you are getting out of the system. That is where you now begin to run around, running around to get information".

Team collaboration emerges with technology adoption. This refers to the emergence of teamwork, creative thinking and collective participation approach towards the achievement of project objectives facilitated by the adoption of technology by all project team members. Technology adoption initiates and promotes collaborative behavior among individuals embedded in team settings with interdependent roles

(Maruping & Magni, 2015; Maruping, Bala, Venkatesh & Brown, 2017). The industry still lacks adoption of necessary technology platforms that promote teamwork collaboration and management of information necessary to support project efficiently from conception to completion and throughout the life cycle of projects (Onungwa & Uduma-Olugu, 2017) as expressed by the following participants:

Participant 3: "And in terms of the project all of us will work towards the same goal. And have area of interface where we can collaborate to make things work. But at the end of the day we will know that these are very different roles. So, I like it when I see a company that has a project manager. Then they have a project director, they have a commercial director, then commercial manager, then they have account director and account manager. They have a procurement director and a procurement manager. So, you know that the account manager is reporting to the account director. And the project manager is reporting to the project director. So, you don't switch some of these roles and try to go into another person's area of expertise. If you are project manager, be into scope management, the project itself. Look at the work breakdown structure of your project and be able to manage your resources very well. The human, the time and every other resource to make sure the project is successful. They would put up a list illustrating the tasks to be done by the site team manually on the paper. Then it got to a point where mobile technology and project management software were introduced to allow us to do those things efficiently. Adopting those technologies makes life much easier, the project team becomes less fragmented and gives one access to real time project data. But I tell

you that in the company that I worked with in the past few years we are still into manual way of drawing project outlines".

Participant 5: "It's good to have technology based project management system in construction industry because as a project manager, we collaborate with all project team members and when we introduce a particular technology to them, and they can easily invent it into their own system or instill rather into their work culture it, there is tendency for Nigeria to compete with the advanced construction companies of the world".

Empower project managers to lead. This refers to the emergence of a project management environment among team members that permits genuine and professional project management practices on projects in which project managers can act and exercise their authority as project managers unencumbered. A project manager is the leader of the project team (Harrison & Lock, 2017) and consequently has a critical role to play not only as an initiator of the technology adoption decision process (Sepasgozar & Davis, 2018). The Nigerian construction industry operates a traditional project management structure that gives power to the architect being the first point of contact by the client to act and perform the role of project managers even when they are not qualified for such (Igwe & Ude, 2018). As noted by the participants, the role, power, and authority of project managers are yet to be properly delineated within the context of project management practices in the Nigerian construction industry.

Participant 3: "Another thing I realized again about the company I worked for, is that the actual definition of project management was not what the project managers were doing. They were like executive managers of the company not project managers.

Because, they did more of the administrative services than project management services. So, we have someone that is supposed to be purely doing administrative work but taking up the responsibility of the project manager".

Participant 5: "Often, it's beyond the scope of a project manager working on site as a project manager and as a coordinator on site at the same time".

Summary

In this chapter, I presented the result of the thematic analysis of 10 participants, followed by the synthesis of the results to answer this study's central research question: How do construction project managers in Nigeria describe their barrier to technology adoption? A total of five conceptual categories comprising of 14 themes emerged from the findings of this single case study with embedded unit after the study is grounded in the two conceptual models: Usman and Said's (2014) model of factors contributing to ICT adoption in Nigerian construction firms and Waziri et al.'s (2017) model of factors influencing IT adoption in Nigerian construction organization. These provided rich data on the experiences of participants. The five codes that emerged are (a) adoption of technology, (b) culture, (c) organizational performance, (d) innovative technology, and (e) interorganizational collaborations. The 14 themes that emerged from the data analysis process include (a) policy, (b) costs, (c) commitment to change, (d) company culture, (e) ethnic culture, (f) below industry standards, (g) influenced by low technology adoption, (h) lack of younger, tech-savvy professionals, (i) lack of adequate financial investment, (j) lack of appropriate technology training, (k) low access to latest technology due to

government policy, (l) communication system issues, (m) team collaboration emerges with technology adoption, and (n) empower project managers to lead.

I evidenced the trustworthiness of the study using methods established by seminal methodology scholars (Stake, 2013; Yin, 2017). The results of the single case study were comprehensively analyzed and interpreted within the context of Usman and Said's (2014), and Waziri et al.'s (2017)'s conceptual framework to describe how construction project managers in Nigeria perceived their barriers to technology adoption. In Chapter 5, I present the interpretation of the findings, describe the limitation of the study, and recommend areas for future research. Finally, I discuss the implication of the findings to social change, theory, practice, and provide a conclusion.

Chapter 5: Discussion, Conclusions, and Recommendations

The purpose of this qualitative single case study was to understand the perceptions of 10 construction project managers in Nigeria regarding their barriers to technology adoption. I used a single case study with embedded units research design to meet the purpose of the study. Three sources of data were used throughout this study: (a) a semistructured interview protocol, (b) archival data in the form of government reports (Yin, 2017), and (c) reflective field notes (Merriam & Tisdell, 2015), which I kept throughout the entire data collection process.

A qualitative case study approach allowed me to give voice to the study participants to express their perceptions regarding barriers to technology adoption within the Nigerian construction industry. This study was framed by two conceptual models: Usman and Said's (2014) model of factors contributing to ICT adoption in Nigerian construction firms and Waziri et al.'s (2017) model of factors influencing IT adoption in Nigerian construction organizations. Usman and Said (2014) developed a conceptual model that captures those attributes that contribute to slow technology adoption in Nigerian construction firms. Waziri et al. developed the model of factors influencing IT adoption in Nigerian construction organizations by extending Usman and Said's conceptual model using the initial assumption that innovative technology is primarily driven by an effective communication system among the members of organizations as well as interorganizational collaborations (García-Sánchez et al., 2018).

Thematic analysis of data from face-to-face interviews with 10 participants revealed 14 themes: (a) policy, (b) costs, (c) commitment to change, (d) company culture,

(e) ethnic culture, (f) below industry standards, (g) influenced by low technology adoption, (h) lack of younger, tech-savvy professionals, (i) lack of adequate financial investment, (j) lack of appropriate technology training, (k) low access to latest technology due to government policy, (l) communication system issues, (m) team collaboration emerges with technology adoption, and (n) empower project managers to lead.

Interpretation of Findings

The findings of this single case study with embedded units confirm or extend current knowledge in the discipline, with each case presenting examples of issues discussed in the literature review in Chapter 2. In this section, I present and review the study's findings in the context of the coding categories that emerged from the data analysis. I compare each of these five categories with relevant concepts from the conceptual framework and the extant literature presented in Chapter 2. I provide evidence from the 10 semistructured interviews to support how the study's findings either confirm or disconfirm existing knowledge or even extend it. Extension studies, such as this single case study with embedded units, not only provide replication evidence, but also support extending prior research results by offering new and important theoretical directions (Bonett, 2012).

Findings and Coding Categories

Adoption of technology. The adoption of technology concept deals with the understanding of the influencing factors in the decision-making process that lead to the adoption or rejection of the technology (Muhammad et al., 2018; Sepasgozar & Davis, 2018). In their conceptual framework of factors contributing to ICT adoption in Nigerian

construction firms, Usman and Said (2014) noted that the slow adoption of technology in Nigerian construction firms is greatly influenced by the interacting causal factors of culture, policy, and cost in the Nigerian construction industry. The findings of my study show that adoption of technology is influenced by policy, cost, and commitment to change. This not only confirmed Usman and Said's findings, but also extended their findings. To date, the concept of commitment to change has seemed to be alien to the extant literature on technology adoption. What has been known in the literature on technology adoption is resistance to change and what a prospective technology-adopting organization could do to deal with the resistance to make members in the organization accept the change (Waziri et al., 2017). In Usman and Said's conceptual model, cost is mentioned as the third factor influencing adoption of technology, and this seems to be consistent with the earlier findings that cost is often not the most important factor influencing the technology adoption decision (Shaikh & Karjaluoto, 2015, Sepasgozar & Davis, 2018). However, in this study, Participants 3 and 4 considered cost not just one of the major determining factors influencing adoption of technology in the Nigerian construction industry within the context of its domestic economies, but also saw cost as limiting the kind of technology that firms in the Nigerian construction industry can provide for their project managers.

Culture. The concept of culture refers to the expression of value and behavior that organizations attach to technology adoption, and it is the first key variable influencing organizations' decisions to adopt technology (Usman & Said, 2014). It is about how organizations treat technology adoption practice. While Usman and Said

(2014) conceptualized culture from an organizational and national perspective, Waziri et al. (2017) conceptualized culture with an organizational context only. My findings were not only consistent with the findings of Usman and Said and Waziri et al. regarding the influencing factor of organizational culture on technology adoption decisions, but also extended the literature regarding the influencing factor of ethnic culture. The responses of Participants 4 and 5 show that ethnic culture limits the extent to which freedom can apply technology in some ethnic areas (Lachman, Lachman, & Butterfield, 2015).

Organizational performance. Waziri et al. (2017) developed a model of factors influencing IT adoption in Nigerian construction organizations by extending Usman and Said's (2014) conceptual model using the initial assumption that innovative technology has been a driving force behind organizational performance. Literature also shows that the slow adoption of technology or avoidance of technology has resulted in inadequate automated evaluation and monitoring of construction project performance (Afolabi, Amusan, et al., 2018; Amusan et al., 2018), while adoption of up-to-date technology has significantly contributed to improved project performance and organizational performance (Aigbavboa, Oke, & Mojele, 2016; Sabiu & Agarwal, 2016). My findings not only confirmed previous findings that technology adoption drives organizational performance, but also extended the extant literature indicating that the influencing factor of technology adoption on poor organizational performance in the Nigerian construction industry is mediated by three factors: below industry standards, low technology adoption, and lack of younger, tech-savvy professionals.

Innovative technology. Usman and Said's (2014) conceptual model was grounded on Rogers's (1995) innovation diffusion theory. Innovative technology is a concept that deals with constantly evolving cutting-edge technology. Recent findings show that the adoption of innovative technology is still in its infancy among project managers in the Nigerian construction industry due to investment-funding constraints (Sepasgozar & Davis, 2018; Shaikh & Karjaluoto, 2015), technical skill deficiency due to lack of qualified and globally recognized IT personnel (Muhammed, Zaharadden, & Turaki, 2015), and absence of enabling government policies and functioning regulatory government agencies (Ogunde, Olaolu, Afolabi, Owolabi, & Ojelabi, 2017). The findings from my study confirmed that the tendency of construction project managers in Nigeria to engage in the adoption of innovative technology is weakened by lack of adequate financial investment, lack of appropriate technology training, and low access to latest technology due to government policy.

Interorganizational collaborations. Interorganizational collaboration occurs when organizations collaborate using a common information and communication platform to support sharing of information among themselves. Previous findings show that interorganizational collaboration stimulates organizational performance through the adoption of innovative technology (García-Sánchez, García-Morales, & Martín-Rojas, 2018). The finding from my study confirmed and extended this finding that team collaboration among organizations emerges with the adoption of technology but is hindered by ineffective communication systems and lack of power required by project managers to lead construction teams effectively in Nigeria.

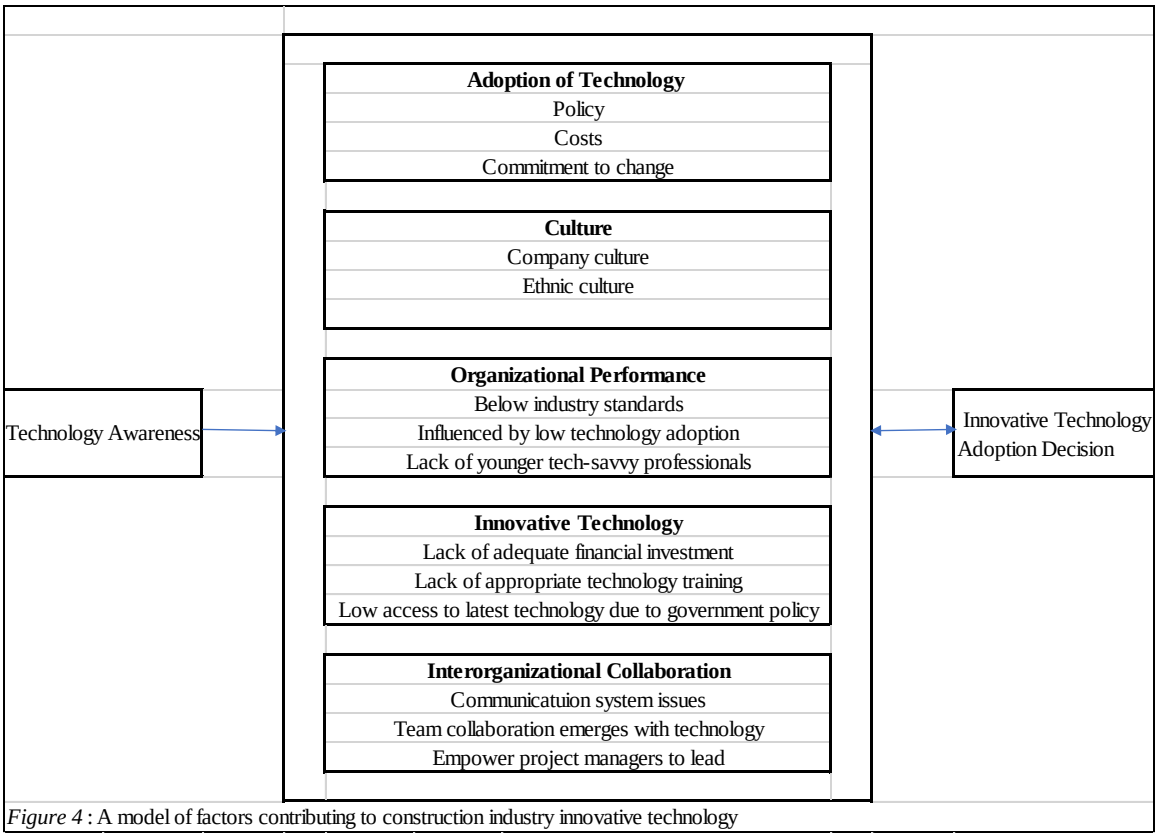

Figure 4. A model of factors contributing to construction industry innovative technology.

A model of factors contributing to construction industry innovative technology (CITA) shown above represents a model of innovative technology adoption in the Nigerian construction industry based on the conceptual categories and themes generated from this study. The model will help guides construction industry stakeholders in their technology adoption effort from technology awareness through technology readiness into innovative technology adoption decision for their project managers. The model also helps organization to be sensitive to the position they are in their technology adoption effort, the barriers confronting them and how can manage and mitigate the barriers.

Limitations of the Study

One limitation of this qualitative single case study was the unheard voice of some construction project managers who met the inclusion criteria but could not be considered for the interview due to the limited sample size required for qualitative studies. I mitigated this limitation by recruiting construction project managers with an active presence on LinkedIn professional platform. The use of criterion-based snowball sampling technique also offered opportunity for the construction project managers outside the LinkedIn platform to be recommended for invitation by participants recruited for the study. I scrutinized the consistency of the achieved information across other achieved sources in related sectors and industries. I mitigated tendency for poor quality interview response data through a careful appraisal of the inclusion criteria and recruited participants with wide range of experience as project managers, deep understanding of construction technology, and greater educational exposure.

The participants were provided with a privacy statement, which serve as a form of guarantee that enabled them to express their perception and experience about the interview questions unhindered. I adopted reflectivity throughout the study period which helped me in addressing potential bias before they occur. The use of prolonged contact combined with member checking enhanced the accuracy and credibility of the research, while triangulation of data helped to support the overall trustworthiness of the study. This study is limited to male construction project managers even though female construction project managers are in the industry; the only female participant recruited was not available for the interview.

Recommendations

Three years after Usman and Said (2014) wrote about the need for the Nigerian construction industry to adopt innovative technologies, the problem of low-level IT utilization in the Nigerian construction industry continues (Waziri, Mustapha, & Idris, 2017). The problem of low technology utilization in driving construction execution and delivery strategies in Nigeria continues until a proactive approach is applied that will radically and drastically address the barriers posed to technology adoption by policy, costs, change, culture, standard, training, finance, project manager's power factor, and other findings that emerged from this study. The uniqueness of the products, the multifaceted layers of construction trades and task activities involved, and the variability of expertise and technology required to effectively and efficiently deliver construction products (Fadun & Saka, 2018) ordinarily classify the industry as a high technology–high innovative industry (Aydalot & Keeble, 2018). The industry is classified as the least digitized sector globally with less than 1% spending on technology R&D (Agarwal, Chandrasekaran, & Sridhar, 2016; Gandhi, Khanna, & Ramaswamy, 2016). The low ratio of R&D spending to sale (Aydalot & Keeble, 2018) combined with the barriers identified from this study makes the industry worse off and far off from being truly classified as a high technology–high innovative industry.

The project management maturity level in the Nigerian construction industry is at basic project management practice, which is generally below the acceptable standard benchmark required to effectively deliver construction projects (Kerzner, 2018a; Pawar, Deshmukh, & Chavan, 2016). A major driver of project management maturity is

innovative technology (Katane & Dube, 2017). Hence, there is a great connection between technology, project management maturity, and project performance. From the findings of this study, there is strong evidence that this study deepened and broadened the technology adoption literature using qualitative approach than the works of previous researchers. Therefore, the Nigerian construction industry as it stands today requires innovative thinking through a careful combination of the concepts of adoption of technology, culture, organizational performance, innovative technology, and interorganizational collaboration derived as from this study to arrive at a construction innovative technology adoption (CITA) framework (Figure 4 above) and the influencing roles that policy, costs, change, culture, finance, training, communication system, team collaboration, power, and other themes identified in this study play in the framework.

Though a qualitative research is inherently limited in temporal precedence when establishing cause and effect (Yin, 2017), nevertheless, qualitative research helps maximize the discernment of how one factor indeed led to another in a study through the triangulation of multiple data to provide accurate insight into changing processes and minimize retrospection bias (Affleck, Zautra, Tennen, & Armeli, 1999). Qualitative research is generalizable to a theoretical proposition and not to sample size (Yin, 2017); considering the study's strengths and limitations, future researchers should focus on reproducing this study by making use of a quantitative research approach.

Methodological Recommendation 1: Quantitative Validation

Making use of quantitative research methodology, such as a survey to investigate technology adoption barriers among construction project managers in Nigeria may help

expose important views about the transferability of the study. Though participants in this study expressed views that are generally similar and diverse, a quantitative study involving a wider range of construction project managers in Nigeria across the nation geopolitical and ethnic zones may reveal other important aspects of my study with respect to their years of domestic and international exposure to project management practices.

Methodological Recommendation 2: Qualitative Replication

Most of the participants in this study are from the Southwest geo ethnic zone. I encourage the use of qualitative research methods in future studies that may help determine how the research findings may vary when conducted using participants from different geographic ethnic zones in Nigeria, such as the North and the East. A qualitative replication with a focus on participants from different geopolitical and ethnic groups may bring about more in-depth and valuable understanding of how the construction project managers from such zones will describe their barriers regarding technology adoption in Nigeria.

Recommendations for Future Research

In this study, future researchers can make use of quantitative research methodology to examine relationships and test theories using quantifiable data (Harkiolakis, 2017). There are potential areas in this study to which quantitative validation can be applied. For example, research is still lacking in understanding the nature of the relationship between technology adoption, project management maturity, and project performance. There is a need to examine this relationship quantitatively and

draw causation and causal inference concerning the variables in the relationship. Most often, a quantitative approach adoption to study investigation requires the use of a validated survey instrument for gathering quantitative data. Therefore, there is an urgent need to construct and test a new survey instrument based on the framework of construction industry innovative technology adoption (CITA) proposed in this study.

There are also potential areas for future research in which qualitative methodology can still be extended based on the literature reviewed in this study. The literature shows that construction industry spends less than 1% on technology R&D (Agarwal, Chandrasekaran, & Sridhar, 2016; Aydalot & Keeble, 2018). Research and development drive innovative thinking. Hence, there is an urgent need for qualitative researchers to investigate why and how construction companies are averse to research and development. Relying on Pew Research Center's (2019) generational age classification, 40% of my research population sample were Millennials, while 60% were Generation X age. One of the major characteristics common with the Millennials is the technology savviness behavior. There is a need to adopt qualitative methodology to investigate and focus mainly on the perception of Millennial construction project managers in Nigeria regarding their barriers to technology adoption.

Implications

Implications for Positive Social Change

This study addressed the under-researched area of technology adoption avoidance of construction project managers in Nigeria to mitigate the high failure rate and abandonment of public infrastructure projects in Nigeria (Akande et al., 2018; Afolabi,

Ojelabi, et al., 2018). The construction industry is the sector through which developing countries like Nigeria can accomplish their infrastructural growth and socioeconomic developments (Agyekum-Mensah & Knight, 2017). This study presented the perception of construction project managers in Nigeria regarding the barriers influencing their technology adoption avoidance behavior among construction project managers and recommendations for improving technology adoption behavior towards successful project delivery in the Nigerian construction industry.

Technology helps transform construction product and service delivery, and this positively affects social change (Andrés et al., 2016). Although Nigeria, just like other developing countries in Africa, is in the practice of keeping old ways of doing business firmly in place (Amavilal, 2016), this study challenged the status quo by unraveling the barriers confronting Nigerian construction project managers in their technology avoidance behavior. The findings from this study provide a platform for a deep understanding of the barriers which consequently spark a national discourse among policymakers and other stakeholders in the Nigerian construction industry on how to curtail these barriers to technology adoption thereby enhancing positive social change in the Nigerian public projects sector and the Nigerian society. Improving the success rate of public project delivery in Nigeria can affect social change by contributing positively to the nation's economic growth and development thereby improving the standard of living for Nigerians and Nigerian residents (Djukic et al., 2016). The tendency that the Nigerian government will begin to include professionals from specific sectors in policy decisions

that affect those industries makes the outlook for positive social change deemed hopeful (Afolabi, Ojelabi, et al., 2018).

Implication for Theory

The challenges of high failure rate and abandonment of public projects infrastructure accompanied with delay and budget overrun in the construction industry has always been a focus of attention by scholars and construction professionals over the years (Akande et al., 2018; Akhund, Imad, Memon, Siddiqui, Khoso, & Panhwar, 2018; O'Neill, 2019; Akande et al., 2018;). Attempts have been made by scholars to identify the influencing factors of technology adoption, but the absence of a study on construction project managers' technology avoidance behavior in Nigeria leaves a critical knowledge gap in literature (Akande, Olagunju, Aremu, & Ogundepo, 2018; Ozumba & Shakantu, 2018). This study provided a unique and holistic approach to the problem of technology adoption by exploring the perception of construction project managers on how they describe their barriers to technology adoption. The findings of my study unveiled the technology adoption practice of construction project managers in Nigeria and the challenges confronting them, thereby providing opportunities for theoretical application of these findings towards improving project success delivery. This study is significant to theory as it resulted in a construction industry innovative technology adoption (CITA) framework for guiding the decision-making process towards technology adoption.

Policy Implications

The adoption of a well-structured technology adoption practice in the Nigeria construction industry by all stakeholders can potentially bring about efficiency in the

construction process and improved project performance and delivery. The findings of this study will bring serious-minded construction policymakers in Nigeria to their feet in enacting and supervising the implementation of policies that effectively addressed the barriers confronting construction project managers in Nigeria towards technology adoption. Apart from policy re-enactment, the findings from this study have a greater tendency to lead into a re-engineering of public parastatals responsible for technology adoption in Nigeria for a better technology adoption practice and culture.

Implications for Practice

With the findings of this study, there is a greater tendency for all stakeholders in the Nigerian construction industry, now having a deep knowledge of the barriers and their influencing roles in technology adoption, to effectively establish intervention strategies to recover public projects that are already passing through this problem from failing. The findings from this study will not only positively affect construction industry alone, but may also positively affect the technology adoption practice of the private project sector and public–private project sector and other related industries, such as manufacturing, facing similar challenges The new knowledge that has emerged from this study will bring a new culture of technology-aided project management practice for effective planning and coordination of construction tasks for efficiency and the attainment of projects objectives.

Conclusions

Each of the participants in this qualitative single case study with embedded units effectively played a vital role in understanding the perceptions of construction project

managers in Nigeria regarding their barriers to technology adoption to help mitigate rising high rate of failed and abandoned public projects in Nigeria. The in-depth insight provided in the participants' responses to the semistructured interview questions led to the emergence of themes for answering the central research question. Improved technology adoption among construction project managers in Nigeria will usher in a new approach to construction project management practice towards effective project delivery in real time. The era of failed and abandoned projects that litter the public landscape with its attendant long-range financial, environmental, and socioeconomic implications will gradually disappear, and a new era of technologically supported project management practices for effective project delivery will emerge with the outlook for positive social change being deemed hopeful. The extended construction industry innovative technology adoption (CITA) framework that resulted from this study will undoubtedly aid and guide policymakers and stakeholders in the Nigerian construction industry in their decision-making efforts towards technology adoption.

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Appendix A: Recruitment Letter

Dear Potential Research Participant:

I am a doctoral student at Walden University currently undergoing a research and would like to invite you to participate as a PARTICIPANT in my dissertation research study on the experiences of project managers in the Nigerian construction industry regarding their barriers to technology adoption. The rate at which public projects fail and are abandoned in the Nigerian construction industry on a mass scale is worrisome and constitutes one of the impediments to growth within the Nigerian economy. Technology is available for the coordination of complex tasks and for evaluation and monitoring of construction projects for successful project delivery but many construction companies in Nigeria are failing to adapt and respond to the complexity of the new technology-led business environment and hence face survival problem.

However, project managers in the Nigerian construction industry being the project leaders and whose responsibility is to steer projects from inception to successful project delivery are still generally about five years behind in the adoption spectrum of new technology when compared to project managers in developed countries. The problem of poor coordination of construction tasks by Nigerian project managers leads to inefficient and inappropriate project management practices resulting in a low rate of project completion within the nation's construction sector. The goal of this study is to explore and gain a deeper understanding on why construction project managers in Nigeria remain slow to adopt new technologies for improving decision-making processes and project success rates. The loss due to project failure and abandonment has long-range economic,

social, and environmental implications and the loss of potential gain if the money wasted was invested efficiently into other areas of public life. When barriers to technology adoption are understood and curtailed, a new project management culture may begin to emerge among all stakeholders in the Nigerian construction industry that will help reduce the rate of project failure significantly and increases the chances of project success, thereby enhancing positive social change in the Nigerian public.

You are eligible to participate in this study if you are:

1) An adult over the age of 18 years

2) You have a 3 years' minimum experience in the construction project management field in Nigeria, and

3) You possess knowledge regarding construction technology

If your answer is YES to all the THREE criteria listed above, and you are interested in being a PARTICIPANT in the study, I invite you to VOLUNTARILY participate in this study. Your ROLE as a PARTICIPANT in this study is to describe and share your experience on each of the semi structured questions during a 40–60 minutes interview on Skype to be scheduled at your most convenient date and time and if possible, suggest referrals for other participants that you know meet the above criteria. If you would be interested in being a part of this study, please review and return the signed consent form which is attached to this email. Thank you sincerely,

Rasaq Olaniyan (RESEARCHER)

Appendix B: Interview Protocol

Barriers to Technology Adoption Among Construction Project Managers in Nigeria:

A Single Case Study

Date: _____

Introduction

To Interviewee:

"The interview is recorded on tape for the best possible data. Is this okay? I can turn off the tape recorder along the way if you wish."

"Have you read the information I sent in the e-mail? Have you signed the Informed Consent Form to participate in this study?"

"The title of this research project is: Barriers to Technology Adoption Among Construction Project Managers in Nigeria: A Single Case Study"

"Do you wish to ask any question regarding the study or this procedure before we proceed?"

Exploring Interviewee Perceptions on the Study Topic

To Interviewee:

"Although new technologies are available to improve project performance, scholars identify that many project managers in the Nigerian construction sector avoid their adoption. This technology adoption avoidance has resulted in continued inadequate automated evaluation and monitoring of construction project performance in the Nigerian construction industry. While the high rate of failed projects within the Nigerian construction sector due to poor coordination of complex tasks has been well-documented, a deeper understanding is needed on the barrier to technology adoption for improving decision-making processes and project success rates among construction project managers in Nigeria"

Part A (Participant Information)

A1. First name of the Interviewee

A2. Last name of the Interviewee
A3. Age (in years)
A4. Nationality
A5. Gender
A6. Education (highest degree)
A7. Construction Project Management experience (in years)
A8. Title / function

Interview Questions:

1. What do you believe is the state of new technology adoption aimed at efficient completion of construction projects within your organization?
2. What is your opinion on the state of technology your company's owners make available to construction project managers to support your work in efficient project completion?
3. What role do you believe cost plays in the state of technology your company's owners make available to construction project managers to support your work in efficient project completion?
4. What role do you believe competitive pressure plays in the technology your company's owners make available to construction project managers to support your work in efficient project completion?
5. What role do you believe government support plays in the technology your company's owners make available to construction project managers to support your work in efficient project completion?
6. What do you believe is the primary barrier to your adoption of new technology to support your work in efficient project completion?

7. What do you believe is a secondary barrier to your adoption of new technology to support your work in efficient project completion?
8. What do you believe is a third barrier to your adoption of new technology to support your work in efficient project completion?
9. What role do you believe national laws in Nigeria play for new technology adoption within the construction industry?
10. How do you believe ethnic culture influences the actions of construction project managers in Nigeria in new technology adoption?
11. Project management software is constantly evolving. As a construction project manager in Nigeria, what do you believe would better support your adoption of new technology to efficiently do your job?
12. As a final question, would you like to add any further reflections on barriers to technology adoption construction project manager in Nigeria?

Prompts to facilitate conversations around the facts:

"Can you give me an example of that?"

"Please tell me more about that."

Thank you for your participation.

Appendix C: Author's Permissions for use of Figure 1, 2 and 3

E-mail Trail Granting Permission for the Use of Figure 1

Rasaq Olaniyan
Sat 10/19/2019 4:04 AM

Nuruddeen Usman <nusman1974@gmail.com>

Yes. I have done that. It is a scholarly requirement to reference any cited works.

Rasaq

From: Nuruddeen Usman <nusman1974@gmail.com>
Sent: Thursday, October 17, 2019 5:43 AM
To: Rasaq Olaniyan <rasaq.olaniyan@waldenu.edu>
Subject: Re: Request For Permission

Ok, you are granted the permission to use it with the hope that you will acknowledge us in your PhD dissertation.

On Thu, 17 Oct 2019, 05:47 Rasaq Olaniyan, <rasaq.olaniyan@waldenu.edu> wrote:

Dr. Usman & Dr. Said,

I am a doctoral student at Walden University currently working on my dissertation on technology adoption barriers among construction project managers in Nigeria. I came across your work "Key Factors that Affects Adoption of Technology in the Nigerian Construction Firms: A Theoretical Framework ".
Sir, I am writing you to grant me the permission to reprint your ***Fig. 1: Theoretical Model*** in my dissertation as a conceptual framework for my study.

Thank you,

Rasaq Olaniyan
Walden University
Tel: +1-936-340-8669

E-mail Trail Granting Permission for the Use of Figure 2

Re: Request For Permission

Abdullahi Waziri <aywaziri@gmail.com>
Mon 10/21/2019 3:30
Great, thanks!

On Oct 21, 2019 6:28 PM, "Rasaq Olaniyan" <rasaq.olaniyan@waldenu.edu> wrote:
It will be available in ProQuest. I will send a link to you.

Thanks,

Rasaq

From: Abdullahi Waziri <aywaziri@gmail.com>
Sent: Sunday, October 20, 2019 2:11 AM
To: Rasaq Olaniyan <rasaq.olaniyan@waldenu.edu>
Subject: Re: Request For Permission

Goodluck then. Perhaps I should get a copy of the work when its ready

On Oct 19, 2019 3:21 AM, "Rasaq Olaniyan" <rasaq.olaniyan@waldenu.edu> wrote:
Yes. I have done that. It is a scholarly requirement to reference any cited works.

Rasaq

From: Abdullahi Waziri <aywaziri@gmail.com>
Sent: Friday, October 18, 2019 6:06 PM
To: Rasaq Olaniyan <rasaq.olaniyan@waldenu.edu>
Subject: Re: Request For Permission

As long as your work will mention where it is taken from

On Thu, Oct 17, 2019 at 8:41 PM Rasaq Olaniyan <rasaq.olaniyan@waldenu.edu> wrote:
Sir,
It means to use or reproduced for scholarly reference. That is the APA official language

Thanks
Rasaq

From: Abdullahi Waziri <aywaziri@gmail.com>
Sent: Thursday, October 17, 2019 12:52:39 AM
To: Rasaq Olaniyan <rasaq.olaniyan@waldenu.edu>
Subject: Re: Request For Permission

Kindly come again. To reprint? How do you mean?
Dr. A.Y.Waziri

On Thu, Oct 17, 2019 at 12:48 PM Rasaq Olaniyan <rasaq.olaniyan@waldenu.edu> wrote:
Dr. Waziri, Dr. Mustapha, & Dr. Idris,

I am a doctoral student at Walden University currently working on my dissertation on technology adoption barriers among construction project managers in Nigeria. I came across your work "A Theoretical Model of Factors Influencing IT Adoption in Nigerian Construction Organizations".
Sir, I am writing you to grant me the permission to reprint your ***Fig. 1: Theoretical Model of IT Adoption in Construction Organizations*** in my dissertation as a conceptual framework for my study.

Thank you,

Rasaq Olaniyan
Walden University
Tel: +1-936-340-8669

E-mail Trail Granting Permission for the Use of Figure 3

From: Harold Kerzner <hkerzner@hotmail.com>
Sent: Friday, November 1, 2019 7:33 AM
To: Rasaq Olaniyan <rasaq.olaniyan@waldenu.edu>
Subject: Re: Metrics

Hi Rasaq,
Yes, this is the most current version of the figure. You have my permission to use the figure in your thesis. Let me know if you need a description of any of the five levels.

Good luck with your research.

Sincerely,
Harold Kerzner

From: Rasaq Olaniyan <rasaq.olaniyan@waldenu.edu>
Sent: Thursday, October 31, 2019 10:30 PM
To: Harold Kerzner <hkerzner@hotmail.com>
Subject: Re: Metrics

Please find the Figure as attached.

Thanks,
Rasaq

From: Harold Kerzner <hkerzner@hotmail.com>
Sent: Thursday, October 31, 2019 8:31 PM
To: Rasaq Olaniyan <rasaq.olaniyan@waldenu.edu>
Subject: Metrics

Hello Rasaq,
I need to see the figure you wish to use in your thesis. I cannot find the white paper you mention. Please e-mail me a copy of the figure.

I may be able to send you a different figure that is more current.

Good luck with your thesis.

Sincerely,
Harold Kerzner