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Successful Strategies for Adopting Open-Source Software

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This is to certify that the doctoral study by

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has been found to be complete and satisfactory in all respects,
and that any and all revisions required by
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Abstract

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MS, Wilmington University, 2015

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Doctoral Study Submitted in Partial Fulfillment

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Abstract

Middle-level information systems managers (ISMs) in small-scale organizations often have challenges in determining the most appropriate strategy for adopting open-source software (OSS) in their organizations. The ISMs need to determine the right strategy for adopting OSS to protect the organizations' information technology infrastructure. Grounded in the diffusion of innovation theory, the objective of this multiple case study was to explore strategies middle-level ISMs used to adopt OSS in their small-scale organizations. Six middle-level ISMs from three small-scale organizations with experience of not less than six years in OSS adoption strategy in the city of Frederick, Maryland, shared their strategies during semistructured online interviews. Data from archival documents augmented data collection. Thematic analysis yielded four themes: Relative advantage, cost control, support services, and staff knowledge. The study's findings revealed that ISMs employ different strategies when adopting OSS in their small-scale organizations. These strategies seek to ensure the small-scale organizations gain a relative advantage, incur minimal costs, are guaranteed support and services, and enjoy staff knowledge. The implications for positive social change include the potential for organization leaders to provide customers affordable products and services and gain a competitive advantage in improved services.

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Dedication

I dedicate this doctoral study to my close and supportive late parents. My mother Ahoua Barro/Soro and my father Tieba Barro have played a significant role in the development of my personality, ambition and interests in life. They were the ones who encouraged and motivated me to further my studies and without them, I would not be the person I am today. They are and will always remain a reference in my eyes due to their hard work, dedicated persona, modesty and kindness.

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Section 1: Foundation of the Study

Background of the Problem

The open-source software (OSS) approach involves making software available with both the source code and the open-source license (Mouakhar & Tellier, 2017). The need for OSS use or implementation in small-scale organizations is increasing, but various challenges exist that make the implementation and use of the OSS difficult (Felderer & Ramler, 2016). Among the challenges affecting OSS implementation include the cost of OSS, its relative advantage, necessary service and support, and staff knowledge and familiarity (Felderer & Ramler, 2016). Small-scale organizations have to determine answers to these questions to succeed in effectively implementing their OSS strategy.

Problem Statement

Small-scale organizations wishing to adopt OSS face challenges that include substantial ongoing usage costs and dwindling developer communities for certain OSS products (Nevo & Chengalur-Smith, 2017). In Canada for instance, the adoption of open-source content management software stands at 24.3% while in Australia it is at 24.5%; the adoption of open-source productivity software stands at 16.3% in Canada and 15.5% in Australia (Rathi & Given, 2017). The general information technology (IT) problem is the slow adoption of OSS by some small-scale IT organizations. The specific IT problem is that some middle-level information systems managers lack strategies to adopt OSS within their small-scale organization's IT infrastructure.

Purpose Statement

The purpose of this qualitative multiple case study was to explore the strategies used by middle-level information systems managers (ISMs) to adopt open-source software in their small-scale organizations. The targeted population of this study consisted of small-scale organizations' middle-level information systems managers, located in the city of Frederick, Maryland, who utilize strategies for adopting the open-source software. The selected population was appropriate for this study as they represented the key people responsible for adopting security strategies to protect organizations' IT infrastructure. These study findings could socially benefit communities because open-source software helps small scale organizations enhance efficiency in their operations. The enhanced efficiency, in turn, would ensure that the organizations grow and offer more employment opportunities, increase their allocations for corporate social responsibility programs, and also present learners in the community with internship opportunities to further their skills on open-source software.

Nature of the Study

I used the qualitative method in this study because the research objective was to achieve a comprehensive understanding of successful OSS adoption strategies used by middle-level ISM in small-scale IT organizations. Researchers use the qualitative method to understand a phenomenon from the participants' perspective (Gaus, 2017). In contrast, a researcher who uses a quantitative study utilizes mathematical models, theories, or hypotheses to examine relationships among study variables (Chigbu, 2019). Investigators

use the quantitative method to examine the relationships amongst variables by measuring quantities (Landrum & Garza, 2015). Because I did not use any mathematical models, hypotheses, theories, or examine the relationship between variables, the quantitative method was not appropriate for this study. Turner et al. (2017) defined the mixed-method approach as a mixture of the two methods as mentioned above and used by researchers to both explore a phenomenon and examine quantitative relationships or differences among the variables. My goal was to explore strategies used to adopt open-source software; hence, the mixed-method approach was not appropriate for this study. Since my plan did not seek to study the relationship between variables, and since I was not planning to use a quantitative method, I did not use a mixed-method approach in this study.

There are multiple qualitative designs used in research, including case study, phenomenology, ethnography, and narrative inquiry. According to Attia and Edge (2017), a case study includes the use of multiple data sources such as interviews, documentation reviews, and reflexive journals. The multiple case study was suited for this study because my main goal was to identify and gain an in-depth understanding of the strategies middle-level information systems managers from multiple small-scale organizations used to adopt OSS within their organizations' IT infrastructure. A researcher uses a phenomenological design to study the participants' experience and perception of phenomena delve into the feelings, perceptions, understandings, and perspectives of the people who have directly experienced the situation of interest (VanScoy & Evenstad, 2016). Because my intention was not to understand the experience and perception of the

participants, I did not to select the phenomenological design. Lamont and Swidler (2014) defined ethnographic research as the study and exploration of human cultures. Because my goal was not to explore the research participants' culture, I did not choose the ethnographic design. Rechel et al. (2013) defined the narrative inquiry as the process of understanding and inquiry into the experience of ways humans experience the world through their stories. I did not consider narrative design for this research because it focuses mainly on studying an individual, and the researcher interpreting the individual's stories. In this research, I planned to explore the strategies used to adopt OSS rather than interpreting an individual's stories. I therefore chose the multiple case study approach, as it was best suited to meet this goal.

Research Question

The research question that I answered in this study was: What strategies do middle-level information systems managers use to adopt open-source software within their small-scale organization's IT infrastructure in the city of Frederick, Maryland?

Interview Questions

1. How have you implemented OSS in your organization?
2. How did you do to control the cost of implementing OSS in your organization?
3. How do you evaluate the relative advantage of OSS?
4. What OSS service and support do you offer to the employees?
5. What staff knowledge and familiarity aspects do you prioritize before

adopting OSS?

6. How do you encourage the use of OSS in your organization?
7. How do you find additional information on OSS adoption that you would wish to explain further before finishing the interview?

Conceptual Framework

The conceptual framework that I used in this study was the diffusion of innovations (DOI) theory. Everett Rogers proposed the DOI theory in 1962, explaining that an idea or a product will likely gain momentum over time and end up diffusing or spreading through a particular social system or population group (Rogers, 1962). The philosophy behind the DOI theory is that when people adopt a new idea, product, or behavior, they will do things differently compared to how they did them previously (Aizstraut et al., 2015). Nonetheless, adoption does not just occur easily unless people consider the idea or product to be innovative or new. Under the DOI theory, adoption decisions are controlled by perceptions regarding the technology involved, and the adopters' characters.

Borrowing from the DOI theory, the adoption of open-source software within an organization's IT infrastructure would be influenced by three factors. The first factor is the technology factor which includes such aspects as the reliability of the system, cost advantages, the new technology's compatibility with the skills, tasks, and current technologies, and the complexity of the system in general. The second factor is the organizational factors such as the organization's overall stance with respect to IT/IS

innovation. In general, organizations may be classified as early adopter, fast follower, or late adopter. Moreover, such aspects as the strategic relevance of the system to the organization also fall under the organizational factors. The third factor is the environmental aspects, such as support for open-source system by the major vendors, and the perceived accessibility of the relevant OSS skills and services. Applying the concept of DOI to this study, open-source software takes up the position of an idea or product likely to gain momentum over time and end up diffusing through small-scale IT organizations. Although there is dwindling adoption of the open-source software in the said small-scale IT organizations, I sought to understand how this trend can be reversed and instead full diffusion achieved using the DOI theoretical concept.

Definition of Terms

Open-Source Software: This refers to the outcome of software development achieved using open-source code (Jussila et al., 2019). Open-source code is a program with a license that allows programmers to modify a software such that it may suit their preferences, including fixing bugs and improving functions.

Assumptions, Limitations, and Delimitations

Assumptions

Research assumptions reflect the ideas regarded as true by the researcher, but which may not be having substantive factual support (Haynes, 2015). My assumption as the researcher was that interviewing managers from small-scale IT firms would result in rich data to be applied in the research question. The participants in this research were

experienced managers directly involved in strategizing and overseeing open-source software adoption in their organizations. With this experience, they were able to provide wide-ranging information that had, in turn, answered the research question.

Limitations

Research limitations are constraints in a study that cannot be controlled by the researcher. Virtually all research studies have their limitations that may range from funding challenges to research design issues and statistical model constraints, among many others (Haynes, 2015). This research included a relatively small number of interviewees, whose considerations and views were not fully representative of the open-source software adoption strategies by small scale organizations in the city of Frederick, Maryland. To mitigate this limitation, I used companies' documents as well to establish additional data about open-source software adoption strategies in the respective organizations.

Delimitations

Research delimitations constitute distinctive aspects that define the scope. Among the delimiting factors are the variables of interest, research questions, research objective, study population, and theoretical perspectives (Haynes, 2015). The delimitations of this research were defined by small scale IT organizations that were: (a) operating legally in Maryland (b) implementing or already implemented open-source software and (c) employing at least 150 employees.

Significance of the Study

Contribution to Information Technology Practice

The findings resulting from this study could be considered valuable, especially to middle-level ISMs in small organizations to help in executing open-source software with greater success in their organizations. Open source software promotes the free sharing of ideas that eventually drive creative, scientific, as well as technological advancement because it eliminates existent barriers between innovators. It helps in expanding the capacity of the software in a more customized way that benefits the organization absolutely, based on the creativity of the person modifying the original software. Essentially, the findings attributed to this research could provide the middle-level ISMs with a greater opportunity to regenerate unique software that may be enormously beneficial to the organization because it may be customized to serve the very expectations of the organization.

Implications for Social Change

The social benefit may be specifically in the form of an expanded working opportunity where employees of the organization may have a chance to improve their creativity by modifying the software to suit different circumstances. Additionally, the positive social change attributed to these findings include organizations guaranteeing customers affordable products and services, and gaining competitive advantage in terms of improved services to their customers. The findings of this study may prove effectual to individuals who buy the products or services of an organization that implements OSS.

Since the use of OSS reduces costs significantly, the organizations implementing OSS could lower the prices of their products and services. Using OSS may guarantee affordability for the consumers of the products and services in the society, thus ensuring that they also enjoy the benefit of such products and services. Because the OSS may also provide a competitive advantage to the organization, the organization may have an increased opportunity to offer improved services to their customers. Consumers may benefit from high quality products and services that are of value when organizations implement OSS solutions.

A Review of the Professional and Academic Literature

Overview

I completed the literature review to find related concepts published by other scholars and researchers about the strategies used by middle-level ISMs for adopting open-source software within their small-scale organizations. The review enriched this research a great deal because I used it to incorporate facts that many researchers and scholars have already tested and confirmed. I picked a substantial proportion of literature sources based on their coverage of the DOI theory, which forms the conceptual framework in this research. The focus of the literature review materials was on materials published more recently. I focused on materials with publication date not older than 2016 to enhance the practicality of the research findings. I used a total of 183 literature materials in the literature review section. Peer-reviewed articles made up 86% of the total literature materials, while 90% of the materials were published in 2016 or later.

The literature review features four subsections systematically ordered to ensure a logical flow of the discussion. The first subsection is dedicated to the conceptual framework, including an elaboration of its evolution. In the second subsection, I drew comparisons between the conceptual framework and other theories in terms of those supporting and those contrasting. In the third subsection, my focus is on innovations diffusion attributes, which include the cost of open-source software, relative advantage, service and support, staff knowledge and familiarity, and observability.

I used various online libraries, such as EBSCOhost, Google Scholar, and ProQuest, to find the most applicable literature materials for the study. I used the research topic, *successful strategies for adopting open-source software,* to derive the actual search terms applied in the online library websites. Newer materials published within five years of this research's publication formed the bulk of literature sources considered in this research. New trends and practices in IT keep emerging virtually every day, meaning that most IT practices and trends that were applied five years ago may no longer be relevant today. Essentially, enhancing the viability of the study findings informed the decision to stick with newer literature sources published within 5 years of this research's publication.

Diffusion of Innovations (DOI) Theory

DOI theory was the conceptual framework for this research. The DOI theory dates from 1962, when Everett Rogers first proposed it (Rogers, 1962). Based on Rogers' (1962) explanations, diffusion refers to the process through which an innovation is conveyed among the individuals of a given social system. The conveyance of the

innovations takes place over time and is made possible through specific channels. In particular, Tanye (2016) explained Rogers' (1962) DOI theory by opining that conveying the innovations is mainly about communicating the new ideas that are involved. Tanye (2016) identified four main elements that makeup Rogers' DOI theory, including the attributes of innovations, channels of communication, time, and social system. These elements mean that the DOI theory is only complete when there is a real innovation in place, mechanisms of communicating the innovation to society, time duration during which the diffusion or communication of the innovation occurs, and an existent social setup impacted by the innovation.

The perceived attributes of innovations make up the first element of the DOI theory as pronounced by Rogers (1962). According to Al-Rahmi et al. (2019), this element comprises up to five important characteristics that include relative advantage, compatibility, intricacy and complexity, trialability, as well as observability. To begin with, Al-Rahmi et al. (2019) described the relative advantage characteristic in terms of the extent to which the innovations in question is considered superior vis-à-vis the existent practice. On the other hand, Dearing and Cox (2018) described the compatibility characteristic in terms of how well the innovations is congruent with the systems already in place, while the complexity characteristic is defined as the extent at which the innovations is considered easy or tough to be understood and used. Tanye (2016) defined the trialability characteristic in terms of the extent at which experiment on a given innovations may be conducted on a limited basis. Finally, the observability characteristic

implies the perceived visibility of innovations to others (Smith, et al., 2018). Overall, before the decision on whether to adopt an innovation is made by an organization, all of its five characteristics as elaborated above will be evaluated by those in charge.

The concept of innovations diffusion is based on the notion that the model undergoes the different diffusion life cycle stages, where each stage is defined by dissimilar determinants of diffusion (Bhattacharya, 2015). The different classifications of adopters, as Bhattacharya (2015) explained, have unique characteristics about the adoption of innovations. This means that with the diffusion process going on, the factors determining innovations adoption will keep changing with time. Innovations adoption is determined by the five characteristics of the DOI theory as already highlighted in the previous paragraph. Rogers (1995) emphasized the presence of a strong relationship between the five characteristics of perceived innovations and the practical adoption of the innovations. Adoption itself occurs in the form of a process, where individuals undergo different mental stages. According to Miranda et al. (2016), these mental stages provide an opportunity for individuals to gradually acquaint themselves with the innovation before determining whether they would purchase it. This means that for any potential adopter of innovations, they are first made aware of the new product where they make an effort to learn how it functions (Miranda et al., 2016). Once this has happened, Pichlak (2016) observed that the individual gets to form an attitude toward it, which eventually enables the formation of a decision about the innovations' adoption.

According to Abbas et al. (2017), both cognitive as well as affective stages are

involved when individuals encounter new technologies and make determinations about them. The perception of the adopter, more than their social behavior, is therefore critical when it comes to determining whether or not to adopt an innovation in the organization (Abbas et al., 2017). Kim (2015) underscored the fact that the attitudes of the likely adopters create the intent toward the innovations, thereby paving room for the decision to either adopt or reject it. This argument can best be understood when considered alongside other theoretical bases, such as the theory of planned behavior, which holds that attitude toward behavior, perceived behavior control, and subjective norm collectively determine intentions (Ramos-de-luna, et al., 2016). These intentions, in turn, determine the actions.

As a social process, diffusion of innovations takes place among people as a result of learning about an innovation (Gregoire, 2016). Diffusion of innovations, thus, may be in the form of a new evidence-based approach through which software in an organization can be improved or have its functionality extended. Conventionally, diffusion of innovations involves an advancement or improvement that is conveyed through specific channels over a period amongst the individuals making up a social system (Adarsh et al., 2016). Anand et al. (2018) explained that the characteristic dependent variable in as far as diffusion research is concerned is the time of adoption. However, when innovations adoption involves complex organizations, subsequent implementation constitutes a more meaningful aspect of change.

In DOI theory, communication channels impact the tempo at which an innovation is adopted (Gledson & Greenwood, 2017). There is a distinct difference between

the *source* from where the communication originates and the *channel* the communication flows in (Tran & Corner, 2016). According to Tran and Corner (2016), communication channels' classification *includes internal* interpersonal channels of communication and *external* mass media channels of communication. Gledson and Greenwood (2017) explain that internal channels of communication play the crucial role of convincing and persuading members against resisting the innovations. Internal communication happens during the persuasion stage and involves a dynamic face-to-face exchange of information that also targets greater favorable attitudes. The external communication is aimed at bigger audiences to accelerate the dissemination of information, comprehension, and understanding (Tran & Corner, 2016). The use of external channels is particularly more significant during the knowledge stage. Early adopters and innovator groups are subjected to external communication channels more often than the late adopters and laggards, subjected to internal communication channels. According to Gledson and Greenwood (2017), interpersonal communication best serves innovations diffusion where the information transfer is internal between near-peers.

According to Rogers (1995), individuals of a social system characteristically fall into five groups. The attitudes of the individuals towards innovation determine the classification of the five groups. These groups include innovators, early adopters, and late adopters. Others include later majority and laggards (Mollaoglu et al., 2016). Innovators form a small percentage of the entire population in the social system and are often the first to adopt an innovation. Dibra (2015) pointed out that innovators can

understand and apply intricate technical knowledge critical in occasioning the innovations from sources lying external to the social system. On their part, early adopters constitute a more integrated element of the social system compared to the innovator. The early adopters have relatively better innovation knowledge and a better connection with the new technologies. This group also tends to be more successful on the economic front. The earlier and later majority adopters make up the largest proportion of the entire social system population. Finally, the laggards offer the most robust resistance to the innovation adopted and eventually tend to become nonadopters owing to their limited or total absence of knowledge about the innovations and their lack of adequate resources (Mollaoglu et al., 2016).

Rogers (1995) explained that DOI emphasizes the need to consider a social system's beliefs and norms in a diffusion process with the participants needing mutual understanding. According to Rogers (1995), the social system refers to the combination of interrelated units engaging to achieve a common goal by solving a problem. Essentially, the social system's characteristics, the norms of the system, the role of change agents such as opinion leaders, and the variety of innovations decisions arrived at influence diffusion. From Zhang et al. (2015) perspective, a region’s social capital aids its social system in using the material, intellectual, and economic resources for achieving innovations. Based on Zhang et al. (2015) position, social capital constitutes a requisite condition that influences social innovations emergence in a given society. Generally, if social norms contradict innovations, the diffusion process will likely encounter obstacles

(Cheng, 2017). Furthermore, Cheng (2017) added that behavioral modes set up by social system members are norms that serve as a guide to all the members.

Evolution of the Conceptual Framework

The DOI theory's evolution falls into two perspectives: the classical diffusion theory, and the second one, the dissemination science (Dearing & Cox, 2018). The classical paradigm, in particular, is linked to a variety of studies that have all depicted a conventional pattern that illustrates how innovations spread over time. Studies such as the one conducted by Aguilar et al. (2017) tend to uphold the notion of the well-known S-shaped cumulative adoption curve. Based on Hayes et al. (2015) explanation, the S shape results from the engagement of opinion leaders through discussions and modeling of the innovations for others' sake to hear and see. In general, Dearing and Cox (2018) listed up to five main components that form the basis of the classical diffusion theory, including the innovations, adopter, social system, individual adoption system, and finally, the diffusion system.

The innovation component of the classical diffusion theory paradigm encompasses the potential adopter perceptions of the attributes of relative advantage. Other components include the complexity of the innovations, compatibility or fit of the innovations, observability of the innovation, and trialability of the innovation (Vagnani & Volpe, 2017). On the other hand, the adopter component reflects the innovation's degree of innovativeness concerning each of the individuals adopting. The social system component reflects the structure of the system in terms of the local informal opinion

leaders and the potential adopter perception based on the social pressure to adopt (Vagnani & Volpe, 2017). Hayes et al. (2015) defined the individual adoption process component as one that involves a stage-by-stage model of awareness, influence, decision, implementation, and continuation. Finally, Hayes et al. (2015) described the diffusion system model in terms of the external change agency and the paid change agents involved who effectively seek out and mingle with the opinion leaders of the client system, innovations champions, and paraprofessional aides.

The S-shaped curve of innovation diffusion comes about because, during the new technology's initial stages, the decision-makers of the social system are apprehensive about it (Adarsh et al., 2016). As Pathania et al. (2017) explained, graphing time-of-adoption data eventually results in an S-shaped curve. The S-shaped curve illustrates a slow adoption rate at the initial stages, before attaining a rapidly accelerating rate and, after that, slowing down as a result of fewer nonadopters remaining in the social system involved (Pathania et al., 2017). Dearing and Cox (2018) clarified that not all cases of innovations diffusion happen this way. For instance, an instance of policy diffusion will generally have a shorter time to adoption owing to the occasional convergence issues, such as financial incentives, positively perceived innovations solution, or willingness to change among officials (Dearing & Cox, 2018).

It takes some time for the decision-makers to learn about the new technology and get convinced by the external agents before considering it. According to Adarsh et al., (2016), however, a few early adopters pick the innovations and begin to experience them

in their systems. As time goes by, Aguilar et al. (2017) explained that the innovations' diffusion rate also increases mostly because more decision-makers in other social systems begin to accept the innovations after having encountered them from the early adopters. With time, the diffusion rate of the innovations diminishes because only a few social systems considered as late adopters are still making efforts to adopt it (Adarsh et al., 2016).

Apart from the classical innovation diffusion paradigm, the dissemination science perspective also captures quite effectively the evolution of the DOI theory. Even where organizations have optimal internal conditions, Birken, et al., (2017) argued that a host of factors could hinder the adoption of innovations, among them including a dynamic external environment of the organization, such as changes in funding, changes in contracting practices, new legislation, or new technology. According to Birken, et al., (2017), the adoption frameworks, such as the leadership adopted, organizational structure, and social context, reflect heavily. Thus, the dissemination science perspective differs from the classical diffusion paradigm in the sense that it suggests an *inside-out* approach for adopting technology innovations (Dearing & Cox, 2018).

Supporting Theories

There are four other theories, namely Hall's Concerns-Based Adoption Model, technology acceptance model, the Chocolate Model, and the Unified Theory of Acceptance and Use of Technology, supporting the DOI theory (Lai, 2017).

Concerns-Based Adoption Model (CBAM). According to Nwulu (2020), Gene

Hall is behind the Concerns-Based Adoption Model (CBAM), which was pronounced in 1979. The theory considers innovation adoption based on the individuals directly impacted when the innovations are adopted. According to Alenezi (2015), CBAM encompasses six assumptions that include the view that change is never an event. Instead, it is a process that individuals are the ones who accomplish change and that it is a highly personal experience. CBAM's assumptions further hold that change does not happen until there is developmental growth. It is best understood using operational terms. Finally, when facilitating change, the three most important aspects would include individuals, innovations, and context (Nwulu, 2020).

There are three components of the theory derived from the six assumptions of the CBAM (Gundy & Berger, 2016). These components are namely the stages of concern (SoC), innovations configuration (IC), and levels of use (LoU). Gundy and Berger (2016) underscored that these components are crucial because they inform a leader of the necessary planning activities ahead of the change. Firstly, the SoC implies the individual characteristics of those expected to be involved directly in adopting the change process (Maggino & Facioni, 2017). SoC is essentially the primary reason behind the formulation of the CBAM. Bennet et al. (2017) pinpointed the SoC scale's seven stages that include awareness concerns, information concerns, management concerns, consequences concerns, collaboration concerns, and refocusing concerns.

IC and the levels of Use (LoU), mainly cover the innovation's characteristics. As the individuals interact with the innovations, they undergo behavioral changes, passing

from lower-level use to higher-level use. Gundy and Berger (2016) described these stages of behavioral changes in terms of LoU. IC captures the entire process through which the implementation of the innovation occurs. Comparatively, the CBAM theory holds the same notion as the DOI theory because they talk about the change agents involved in the innovation process (Nwulu, 2020). I did not choose CBAM in this study because it focuses on adopting OSS strategies and not merely on the change agents.

Technology Acceptance Model (TAM). The technology acceptance model (TAM) is equally supportive of Rogers's (1962) DOI theory. Davis (1985) announced TAM premising it on the notion that the chances of an innovations' adoption are affected by the attitude of a potential adopter and the expectations of the innovations. Two focus areas of the TAM include considering the innovations in terms of the potential adopter's perceptions regarding its ease of use and the extent to which the innovations are likely to enhance the user's job-related or personal performance. These focus areas are directly related to the DOI theory elements (Al-Rahmi et al., 2019).

According to Davis (1985), the ease of use, as a TAM focus area, directly impacts perceived usefulness. For users, the easier they perceive an innovation to be, the greater the likelihood that they will adopt it and achieve improved productivity. In essence, Taherdoost (2018) asserted that the ease-of-use consideration regarding TAM would significantly help adopters. Davis (1985) also ascertained that there exists a higher association linking perceived usefulness and technology adoption. This association level is greater than the correlation between the adopter's perceived usefulness and adoption

(Lai, 2017). The interpretation of Davis' (1985) findings of TAM was that the ease of learning a new technology might not necessarily cause the people to adopt it unless they perceive the technology to be useful. According to Lai (2017), people usually consider technology's influence toward improving their productivity as the best yardstick for deciding to adopt it. I did not choose TAM in this study because the research's focus was not about the attitude of the potential adopter of OSS or the extent to which OSS is likely to enhance performance. Instead, the focus of the research was on strategies implemented in adopting OSS.

Chocolate Model. The Chocolate Model has been another theoretical framework that strikes similarities with Roger's (1962) DOI theory. Dormant (2011) originated this model whose core focus is on innovation adoption and the related changes to an organization. Dormant (2011) illustrated the four elements of the Chocolate Model, which include change, adopters, change agents, and the organization. The Chocolate Model's elements are similar to DOI theory's elements (Dormant, 2011). However, the Chocolate Model goes a notch higher than the DOI theory because its applicability is viable when planning ahead of organizational change and the subsequent innovation's adoption. I did not select Chocolate theory in this research because the study's focus was on strategies implemented in adopting OSS and not change, adopters, change agents, and the organization.

Unified Theory of Acceptance and Use of Technology (UTAUT). The Unified Theory of Acceptance and Use of Technology (UTAUT) equally draws similarities with

Rogers (1962) DOI theory. The UTAUT was proposed in 2003 by Venkatesh et al. to explain the acceptance and use of information systems/information technology (Venkatesh et al., 2003). The original basis of the UTAUT model was to elaborate on the existing variation between behavioral intention and usage behavior (Venkatesh et al., 2016). According to Venkatesh et al. (2003), researchers often encountered a huge number of constructs from many theoretical models, making them select constructs from the theories or go for a model they considered favorable. Venkatesh et al. (2003) essentially combined propositions by separate models of acceptance, such as TAM and C-TAM-TPB, to come up with the UTAUT.

The UTAUT is premised on three main aspects, including age, gender, and experience regarding effort expectancy and performance expectancy, to investigate and clarify the variables which slow down acceptance and use (Venkatesh et al., 2016). In particular, UTAUT has elaborated the influence caused by social and attitudinal factors on behavioral intention. Both UTAUT and DOI theories underscore that the extent to which innovations are successfully incorporated depends on individuals' persuasion on the innovation's value (Rahi & Mazuri, 2018). I did not choose UTAUT because its focus is on behavioral intention and usage behavior instead of this research's focus on strategies implemented in adopting OSS.

Contrasting Theories

Chaos Theory. One theory that contrasts the DOI theory is chaos theory, which particularly came into formation following efforts to develop weather forecasting

predictions. According to Kasianova et al. (2019), chaos theory is a non-linear model that refers to controlled randomness likely correlated with recognizable patterns and, to some extent, predictable. This position contrasts with the DOI theory, which applies mainly to planned change situations (Rosenbaum et al., 2017). As Kasianova et al. (2019) elaborated, DOI theory focuses on how individuals move from awareness of innovations to accept to implement or rebuff the idea eventually. Chaos theory, however, does not offer any direct path or approach to implementing change. Çağlar (2018) argued that in chaos theory, the idea of predicting the future is limited because of many variables existing. This idea applies even in well-organized institutions because they might fail to forecast their organizations' future indeed (Çağlar, 2018). Chaotic models feature nonlinear dynamics that are internally generated and independent of exogenous shocks (Guirao & Luo, 2016). I did not use chaos theory because it focuses on controlled randomness that may correlate with recognizable patterns, which contradicts this research's aim in terms of exploring strategies implemented in adopting OSS.

Applicability of DoI to This Project

In considering the most successful strategy for adopting open-source software, the management of small-scale organizations needs to understand the attributes of the diffusion innovations concept (de Araújo & Zilber, 2016). In general, organizations will likely adopt new techniques if there is guaranteed value addition or improved organizational performance such as profit, quality, or added value (Askarany, 2016). The small-scale organization's management must evaluate the benefits of the OSS they are

seeking to adopt based on its costs, its comparative advantage over the software currently adopted, and its complexity (Askarany, 2016). In other words, this research considered the characteristics of innovations, including cost, comparative advantage, and complexity (Dutta & Omolayole, 2016), as the basis of formulating successful strategies for adopting open-source software.

Cost of OSS

Managers of small-scale organizations should consider the costs that the organization is likely to incur before adopting the OSS (Taha et al., 2018). Additionally, the organization must consider the costs likely to be incurred after switching to OSS (Taha et al., 2018). According to Parmentola et al. (2018), an extra cost for small-scale organizations arising from OSS's adoption is considered a significant barrier with a slow-down effect on the overall diffusion process. Furthermore, small-scale organizations seeking to implement OSS will frequently depend on OSS communities to get the necessary help and support because no reputable vendor offered them (Nevo & Chengalur-Smith, 2017). Based on Nevo and Chengalur-Smith (2017) analysis, the uncertainty regarding the maintenance, support, and upgrades means that small-scale organizations that adopt OSS incur added costs.

Apart from the direct acquisition and maintenance costs, small-scale organizations incur product evaluation costs, learning costs, setup-costs, and economic costs that may be in the form of uncertainty in case of a negative outcome with a negative effect on customers (Taha et al., 2018). Ciesielska and Westenholz (2016) underscored that

although OSS is considered cheaper, the cost savings realized at the initial stages may end up consuming on maintenance and additional adaptations. Small-scale organizations find the question of cost to be quite exigent, particularly due to their lower latency to benefit from economies of scale advantages.

Having determined cost as a significant dilemma to the adoption of OSS by small-scale organizations, the most practical strategy would be the one that addresses this challenge directly. The characteristics resulting in less costly searching costs in small-scale organizations are high observability, high trialability, and low complexity (Parmentola et al., 2018). Observability, as Hayes et al. (2015) explained, refers to the measure to which innovations are detectable to others. Small-scale organizations seeking to adopt OSS will experience challenges establishing observability because proprietary software dominates the market (Hayes et al., 2015). However, Vagnani and Volpe (2017) advised on the need for small-scale organizations to rely on role modeling or do peer observation to clearly understand the cost barriers impacting OSS's adoption and diffusion. Essentially, small-scale organizations require undertaking peer observation to avoid incurring searching costs. Peer observation presents a better opportunity through which the organization bypasses too much unnecessary expenditure in the quest to adopt OSS (Kassen, 2018).

The management should equally focus on high trialability characteristics to lower costs. According to Hayes et al. (2015), trialability implies the measure with which an innovation may be carried out as an experiment on a limited basis. It is an integral aspect

of the OSS adoption strategy because small-scale organizations want to witness what OSS innovations can achieve. They understand that a test run would be viable before committing. The adopters can outrightly see for themselves the kind of life they would usher themselves to once they adopt the OSS. Pathania et al. (2017) argued that the organization's failure, as an intended end-user of the OSS, to experiment with the innovations is a significant hindrance to innovation diffusion. This position is underscored further by Dutta and Omolayole (2016), who opined that any innovations considered more trialable is characteristically less uncertain for the organization seeking to adopt it. This less uncertainty defrays the probable costs of implementing the new technology, thereby enhancing its suitability to those willing to experiment with it (Dutta & Omolayole, 2016).

The third characteristic that is of importance concerning the cost of adoption of OSS is concerned is low complexity. Gledson and Greenwood (2017) described complexity as the perceptions of proportional difficulty of use. Based on the diffusion theory concept, the ease of comprehension facilitates innovations' adoption rate (Gledson & Greenwood, 2017). According to Dutta and Omolayole (2016), any new technology fits on the complexity-simplicity classification continuum. Clear innovations are less complicated to potential adopters (Dutta & Omolayole, 2016). The OSS complexity has a bearing on the adoption cost because, like Vagnani and Volpe (2017) explained, highly complex technology will pose difficulty to the users. As a result of such complexity, the small-scale organization will cater to its employees' training to enhance their capacity to

interact and use the technology. The cost incurred in catering for the training and the training duration will make it less viable for adoption (Vagnani & Volpe, 2017). Essentially, as managers of small-scale organizations determine the most successful strategy to consider when adopting OSS, they must consider low complex OSS that will not require costly retraining of the users (Parmentola et al., 2018).

Relative Advantage of OSS Adoption

Several studies exploring the significance of relative advantage on technology adoption have established a positive influence on the diffusion of innovations in general (Abbas et al., 2017). Mullan et al. (2017) equally established positive influence between the relative advantage derived from the technology and consumer adoption in their research. Chiu and Fogel (2017) defined relative advantage in terms of the extent at which a prospective adopter will gain out of the decision to adopt new technology. According to Abbas et al. (2017), users expect that new technology should offer significant benefits compared to traditional offerings. Based on these findings, the adopting organization must ascertain the OSS's benefit over the existing technology to guarantee its adoption (Chiu & Fogel, 2017). Thus, the basis of the adoption strategy should be to acquire an OSS that proves to deliver greater advantage to the organization compared to the already existing technology (Chiu & Fogel, 2017).

Junglas et al. (2019) operationalized relative advantage in terms of high quality, a unique feature, and better customization toward meeting the needs, cutting down cost, and completing a task. Managers of an organization adopting an OSS must weigh the

new technology against these qualities to determine whether it is practicable to acquire the new technology in the first place (Hsu & Lin, 2016). Thus, the strategy to acquire the new software should determine whether the OSS is likely to lead to savings for the organization based on maintenance performance, unique completion of a task, and efficiency (Hsu & Lin, 2016). The relative advantage concept also extends to mechanical advantage, price/quality relationship, the regularity of reward, reduced discomfort in use, and customer needs fulfillment, among other factors (Flight et al., 2011).

The adopting organization must seek early knowledge regarding the OSS they are seeking to acquire, and incorporate the details in the software adoption strategy. As Saunders et al. (2019) revealed, information about innovations often is gotten from either impersonal sources such as advertising and pre-launch announcements, or through external information search conducted on the Internet and specialty publications. With the continuation of diffusion, nonetheless, the organization can rely on numerous other personal contacts to enhance the amount of information regarding the technology's features and performance (Hao et al., 2019). These personal contacts may include other organizations using technology. With time, this knowledge of a technology's benefits and features can be relied upon to inform the adoption strategy of the organization.

The adopting organization must seek early knowledge regarding the OSS they seek to acquire and incorporate the software adoption strategy details. As Saunders et al. (2019) revealed, information about innovations often derives from either impersonal sources such as advertising and pre-launch announcements external information search

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Service and Support

Although the technology used for free software is mostly considered economical and viable, free software faces institutional obstacles that hinder its full adoption (Merlo et al., 2016). Essentially, Merlo et al. (2016) opined that adopting such free software will cause challenges in getting associated with technical support, which is a significant source of concern. Given this revelation, organizations seeking to adopt OSS must ensure that the question of service and support is well guaranteed before committing themselves (Ciesielska & Westenholz, 2016). The aspect of project developers comes in at this juncture because adopting organizations must ensure the technology they acquire is one that they can continuously involve the developer to improve.

Developers are project team members directly listed on the project outline and directly participate in the project development (Behfar et al., 2017). The developers are concerned with numerous project activities that range from programming to appraising the source code and identifying bugs in fixing them (Behfar et al., 2017). As key players in the entire project's functionality, developers play a central role in generating ideas for

the OSS project (Xiao et al., 2018). Studies also establish that, like developers, users equally play a vital role in supporting OSS products' evolution, given their contribution to modifying and improving such products (Annarelli et al., 2017). The developers' availability even after the adoption of the OSS, as Xiao et al. (2018) confirmed, is a crucial factor because it will assist in bettering the project as a whole.

The successful strategy to adopt OSS in small-scale organizations must center on the availability of service and support (Karpen et al., 2017). According to Sharma and Sagar (2018), adequate service and support provision is a strategic imperative because most of the organizations adopting new technology require the service and support to offer them a competitive advantage. The small-scale organizations adopting OSS must work closely with the OSS manufacturers to achieve value from their new technologies (Sharma & Sagar, 2018). Overall, the management of the small-scale organization seeking to adopt OSS must determine whether it is possible to share their preferences with the OSS producers before committing to any agreement (Aloini et al., 2017). Doing this will enable the small-scale organization to configure the software to best suit their operations efficiently and consequently achieve value for money (Aloini et al., 2017). Developers are project team members directly listed on the project outline and directly participate in the project development (Behfar et al., 2017). The developers are concerned with numerous project activities that range from programming to appraising the source code and identifying bugs in fixing them (Behfar et al., 2017). As key players in the entire project's functionality, developers play a central role in generating ideas for the

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Insisting on having a support system for the OSS is for guaranteeing the software's viability once adopted. As Nevo and Chengalur-Smith (2017) explained, certain OSS products may face a declining community of developers, providing a limited number of fixes and upgrades. Given this scenario, Nevo and Chengalur-Smith (2017) underscored the likelihood of the small organizations adopting the OSS facing uncertainty linked to lack of user-friendliness and forking of projects, all of which lead to lowered employee productivity. For small organization managers, focusing on the popularity of the OSS can help determine the technology's success because that would mean it generates attention and high-level interest among present and potential users (Cheruy et al., 2017). This parameter is essential to use in approximating project potential because it indicates how the users and developers appraise a project (Cheruy et al., 2017).

According to Ciesielska and Westenholz (2016), an organization seeking to adopt OSS must bear in mind that it must as well establish a robust association with the open-source software community. The organization must respect the community's standards or practices, a fact that may retrogressively limit its latitude for maneuvering on the other hand (Ciesielska & Westenholz, 2016). The consideration of service and support for OSS

is a delicate balance that the management of the small organizations must approach with caution not to end up curtailing the organization's productivity (Ciesielska & Westenholz, 2016). An organization that decides to abandon a community of developers risks losing the community's innovations and support (Ciesielska & Westenholz, 2016).

Developers of OSS often establish an online user support society as a necessity to promote the use of the project and its popularity (Koch & Bierbamer, 2016). They achieve this by contributing to OSS development and influencing the user community positively and negatively (Eskelinen et al., 2017). According to Ciesielska and Westenholz (2016), user involvement and interest and user communication regarding an OSS technology have been established to influence the OSS popularity positively. As Ciesielska and Westenholz (2016) emphasized, there is a clear recognition of developers' and users' roles in OSS development. Managers of small-scale organizations must put this in perspective because doing so makes them consider the underlying impact this deliberation has on OSS project performance (Simeone et al., 2017). The interaction involving users and developers has the potential of reinforcing the mutual adaptation occurring throughout the project development period to fulfill users' expectations (Simeone et al., 2017).

Staff Knowledge and Familiarity

OSS adoption by an organization may likely be a switchover from proprietary software before (Merlo et al., 2016). The adopting organization's staff must have their ability to use the technology prioritized (Merlo et al., 2016). According to the UTAUT,

three dimensions directly and considerably establish behavioral intention regarding technology use in the organization (Venkatesh et al., 2016). As Venkatesh et al. (2016) elaborated, these dimensions include performance expectancy, social influence, and effort expectancy. Such factors as gender, experience, age, and voluntariness of use further mediate behavior intentions (Tak & Panwar, 2017). The manager of the small organization adopting OSS must equally realize that usage behavior, which implies the real use of the system, is influenced directly by behavioral intention and facilitating conditions (Tak & Panwar, 2017). These aspects are represented by the existing organizational and technical infrastructures that support the system (Tak & Panwar, 2017).

Regarding performance expectancy, it refers to the degree to which technology's use is likely to offer benefits to the users or consumers and result in performance gains (Rahi & Mazuri, 2018). When it comes to using the OSS, the staff members' behavioral intention reflects the concept of performance expectancy. According to Dermentzi and Papagiannids (2018), when the staff members develop a high behavioral intention toward the new technology, they will have a strong determination to make the OSS a success. Thus, if the small organization managers establish that the staff members have a positive performance expectancy toward the OSS, they should be free to adopt the new project (Rahi & Mazuri, 2018). Managers can evaluate their staff members' performance expectancy of the OSS by assessing their communicative messages and information exchange before using the technology (Rahi & Mazuri, 2018).

Staff members expected to use the OSS also have different perceptions toward the technology in question (Khorakian & Jahangir, 2018). According to Aloini et al. (2017), for instance, staff members will look for useful functions that directly benefit them from the new technology. If users establish that the new technology will facilitate their development of new skills, Abubakre et al. (2017) explained that they would likely have a higher OSS adoption rate. Dang et al. (2017) opined that performance expectancy would significantly influence the staff members' behavioral intention and user behavior. Abubakre et al. (2017) observed that its use determines the staff members' decisions about using new technology to enhance the easy completion of a task.

Apart from performance expectancy, social influence reference reflects on the persuasion that friends, colleagues, and family members exert on the staff members when communicating and exchanging information (Herrero et al., 2017). Osatuyi and Turel (2019) described social influence as the degree to which individuals believe or feel that their significant others, such as friends, colleagues, and family, expect them to use technology. As Osatuyi and Turel (2019) explained, this influence often tends to shape the behavior of the individual toward adopting or using a new system. In a small organization seeking to adopt OSS, social influence is a major determinant, especially toward shaping users' behavioral intentions toward the new technology (Singh & Hardaker, 2014). Thus, the organization's management must determine the direction of the social influence of the new technology on the staff members as part of the adoption strategy (Singh & Hardaker, 2014). Herrero et al. (2017) explained that individuals who

embrace social acceptance have a higher likelihood of complying with others' expectations. This higher compliance is an essential factor for the organization because it may influence the staff members' behavioral willingness to use the OSS (Herrero et al., 2017).

Overall, social influence falls into interpersonal influence and mass media influence (Abbas, 2016). The interpersonal influence derives from reference groups that persuade an individual's opinion, behavior, and attitude (Graf-Vlachy et al., 2018). In this case, such reference groups include the co-workers, family members, and friends of the individual (Graf-Vlachy et al., 2018). Social influence, like Graf-Vlachy et al. (2018) highlighted, has a strong influence on staff members' behavioral intentions, especially when it comes to their interaction with new technology. Staff members may develop a strong positive attitude toward the OSS simply because their colleagues, friends, and family have positive feelings toward the technology (Graf-Vlachy et al., 2018). Asare et al. (2016) established that individuals often follow whatever their reference groups say, particularly if the reference groups enjoy greater power and authority to punish non-behavior and award good or desired behavior.

On the other hand, media influence refers to persuasion toward an individual's behaviors deriving from advertisements from television, newspapers, the internet, and radio (Adarsh et al., 2016). Tran and Corner (2016) pointed out that colleagues rather than family members considerably influence young individuals' intention to use new technology. Therefore, the organization's management needs to appraise the social

influence likely acting on their employees and determine how best they would influence their feelings toward OSS before adopting it.

Finally, regarding effort expectancy, the management of the adopting organization needs to understand that the ease of different technologies often varies, bearing on the adoption success levels (Joia & Vinhais, 2017). Effort expectancy refers to the extent of ease linked to the use of a given technology. As Joia and Vinhais (2017) added, effort expectancy is continually considered a significant predictor of the user's behavioral intention toward the technology. According to Kabra et al. (2017), user-friendly technologies cause significant positive persuasion leading to the embracing of technologies. Little effort is needed to use the technology. Studies, such as Kabra et al. (2017), have pointed out that effort expectancy crucially determines behavioral intention in as far as the actual use of the technology is concerned. This expectancy means that before an organization adopts OSS, there is a need for the management to ensure that the technology involved will be easy to use, especially by the staff members (Rahi & Mazuri, 2018).

Research by Chua et al. (2018) illustrated that a system that is simplicity-driven and with optimized efficiency is favored more by consumers than a complicated technology. In this case, consumers imply the staff members in the adopting organization who will be using the newly acquired technology. According to Rahi et al. (2019), effort expectancy positively predicts OSS's adoption in an organization. In formulating the OSS adoption strategy, the organization's management needs to settle for non-complex

technology that will be easy to be embraced by the members of staff. As technology becomes less complicated, the staff's intention to use it increases (Yen-Ting & Hofer, 2015).

Observability

Different scholars have explored the relationship between technology diffusion and the aspect of observability (Roberts & Saint, 2015). For instance, Mamun (2018) concluded a significant correlation between observability as attribute and technological innovations. Cheng (2017) illustrated that innovation diffusion must depend on a variety of diffusion channels. When many people access innovations, innovations will have a higher chance of being diffused. Essentially, a high-density network implies effective communication by members within the network, facilitating the diffusion of information (Cheng, 2017). According to Perra et al. (2017), observability refers to the degree or extent to which others can visibly attest to innovations. Hubert et al. (2019) opined that observability of innovations relates to whether people recognize the benefits and qualities attributed to the innovations. Mainly, the two innovation perspectives of observability include innovations communicability and innovation visibility (Perra et al., 2017). Considering the communicability perspective, it reflects the scale at which potential adopters can usher the features of new technology or innovations.

According to Perra et al. (2017), comparatively simple communicability of the innovations' features related to the purchase will be adopted quite easily. On the other hand, the visibility perspective reflects the "visual perceptibility" of innovations' features

or qualities (Perra et al., 2017).

An organization seeking to acquire open-source software must incorporate observability in its acquisition strategy (Pichlak, 2016). The observability is because, as already explained, the new software must directly cause innovations (Perra et al., 2017). Al-Hakim and Wu (2017) argued that role modeling has the most significant motivational effect on technology adoption and diffusion. Organizations seeking to adopt OSS can effectively rely on peer observation to ascertain the software's level of success before determining whether to adopt it. According to Nath et al. (2016), the results of some innovations are readily observable by others, while others are not. Perra et al. (2017) opined that observability is a vital attribute of innovations because it becomes easier for an adopting organization to implement if all stakeholders can attest to the innovations' positive influence.

Hubert et al. (2019) viewed observability from two different points that include result demonstrability and visibility. Result demonstrability, to begin with, reflects the ability to prove that positive outcomes are eminent for the user (Hubert et al., 2019). On the other hand, visibility reflects the ability to express those demonstrations with other people (Hubert et al., 2019). Asare et al. (2016) explained that observability correlates positively with the adoption rate. An organization seeking to adopt OSS will likely acquire it faster if the OSS is more visible from the early adopters (Asare et al., 2016). An organization's adoption strategy should realize that a technology needing an elaborate explanation is less “observable” (Perra et al., 2017). Cabrilo and Dahms (2018)

mentioned that ambiguous or abstract innovations generally diffuse slowly, which essentially makes it difficult to observe.

In establishing a successful strategy for adopting OSS, an organization needs to approach observability from two angles, as Perra et al. (2017) explained. The first angle should be to observe the visibility of the OSS or the people using the software. The second angle is the observability of adoption results (Perra et al., 2017). According to Hsin et al. (2017), low uncertainty levels and enhanced peer discussions can trace a new technology's visible results. A successful innovation evolves faster to fulfill the needs of the more demanding expectations (Hsin et al., 2017). Thus, as an organization seeks to determine whether to adopt a particular OSS, it must check the technology's visibility in terms of its capability to evolve faster and meet the ever-changing needs and demands (Perra et al., 2017).

Transition and Summary

Attributes of innovation are the most critical characteristics that determine whether an organization would procure a particular innovation type. These attributes include relative advantage, compatibility, intricacy and complexity, trialability, as well as observability. Adoption itself occurs in the form of a process, where individuals undergo different mental stages. Both cognitive and affective stages are involved when individuals encounter new technologies and make determinations about them. The adopter's perception, more than their social behavior, is therefore very critical when it comes to determining whether or not to adopt an innovation in the organization.

The likely adopters' attitudes create the intent toward the innovations, thereby paving room for either adopting or rejecting it. As a social process, diffusion of innovations occurs among people as a result of learning about innovation. Thus, diffusion of innovation may be in the form of a new evidence-based approach through which software in an organization can be improved or have its functionality extended. Individuals of a social system characteristically fall into five groups, including innovators, early adopters, late adopters, and later majority and laggards.

Through this study, I asked questions to evaluate and explore the strategies for adopting open-source software in small-scale organizations. The research questions were based on the broad review of the different literature sources and grounded in the DOI theoretical foundation. This study's findings reveal that the characteristics of innovations, including cost, comparative advantage, and complexity, are the basis of formulating successful strategies for adopting open-source software.

Section 2 of this study researched the strategies used by middle-level ISMs to adopt open-source software in their small-scale organizations. The section focused on the methodology employed in the study. Moreover, section 2 has separate sub-sections that include the purpose statement, method, design of research, research population, sampling methodology, collecting data, organization, analysis, and reliability and validity. Section 2 eventually transitioned into Section 3. In Section 3, a detailed analysis of data collection involving multicase doctoral study was covered.

Section 2: The Project

Purpose Statement

The purpose of this study was to determine the strategic approach that middle-level ISMs in small-scale organizations consider when adopting open-source software. The specific target population in the study was middle-level ISMs working in small-scale organizations in the city of Fredrick, Maryland. This study has social change implications directly benefiting the communities given that open-source software facilitates small scale organizations in enhancing operational efficiency. With this enhanced efficiency, the organizations have the opportunity to register greater growth and created additional opportunities of employment, increased corporate social responsibility spending, and presented internship opportunities about open-source software to learners in the community.

Role of the Researcher

In this qualitative study, I was the primary instrument collecting data. My acquired skills and education, particularly in the area of information security and software development, made me a professional in the field of technology. Abdalla et al. (2018) explained that a researcher's knowledge base is crucial in guaranteeing credibility in the eyes of the study participants.

According to Ketokivi (2019), researchers need to minimize bias in their studies by evading leading questions. I made sure that no leading questions were used in the study and instead I strictly used the interview protocol (Appendix A). I also avoided bias

by ensuring that I held no relations with the selected study participants. While conducting the interviews, I ensured that the study participants got adequate opportunity to elaborate on the issue of open-source software and the strategies they employed in their organizations when adopting it. By strictly following the interview protocol, I gained a deeper understanding of the research topic. Larrinaga (2017) underscores the significance of case study protocols when using interview methodology since they guide the researcher allowing them to collect consistent data. My researcher role in this study implied that I had a duty to use the interview protocol strictly to ensure that each participant subjected to the same questions. The consistency achieved through using the interview protocol throughout resulted in a more reliable qualitative research process (Larrinaga, 2017).

Being the researcher, I had a legal obligation to fulfill ethical guidelines and principles as per the *Belmont Report* (Friesen et al., 2017). Zyphur and Pierides (2017) observe that the ethical principles and guidelines serve to guard against the violation of the participants' rights. In fulfilling these ethical principles and guidelines, I made sure that I notified the participants about the research's aim and objectives before seeking their permission to participate. I did not coerce anybody into participating, but rather made it a voluntary decision.

Participants

Before embarking on a research study, it is important for the researcher to have clear criteria as well as principles that guide them toward participant selection (Gaus,

2017). The researcher uses the significance of such criteria and principle to assess the research's findings, as well as the transferability. When a researcher relies on a given participant selection criteria, they establish a more credible and accurate mechanism for identifying and describing the study participants (Ligita et al., 2019). There is, therefore, need for the researcher to observe closely the research criteria to protect participants in the study (Ligita et al., 2019). Participation in this study was confined to 6 middle-level ISMs from 3 small-scale organizations. The middle-level ISMs held experience of not less than 3 years in open-source software adoption strategy, and were directly involved in the process of adopting open-source software in their organizations. My choice of the small-scale organizations was determined by their physical location, which needed to be in the city of Frederick, Maryland.

I used the Frederick County Business Directory (2020), which is an online resource, to identify and select small-scale organizations that were to be involved in the study. After identifying and selecting 3 organizations listed in the website, I researched and reached out to some middle-level ISMs working for the selected organizations using LinkedIn website.

The criteria and principle used aligned to the research question: what strategies do middle-level information systems managers use to adopt open-source software within their small-scale organization's IT infrastructure?

I sought approval from Walden University's Institutional Review Board (IRB), and on getting it, I used e-mail to inform potential participants (Appendix B) of my

intention to carry out a study about strategies employed by middle-level information systems managers in small-scale organizations to adopt open-source software. The e-mail correspondence requested that the potential participants use the same e-mail address to contact me. Once the participants acknowledged this correspondence and indicated their readiness to participate in the study, I established a working relationship with them. Fjellström and Guttormsen (2016) pointed out the need for a researcher to build confidence and establish mutual trust with study participants using communication. Open communication between the researcher and the participants involved in a study results in confidentiality assurance (Fjellström & Guttormsen, 2016). This is important because the study participants who are confident with the researcher will be more realistic in their responses, which in turn makes the study findings more credible (Daniel, 2018).

Research Method and Design

Research Method

I considered the qualitative method as the most appropriate for this study. As an exploratory methodology, qualitative research investigates individuals, groups, human behavior, as well as phenomena (Snelson, 2016). Interpretive approaches are used alongside exploratory research to collect, analyze, and eventually make interpretations of the resultant research data (Ponelis, 2015). Snelson (2016) underscored the objective of exploratory research being to answer the *why* and *how* of a given phenomenon, as opposed to the *what*, *when*, and *where*. A qualitative study produces a solid finding based on the well-documented data that are assembled and the subsequent analysis undertaken

(Snelson, 2016). The qualitative research methodology was the most suitable for application in this study because I adopted a multiple case study plan to interview the participants. This guaranteed more practical responses regarding the strategies that the middle-level information systems managers in small-scale organizations employ to adopt open-source software.

The alternative quantitative research methodology was less ideal for application in this study given that it is intended to scrutinize variables and relationships existing between them, in addition to testing hypotheses (Powell, 2019). Ponelis (2015) clarified that quantitative research uses statistical data to establish findings after concluding with the analysis. The basis of quantitative research, according to Powell (2019), is probability and statistics. Since my research intentions never intended to test hypotheses or even look for statistical data, the quantitative research methodology was less ideal for this study.

Additionally, the mixed-methods was not a proper methodology for this study because it involves using both the quantitative and qualitative methodologies in a single study (Baskarada & Koronios, 2018). Mixed-methods research is used in designing, building, and testing theories (Turner et al., 2017). Moreover, when conducting an inductive and deductive analysis of a research question and hypotheses, a mixed-methods approach is best used (Baskarada & Koronios, 2018). My research intentions, nonetheless, targeted the insights of participants in particular. This intention essentially rendered the use of mixed-methods research less ideal for this study.

Research Design

I settled on multiple case study design as the most appropriate in this study. There are several qualitative research designs, among them ethnography, phenomenology, and case study (Venkatesh et al., 2016). These approaches contain similar features of research in as far as the research data, problem, data analysis, questions, as well as reporting results go. However, each of these research designs means the researcher uses different data collection processes (Venkatesh et al., 2016). Ethnography research design, for instance, is used mostly when studying people and cultures (Morgan-Trimmer & Wood, 2016). Through ethnography, the researcher achieves a well-suited means and approach for formative evaluation, which results in better understanding the population's response as regards new interventions and processes (Schnefke et al., 2019). The design requires that the researcher observes the participants while domiciled in their natural settings to understand clearly their perceptions, experiences, creation, as well as socialization (Draper, 2015). I did not choose ethnography as my research design because I did not undertake group culture observations. According to Draper (2015), the ethnographic researcher is expected to rely on numerous evidence sources to collect data in real-life situation.

Phenomenology, as a research design, focuses on examining the meaning underlying lived occurrences experienced by an individual or a group (Gaus, 2017). Researchers adopting phenomenology make every effort to identify with a construct as it appears to an individual's personal perspective (Flynn & Korcuska, 2018). According to Squires and Dorsen (2018), phenomenological studies generally have fewer participants

as compared to other qualitative methods, although they use multiple, longer interviews where each participant is intended to capture the real meaning of the experience. I did not consider using a phenomenological design either, because the target of this study was not the participants' lived experiences.

The case study design includes an empirical inquiry in which investigations focus on a contemporary occurrence in its real-life context, particularly when the demarcation distinguishing the purpose of study and perspective are not visibly evident (Ebneyamini & Moghadam, 2018). The intention is to investigate bounded systems in due course, using in-depth methods of collecting data (Tobi & Kampen, 2018). Case study researchers often consider triangulating data, which entails a data collection strategy that results in an elaborate case description (Ridder, 2017). I considered using the case study design because it combined my pragmatic worldview together with the DOI theory concept to facilitate more sensible findings. Using a small sample of participants, data collection and analysis methodologies, and having in consideration the time limits of conducting this doctoral study, the case study design proved effective in deriving plausible results.

Data saturation in research is attained when research interviews result in no new themes (Saunders et al., 2018). According to Boddy (2016), a qualitative researcher can continuously interview more participants until they experience data saturation. Qualitative researchers may consider stopping their interview sessions at the point when they notice that additional participants are not offering new details on the topic being

researched (Saunders et al., 2018). Data saturation was attained when no new themes emerged after all participants had been effectively interviewed.

Population and Sampling

I adopted the snowball technique of sampling for this research. This technique involves a chain referral process that provides a chance for the researcher to reach populations that would otherwise be quite challenging to sample when adopting alternative sampling methods (Kirchherr & Charles, 2018). The snowball sampling technique is not a probability sampling method, meaning using it will not accord me the necessary freedom to review each of the participants before selecting the most appropriate ones (Kirchherr & Charles, 2018). By using the snowball sampling technique, I succeeded in finding and using participants who better understand the strategies used by small-scaled organizations in the adoption of open-source software.

There is no single sample size that is applicable across all research. Vasileiou et al. (2018) argued that the ideal sample size for a particular research will be determined by various factors, among them the individuals and the groups taking part in the study. I relied on the research question, research purpose, and data saturation in this study to determine the most appropriate sample size. I interviewed each of the six middle-level ISMs from three small-scale organizations. This was an ideal sample size as it generated data that resulted in data saturation.

According to Ågerfalk Pär et al. (2015), middle-level ISMs have a direct role in determining the strategy that their organizations eventually use when adopting new

software. The middle-level ISMs also provide recommendations to the senior management of the organizations on other important issues regarding their choice of strategy, including security and other issues (Ågerfalk Pär et al., 2015). I selected small-scale organizations as the reference point in this case study because I aimed to identify strategic approaches employed by medium-level ISMs in small scale organizations in adopting open-source software. The selection of small-scale organizations enhanced my research intentions to access and engage the intended facilities.

I started recruiting the participants making up the sample by searching the Frederick County Business Directory online. This resource listed small-scale organizations in the city of Frederick, Maryland, together with the relevant contacts.

Since no partner organization was involved, I used LinkedIn to reach out to my participants after gathering relevant and essential information regarding their respective organizations. My decision to limit the search exercise to within the city of Frederick, Maryland, ensured that only participants who meet the population criteria identified by the study criteria were engaged and spearheaded the achievement of data saturation.

I relied on three guiding principles to determine the sample to involve in this study. These principles included considering the research question, a reflection of the purpose of the study, and the necessity to achieve data saturation. I began my sampling with at least six participants from at least three small-scale organizations. I pursued data saturation as a critical aspect of this study. I achieved the data saturation through continuous data collection until such a time when there was no new information coming

up from the research participants. As part of this study, I considered each small-scale organization as a case. Therefore, I ensured interviewing as many participants as I could in each case until I reached the data saturation.

Berkovich (2018) explained the need for the real world setting of a phenomenon being assessed by a qualitative researcher. The case study design provides an opportunity through which the investigation of a phenomenon can be undertaken in its natural setting and away from interference from the control and manipulation of participants (Beach & Pedersen, 2016). I recommended the participants to pick their preferences regarding the interview settings they consider most appropriate to ensure improved rigor and validity.

According to Mason (2018), a relaxed interview setting offers encouragement to the participants to respond to the interview questions freely and also ask questions where they feel they did not understand an issue. Essentially, the participants will feel comfortable, relaxed, and more secure to deliberate on their views while freely interacting with me as they familiarize themselves with the whole interview process. I conducted the interviews in a private location away from distractions and deliberate automation bias. This helped achieve the necessary privacy for the participants and the interview process as well. I used questions in the interview protocol (Appendix A) to get answers that reflect the participants' overview of the strategies considered in the adoption of open-source software. I electronically recorded the interview process to ensure that I did not take a lot of time writing the responses but instead sustain an eye contact with each of the participant. I used two recording devices for fail safe purposed in case one

device fails. I also ensured that I focus more on the actual data collection exercise. I also allowed participants to ask questions at the end of the interview, which opened up more opportunities for getting additional data.

Berkovich (2018) explained the need for a qualitative researcher to assess a phenomenon's real-world setting. The case study design provides an opportunity to investigate a phenomenon in its natural setting and away from interference from the control and manipulation of participants (Beach & Pedersen, 2016). I recommended the participants pick their preferences regarding the interview settings they consider most appropriate to ensure improved rigor and validity. According to Mason (2018), participants in a relaxed interview setting are encouraged to freely respond to the interview questions and ask questions where they feel they did not understand an issue.

Practically, the participants will feel comfortable, relaxed, and more secure to deliberate on their views while freely interacting with me as they familiarize themselves with the whole interview process. I conducted the interviews in a private location away from distractions and deliberate automation bias. The participants enjoyed the privacy to continue with the interview process. I used questions in the interview protocol (Appendix A) to get answers that reflected the participants' overview of the strategies considered in adopting open-source software. I electronically recorded the interview process to ensure that I did not take a lot of time writing the responses but instead sustained eye contact with each participant. I used two recording devices to feel safe in case one device failed. I also ensured that I focused more on the actual data collection exercise. I also allowed

participants to ask questions at the end of the interview, which opened up more opportunities for getting additional data.

Ethical Research

Upon getting the relevant approval from Walden University, I selected the small-scale organizations I intended to study. I sent an informed consent form through e-mail and my Walden University e-mail address requesting each selected participant complete it before beginning the research. The form served as official communication expressing the participants' approval to be part of the study. Information in the consent form touched on the study purpose, the researcher's role, criteria to participate in the study, and the process of withdrawing from the study. The consent form also described the publication plan regarding the study findings, and mention the mechanisms involved in safeguarding the data. According to In Smit (2018), all research studies must obtain informed consent. I emphasized to the participants that their involvement in the study was strictly voluntary rather than forced. I also informed the participants that they had a right to stop their participation and withdraw altogether from the process when they deemed such an action to be necessary. The participants were not obligated to explain their withdrawal decision, but part of the condition required they e-mail the researcher notifying their decision to stop participating.

As Spruit et al. (2016) explained, the informed consent ought to uphold participants' rights and ensure they get the respect they deserve. Informed consent further guarantees full adherence to ethical standards. I used Walden University IRB ethical and

legal requirements as a measure to uphold participants' rights. Spruit et al., (2016) explained the need for a researcher to ensure a more balanced participant interaction as a means of guaranteeing total fulfillment of the necessary ethical requirements. It is essential when undertaking any qualitative research to ensure the participants' safety and dignity to guarantee ethical practices. I included a clear statement in the informed consent form to the effect that participants would receive no form of incentive payout before having them enlisted in the study. Instead, the informed consent form announced participation in the study as being voluntary.

According to Lee (2018), upholding research participants' confidentiality should always happen to ensure integrity in the whole study process. One way of ensuring participants' confidentiality is through the use of unique identifiers (Lee, 2018). This approach helps in guarding the participants' professional status. I used letters and numbers that were assigned to each participant to achieve participant confidentiality.

As the researcher, I was the only one with access to data resulting from the study. I used an external drive protected by a strong password to store all the data resulting from the study and encrypted the external drive to make it difficult for anyone to read the information. This external drive will be stored for five years safely before permanent deletion happens. I stored paper documents in a cupboard that will remain locked throughout, and access is limited to me only. The destruction of the paper documents will happen by way of shredding after five years.

Walden University's approval number for this study is 07-17-20-0671822, and it

expires on July 16, 2021.

Data Collection

Data Collection Instruments

Being the researcher in this study, I served as the primary data collection instrument. Kelly (2019) mentions that a qualitative researcher assumes the primary data collection instrument's role in a qualitative study. When collecting data, I ensured that the process happened within the natural setting of the participants. By restricting data collection within the participants' natural setting, I managed to do inductive data analysis. Additionally, I undertook a deductive data analysis concerning the basic themes and patterns established. Qualitative data collection calls for trust establishment with the participants, with the researcher expected to ensure that the whole exercise is credible in the participants' eyes (Greenwood, 2016).

Researchers often use semistructured interviews to choose when collecting data in qualitative research (Azungah, 2018). I had seven open-ended sets of questions (Appendix A) as part of my instrument for collecting data. Semistructured interviews constitute a valid data collection instrument in qualitative research (Azungah, 2018). I used open-ended questions (Appendix A) in the interview to achieve more significant interaction between me as the researcher and the participants. Ponelis (2015) opined that open-ended questions provide a researcher with the perfect chance to explore all the study's relevant aspects.

Different participants in an interview session in research will likely give different answers to the same question. Using semistructured interview formats provides the participants with a perfect chance to understand the topic under research (Azungah, 2018). Adopting a semistructured interview results in an accessible, intelligible, and flexible approach regarding data collection (Ponelis, 2015). Qualitative studies are highly effective when they adopt semistructured interviews. A researcher adopting semistructured interviews methodology in a study will likely determine numerous hidden human behaviors and organizational aspects (Ponelis, 2015).

I used the same set of questions for each participant as per the interview protocol (Appendix A). This consistency guaranteed a more credible and reliable process. I ensured the interview protocol included no leading questions as a way of tackling bias. Another advantage of using the same set of questions for all the qualitative research participants is that the researcher quickly discovers themes (Iasbech & Lavarda, 2018). By asking the same questions repeatedly in a sequential manner, the researcher will likely get numerous responses grouped in themes (Tobi & Kampen, 2018). Moreover, sequentially asking the same questions provides for efficient data analysis on the part of the researcher. The efficient data analysis presents the researcher with the added advantage of drawing comparisons to the responses (Tobi & Kampen, 2018). There is a need for researchers to drop all leading questions to tackle the question of research bias.

Data Collection Technique

Several data collection techniques in use include document reviews, physical artifacts, reflective journals, interviews, archival record reviews, and observations (Alpi & Evans, 2019). The use of multiple data sources in the gathering of qualitative data enhances data reliability and significant authentication of emerging data (Leung, 2015). I reviewed pertinent company documents in addition to conducting interviews with participants.

Assessing supplementary company documents and other external resources offers yet another mechanism for collecting qualitative case study research data. To maximize interview depth, researchers suggest using multiple evidence sources, including personal interviews and document reviews (Ebneyamini & Moghadam, 2018). Reviewing relevant documents about the company, such as policies, magazines, sustainability reports, or procedures, plays a vital role before conducting interviews (Paradis et al., 2016). Tsai et al. (2016) opine that adopting a consistent data protocol in qualitative research improves cross-case analysis.

In the case of study research, the necessity of rich details about the case underscores the complex layers constituting the social domain structure (Ebneyamini & Moghadam, 2018). Understanding the case setting requires adequate contextual description (Winchester & Salji, 2016). I used various sources regarding the evidence and used detailed descriptions in depicting the environmental setting.

Semistructured interviews involving open-ended questions provide opportunities to the interviewer and the interviewees to clearly understand the phenomena topic

(Devotta et al., 2016). I used a set of standardized questions in the interview sessions to investigate the strategies that middle-level information systems managers use to adopt open-source software within their small-scale organizations. Interview protocols contain research questions and guide the researcher on how to undertake the entire interview process (Quinney et al., 2016). Appendix A captures the interview protocol that will allow the interviewer to ask the same questions to each of the participants using the same sequence. I conducted the semistructured interviews personally at the venue agreed on with the rest of the participants. I used the Interview Questions (Appendix A) to gather participants' opinions and experiences regarding the strategies they use to adopt open-source software. After every interview session, I gave each of the participants a chance to ask questions or give additional data.

I used member checking technique to guarantee proper research throughout the interview process and control bias. Member checking accords the researcher the chance to realize rigor in case studies (Iivari, 2018). I carried out a second interview that was in the form of a phone conversation. I continued with the interviews until I ensured that no new information was coming up. The continuing interviews allowed the participants to appraise the interpretation I made about their responses before I could continue with the research exercise. Using member checking provides the researcher with room to ascertain the accuracy of a participant's response. Member checking is also a quality control mechanism that presents the researcher with an opportunity to verify, make clear, and

Data Organization Techniques

Researchers apply numerous data organization techniques to manage data and consequently enhance the reliability and validity of the study (Ashour, 2018). I transcribed the interviews by transforming all recorded audio into written content and organizing all the transcripts in Microsoft Word document. I looked to uphold the research participants' confidentiality by doing away with personal or identifiable details likely contained in the research, giving out the participants' identity. I created different folders with different labels reflecting each case study that could store archival documents, research log, and member-checked transcripts.

I used numbers and letters to uniquely identify them in the transcripts and research log for each participant. I used a combination of the letter 'P' and a number to signify each participant. According to Sim and Waterfield (2019), researchers need to protect all identifiable information about the research participants. By adopting letters and numbers as unique identifiers of research participants, a researcher conceals each participant's privacy and effectively upholds their confidentiality (Sim & Waterfield, 2019). Using unique identifiers equally guarantees the participants the necessary confidence they require as they are convinced none of their personal information is likely to be revealed out by the study. I also ensured I upheld the participants' security and privacy by storing the transcripts, interview recordings, and notes in an encrypted hard drive. This external drive will be stored for five years in a safe before I can permanently destroy the data through deletion. Access to the hard drive will be possible only after imputing a unique password, which no one else other than me will have. I stored the

transcripts, interview recordings, and notes documents in a safe that will remain locked throughout and access limited to me alone because I am the only one having the key. The destruction of the paper documents will happen by way of shredding after five years.

Data Analysis Technique

I carried out thematic investigations of data by interviewing, observing, reviewing member comments, describing narratives, carrying out digital recording and word processing entries. I transformed raw data and consequently organized it to realize rigor in data analysis. I observed all data analysis requirements by fulfilling all the standard principles, such as interview transcription, member checking, determining themes, and data coding development.

My aim of carrying out data analysis was to appraise the themes and patterns observed during the interviews significantly. I relied on QSR NVivo to upload, organize, as well as analyze and transcribe interview data. QSR NVivo is software capable of aiding data collection and the consequent management and analysis of other qualitative data forms such as audio and written content (Woods et al., 2016). My use of QSR NVivo software allowed me to identify meaningful nits, manage data, undertake triangulation, and expand emergent themes.

I further loaded the documents about security and privacy into QSR NVivo to undertake methodological triangulation. Carrying out methodological triangulation provided a chance for me to use numerous qualitative research data sources. By undertaking methodological triangulation, I achieved flexibility with regards to trends

determination during the data analysis process. Using numerous sources of data provides for methodological triangulation, which is critical in supporting a sound research finding, plausible concluding remarks, and practical recommendations.

I equally followed the privacy and security policy documents of the relevant small-scale organizations involved in the study. I accessed these documents on the websites of the organizations and used them purposely for methodological triangulation purposes. I further asked the participants to supply me with documents not available on the website, but they talked about their OSS infusion. Multiple data sources use for methodological triangulation purposes contribute immensely toward achieving a credible, valid, and reliable study (Abdalla et al., 2018). According to Abdalla et al. (2018), merging participant interviews with archived data necessitates a highly robust study. The resultant robust study is because archived data in documents and recordings form essential qualitative research data. When a researcher analyzes archival documents in addition to making observations and interviewing participants, they are likely to reveal essential research themes (Davidson et al., 2019).

Through methodological triangulation, a researcher will clearly understand all the facts under study (Abdalla et al., 2018). With the help of two data collection methods, it is possible to achieve comprehensive and sound data and enhance understanding of the case under study (Heesen et al., 2019). Additionally, using methodological triangulation ensures that patterns are probed within the data, allowing for the making of interpretations by the researcher using multiple perspectives (Berkovich, 2018). The use

of methodological triangulation is effective in boosting confidence in achieving the study's findings. According to Heesen et al. (2019), the boosting of confidence results from using multiple sources that effectively help curb research biases.

I made use of data coding as a way of simplifying pattern comparison and recognition. During the qualitative data coding exercise, I scrutinized the study data to categorize it based on common themes and ideas effectively. The benefit of coding includes aiding the analysis and organization of data, making it easy to draw comparisons and extract meaning. The coding process that I applied arranged the data based on source types and determined emerging themes using interviews and archived documents. The use of QSR NVivo during data coding requires the creation of nodes (Woods et al., 2016). A node implies the references for a specific theme, place, person, or a given area of interest. Types of data sources are characteristic of the nodes.

For each data collected and analyzed, I organized it into separate categories that reflect research themes for easy thematic analysis. Uher (2018) observes that qualitative studies constitute the formation of data categories to allow the researcher to classify relevant themes in analyzing data. Categorizing the emerging themes, patterns, and trends from interview findings and responses form the foundation of data organization (Cunningham et al., 2017).

It is easier for a researcher to discover patterns and themes and draw meanings from the responses by participants when they use transcriptions, notes, and logs (Annink, 2017). The significance of the transcriptions, notes, and logs lies in that they make the

study valid and reliable (Uher, 2018). I made interview notes to reflect a research log to guarantee the validity, reliability, and conformability of this study. Researchers use research logs to capture data and scrutinize actions and assumptions that form themes in a study. A researcher can use research logs as a valuable audit trail, ensuring conformability. The conformability would further provide the researcher with recognition and reflection of the likely challenges that would eventually shape the study. Additionally, keeping research logs helps in limiting likely bias in the study (Annink, 2017).

There is a likelihood of additional themes and patterns emerging in my uploading interview transcripts and other external data for data analysis. Special tools such as QSR Nvivo 12 can help researchers determine themes and trends (Massaro, 2018). Researchers regularly use software to aid them in keeping track of data and consequently organizing it (Woods et al., 2016). I relied on QSR NVivo for purposes of data organization and the discovery of themes and trends. Researchers rely on several computer programs are also relied upon by researchers for purposes of organizing and classify interview responses from participants and data from other sources (Woods et al., 2016). The computer software helps scholars undertake transcription and other essential activities such as data journaling, data analysis, and data organization (Annink, 2017).

Reliability and Validity

Dependability

Dependability implies the research data's constancy over similar conditions (Abdalla et al., 2018). Qualitative researchers often employ a reflexive journal, which serves as an audit trail. The researcher uses the audit trail to ensure their study's confirmability and dependability (Forero, et al., 2018). Gobo (2016) explained methodological triangulation in terms of the action to merge data drawn from varied sources to emphasize validity and reliability. According to Larrinaga (2017), methodological triangulation offers critical insight that effectively addresses potential issues touching on construct validity in as far as case study research is involved. I used methodological triangulation and member checking as the perfect mechanisms to achieve a more accurate, credible, and dependable study. I triangulated semistructured interviews with archival documents that included privacy and security policy statements from the two institutions to be directly involved in this study. This measure mainly looked to address the question of validity in this research.

Credibility

Research credibility intends to do away with bias while equally minimizing qualitative research errors (Ruel et al., 2016). Ramezanzadeh et al. (2016) described the use of transferability, confirmability, and dependability in research studies as major determinants of trustworthiness and validity. According to Pierre (2017), quality, credibility, conformability, and data dependability guide qualitative research findings. When research data interpretation is accurate, the outcome is reliable and valid (Mir, 2018). A qualitative researcher often is driven by the sole purpose of establishing

credibility. Li et al. (2019) advised researchers always to gather adequate detailed data that would result in the construction of study findings, conclusions, and credible recommendations. To maintain a credible study continuously, I followed the stipulated research methodology, design, and data collection and data analysis. Participants responded to similar interview questions. Additionally, I employed member checking by way of reviews of my interpretation attributed to individual responses.

Transferability

Lavrakas and Traugott (2019) consider transferability in terms of the aptitude to generalize the findings of research to benefit a wider population. When a qualitative researcher makes it easy for the individual not involved in the research to find meaning out of the research findings, they are said to have achieved transferability (Lavrakas & Traugott, 2019). The research structure included snowball sampling and a comprehensive outline encompassing the research limitations, delimitations, and assumptions. The researcher relied on this structure to establish the transferability of this particular study by other researchers.

Confirmability

Through cconfirmability, the researcher restrict the relaying of participants' responses instead of their own bias (Forero, et al., 2018). I achieved confirmability and dependability in the case of this study through transcript recording and reviewing, member checking, note taking, and member checking in the course of the interview process.

Transition and Summary

The growing use of OSS and the limited resource capability of small-scale organizations have pushed the need to use the OSS as an alternative to the more expensive. Lack of the necessary software can hinder the potentials of a small-scale organization quite significantly. The quantitative case study offered middle-level IT managers in small-scale organizations with strategy ideas on OSS's adoption. Data from the study might socially impact middle-level IT managers' decision-making by enhancing their knowledge of OSS adoption strategies and enhancing their ability for success.

Section 2 covered the research purpose and research problem and justified the research methodology and design, including data collection, participants, and sampling methodologies. Section 2 also offered a description of the analysis strategy used and explained the approaches used to achieve ethical, valid, and reliable research. Using a case study as a research methodology supports qualitative research because it answers the *why* and *how* questions about the phenomena under investigation. Snowball sampling technique facilitated data collection in this study, where six middle-level IT managers from small-scale organizations in the city of Frederick, Maryland, were involved. Open-ended questions constituted the semistructured interviews, granting the interviewees the chance to explain OSS adoption strategies they use. Using NVivo qualitative software during the data analysis enabled the classification and exploration of the non-numeric data involved.

Section 3 covers the qualitative study overview, where the presentation of conclusions draws from the research data collected and the analyzed outcome. The section also presents an application of the study concerning professional business practices and the potential social change implications. The section also covers recommendations for action based on the themes highlighted by the study. The section concludes with the recommendations for further research and personal reflections.

Section 3: Application to Professional Practice and Implications for Change

In Section 1, I covered the introduction of the study's foundation, which entailed the general knowledge about the study. Section 2 included discussions touching on the numerous elements making up the study. In Section 3, I include the study overview, as well as a presentation of findings, and the application of the findings to professional practice. Moreover, in this section I address the implications toward social change, provided recommendations for action, provided recommendations to guide further study, included reflections, summary, and finally, the conclusion to the study.

Introduction

In this qualitative multiple case study, I explored the strategies used by middle-level ISMs to adopt open-source software in their small-scale organizations. I analyzed data gathered from six semistructured interviews that I conducted with six research participants, as well as from the organizational documents that I reviewed.

Four main themes materialized from data analysis: software acquisition cost, staff knowledge, support services, and relative advantage. Participants also mentioned areas of

deficiency and concern in their process as well as continued struggle in dealing with external and internal change as they make effort to improve.

Presentation of the Findings

The overall research question for this study was: What strategies do middle-level ISMs use to adopt open-source software within their small-scale organization's IT infrastructure? My strategy for responding to this question entailed conducting semistructured interviews intended to generate in-depth information from six middle-level managers from three organizations located in the City of Fredrick, Maryland. In the semistructured interview, my goal was to understand the various strategies used to adopt open-source software in the organizations. Each of the participants qualified to participate based on the fact that they had a minimum of 3 years of experience adopting open-source software in small-scale organizations. The participants had codes Participant 1, Participant 2, Participant 3, Participant 4, Participant 5, and Participant 6, while the respective organizations had codes E1, E2, and E3. Researchers use codes with the intention of protecting the participants' privacy and uphold high-level confidentiality. I analyzed publicly accessible documents from each organization, among which included financial data, newsletters, and press releases. These documents were available on the respective organization's websites. I triangulated data collected during the semistructured interviews as well as data collected through organizational document reviews. All the study participants filled in and signed the informed consent forms expressing their

willingness to take part in the study before they participated in the interviews. Each interview session lasted no more than 20 minutes.

I analyzed data and arranged them into themes using NVivo. I compared themes with the literature reviewed to establish relevance and consistency. This study's conceptual framework was DOI. Using Microsoft Word documents, I transcribed interview data and uploaded transcriptions, research observations from interviews and documents, and interview audio recordings into NVivo. I kept notes as well to contribute to the research journal. By using NVivo, I stored the data in one location to make the analysis easier, highlighted the themes, and conducted in-depth data analyses. Out of my analysis, the four main themes that emerged included: (a) determining the relative advantage, (b) cost control, (c) providing support services, and (d) staff knowledge. Each of these major themes comprised subthemes that I used to contextualize the main theme. The illustration in Table 1 highlights the major themes attributed to the process of data analysis. The order of theme ranking has no relevance.

Table 1

Major Themes Emerging From Data Collection

	Participants		Documents	
Major/minor themes	Count	% of Response	Count	References
Relative advantage	6	100	19	85
Cost control	6	100	17	65
Support services	6	100	19	93
Staff knowledge	6	100	8	36

In the analysis below, I covered all the four themes, analyzed how they are linked to the literature, as well as the conceptual framework adopted in this study.

Theme 1: Relative Advantage

The first theme that arose from my data analysis was relative advantage. This theme included three subthemes: cost efficiency, ease of use, and the level of support required. Cost efficiency results from a combination of lean operating methods that improve the quality of the final products or services, enabling flexibility in production and enhancing the workforce productivity, which in turn generate competitive advantage, effective sustainability and generally good performance for enterprises (Mamun, 2018). Ease of use is an aspect of relative advantage in the sense that it captures user motivation in terms of the characteristic of using the IT innovation, such as the process required to use it and its interface. Essentially, a user will consider it relatively advantageous in case they find the IT innovation to have such ease-of-use characteristics as interface clarity, navigational ease, etc (Fearnley & Amora, 2020). Finally, the level of support required is also as aspect of relative advantage in the sense that when employees of an organization adopting innovation consider an innovation to be complex, they will likely have lower self-efficacy and consequently remain reluctant to use it. A higher level of support will likely generate greater relative advantage, while a lower level of support will diminish the relative advantage (Chiu & Fogel, 2017). Table 2 highlights the three subthemes under relative advantage.

Table 2

Subthemes Under Relative Advantage

	Participants		Documents	
Subthemes	Response	% of Response	Count	References
Cost efficiency	6	75	7	18
Ease of use	4	50	10	41
The level of support required	6	75	9	80

Note. % of response means proportion of responses by participants for each subtheme. References means the frequency by which each subtheme was mentioned or alluded to in the documents

Cost efficiency. The six participants emphasized the importance of appraising the issue of OSS cost, explaining the consideration of cost efficiency as a function that closely relates to organizational goals. Piloting tools were critical in determining whether the targeted open-source software was affordable. Participants were able to assess the time and costs associated with installation, operation, and exit. If the cost and number of man-hours required to support OSS superseded the cost and time required to maintain a commercial tool, then participants adopted commercial software. Participant 1 said,

> …if I implemented an open-source network monitoring tool, and I knew this might take four to eight hours a week, but a commercial one might not have those same maintenance hours, you know, that would have to get factored in.

On the other hand, Participant 3 stated, "As the IT department, we analyzed different experiences from different organizations in terms of the costs incurred during OSS implementation. This evaluation helped us to determine the costs involved, which in

turn informed our decisions." Moreover, review of archival documents from E1 indicated the organization requires cost evaluation for new software acquisition to determine cost effectiveness of the decision.

The management making investment decisions by drawing comparisons between the costs of an OSS and its benefits apportions the available resources effectively (Baharuddin et al., 2018). Companies grapple with an ever-growing cost of IT as they modernize their operations amidst the fact that IT is an indispensable element of company resources. In today's economy, given the heavy price tag linked to IT infrastructure, companies must establish ways to lower their overhead while ensuring their technology remains current.

Cost efficiency is a critical question of the DOI theory because, as already noted, cost efficiency is achieved when an organization implements lean operating methods and innovations that not only improve the quality of the final products or services, but also permits flexibility in production and enhances the workforce productivity. The resultant high-quality products or services, as well as the flexible production and enhanced workforce output generate competitive advantage, effective sustainability, and generally increased performance for enterprises (Mamun, 2018). Small-scale organizations often lack adequate capacity and resources to evaluate, learn, establish, and set aside finances to cater for uncertainty of the technology in future (Taha et al., 2018). As an aspect of DOI, cost efficiency is tied to the economic benefit that is directly associated with innovation adoption decisions. The concept of increasing return holds that something

placed ahead will often get further ahead, meaning that small-scale organizations with greater cost efficiency will likely adopt far much more innovations than those starting with lower cost efficiency (Mamun, 2018).

In general, easy adoption with regard to low cost often tends to inhibit the productivity distribution. In a practical sense, low-cost innovation often appears to spread the distribution. Therefore, the shape that the distribution takes, which typically resembles a truncated Pareto, results from the comparative efficiency of the adopted innovation. The uncertain or random innovation state means that some firms with bad luck or those that are uncreative fall back in comparison to the ones that are adopting and innovating (Buera & Lucas, 2018).

Adopting OSS for small-scale organizations may not necessarily be cheaper, especially given that maintenance and additional adaptations may require more resources to achieve (Ciesielska & Westenholz, 2016). Cost is therefore a major concern for the adoption of OSS by small-scale organizations. According to Parmentola et al. (2018), the three software characteristics of high observability, high trialability, and low complexity makes innovation less costly for small-scale organizations especially in terms of the searching costs. According to Perra et al. (2017), role modeling would help small-scale organizations tackle the question of cost barriers during the adoption of OSS. Through peer observation, a small-scale organization avoids numerous expenditures that would render the OSS being adopted quite costly (Kassen, 2018).

Ease of use. Each of the six participants admitted to having experiences with different open-source software types. From the responses by the participants, each of the specific software type depended on the company's core mandate. For instance, participants who did a lot of network-analysis related work adopted network-scanning tools such as Multi Router Traffic Grapher (MRTG). It was important to establish that the open-source software adopted was better than the existing solution and so all participants had criteria to evaluate potential software for suitability. The first and most critical step was defining the needs. During this step, participants were concerned with the task at hand and what tool, among a pool of possible solutions, would be the best fit for their needs or their client's needs. Participant 2 said, "…the ultimate factor that's gonna help us make the decision is, based on the skills our staff, how quickly can we learn and master the new tool." Review of E3's archival documents underscored the necessity of ease of use of any software acquired to guarantee organization benefit and effectiveness. Ease of use, as a factor of OSS relative advantage, is important because it directly influences the way the end users perceive the usefulness of the software. When users of a new OSS perceive it as easy to use, their likelihood of adopting it grows significantly because they appreciate the resultant relative advantage (Taherdoost, 2018).

As a dimension of relative advantage, ease of use relates to DOI in the sense that it captures social and psychological concepts that assist in forecasting decision-making patterns by people in terms of adopting new innovation. Generally, when users find it difficult to use an innovation, it negatively affects their perceived usefulness of the

innovation (Min et al., 2018). Essentially, small-scale organizations must work to ensure that their employees develop positive perceptions about the use of OSS before adoption to ensure better perceived usefulness. Based on the DOI concept, the rate of adopting innovations depends on the ease of comprehension (Gledson & Greenwood, 2017). Innovations considered clear by the potential adopters are often less complex (Dutta & Omolayole, 2016). According to Perra et al. (2017), the complexity of the OSS poses numerous difficulties to the users. Such complexity forces the small-scale organizations to consider ways that would enhance their capacity to interact and use the technology. An organization, for instance, may consider pursuing employee training to increase the users' understanding of the OSS. However, as Perra et al. (2017) observed, such intervention measures only make the OSS less viable for adoption. As managers of small-scale organizations determine the most successful strategy to consider when adopting OSS, therefore, the question about the software's ease of use must guide their decision-making. The managers must consider low complex OSS that will make it easy for the intended users to interact with the software (Parmentola et al., 2018).

Level of support required. The interview data reflected the fact that if the level of support required for OSS adoption was low, then participants adopted the software that benefits from community-based support and so it is always evolving and getting updated. The downside is of community support is the possibility that a bad actor writes a malicious code. Participant 6 said, "One of the major risks is if you have a bad actor in those communities that have participated in updating or writing some of those codes."

Additionally, analysis of Participant 6's archival documents revealed high level of support needed "must be avoided or given low priority as this is likely to leave the organization at a disadvantaged position."

The level of support required potentially links with the DOI concept in the sense that for an innovation to gain momentum and spread through a particular social system, it requires aiding in one form or another. Generally, implementing an innovation involves overt behavior change that may prove difficult for small-scale organizations seeking to adopt OSS. According to Joia and Vinhais (2017), the novelty of an innovation coupled with uncertainties prevailing can hinder the adoption process altogether, owing to the displacement of information flow from the users to other people. Technical assistance is vital during the innovation's actual implementation phase, often from change agents and other important players. A higher degree of technical support to the small-scale organization adopting OSS will reduce the level of uncertainty around the consequences (Joia & Vinhais, 2017).

Since small-scale organizations may not have the capacity to procure support services from software experts based far away from the organization's physical location, local-based support's option receives priority. However, the risks mentioned by participant 6 forces the small organizations to go for commercial software where they had guaranteed support. Participant 5 responded, "…if I needed a tool that needed 100% uptime or that was very critical and business nature, I would probably not opt for open-source." Review of archival documents from E1 reflected, "For critical operations in our

organization that highly depend on software performance and support, the management prioritizes an alternative to open-source software." The availability of OSS developers must be guaranteed even after a small-scale organization has adopted the software because the assistance they offer helps improve the project (Xiao et al., 2018). As part of their strategy, small-scale organizations must ensure that they can easily access OSS service and support before acquiring it. Unless a small-scale organization can access effective service and support, adopting an OSS would not offer them a competitive advantage (Sharma & Sagar, 2018). The management of the small-scale organization must consider the possibility of sharing organizational preferences with the OSS producers to guarantee the software's configuration in a way that best suits their operations (Aloini et al., 2017). As Cheruy et al. (2017) observe, an OSS's popularity serves as a good indicator in determining the availability of support because the more popular a technology is, the highly likely it generates attention among the users.

The level of support required is also linked to DOI because the theory premises that a typical commercial consumer marketplace comprises different consumer types whose enthusiasm for a product varies. According to DOI, innovative products "diffuse" out to the market in alternating periods and not on a straight pathway (Gregoire, 2016). The innovators become the first consumers of the innovation before the early adopters, and the early majority follow suit. In the end, the late majority and laggards become the last ones to utilize the invention (Mollaoglu et al., 2016). The level of support required plays a vital role in convincing the would-be consumers to embrace the innovation even

if it fails to meet their anticipations. The DOI theory holds the perception that if consumers get convinced through the level of support required that the invention is innovative, they will most likely embrace it as it diffuses through the marketplace (Gregoire, 2016).

Theme 2: Cost Control

Cost control ranked as the second theme from the research analysis. The constitution of this theme comprised two subthemes, among them adopting mature OSS and in-house technical skills. The illustration in Table 3 highlights the two subthemes under cost control.

Table 3

Subthemes Under Cost Control

	Participants		Documents	
Subthemes	Response	% of Response	Count	References
Adopting mature OSS	6	75	10	71
In-house technical skills	3	37.5	7	58

Note. % of response means proportion of responses by participants for each subtheme. References means the frequency by which each subtheme was mentioned or alluded to in the documents

Adopting mature OSS. The level of maturity of the open-source software determined the level of support required. A newly released software has a high cost and time demands. Hence, participants opted to adopt a mature tool whose time and cost of customization were low. Participant 2 said, “We look for open-source software that is

almost complete so that we don't have to do much customization to it so that we would keep the cost down." The archival document from E1 illustrated that new OSS was likely to drive the IT operation costs high compared to mature OSS that has been in the market for a while. The question of mature OSS comes about because it is crucial to understand the technology before deciding to implement it. When a technology is still new, many decision-makers often remain apprehensive about it, causing its minimal adoption rates (Adarsh et al., 2016). The majority of innovations follow this diffusion pattern.

Decision-makers will take time before they begin learning about new technology. With time, the decision-makers also interact with the new technology's external agents who convince them to consider it. Once the technology begins maturing, it has been around in the market, where several early adopters have contributed to bettering it by suggesting ideas to the developers. Mature OSS, therefore, has experienced acceptance by a majority of the decision-makers after having encountered it from the early adopters (Adarsh et al., 2016). This high acceptance guarantees small-scale organizations a functional technology that guarantees them a competitive advantage and value for money.

The maturity of an innovation constitutes a critical aspect of DOI because, over time, an increasing number of potential users in an industry will acquire a particular innovation if they consider it profitable. Typically, the users of innovation will increase at a slow rate at the early stages of the innovation. The rate will then accelerate at some point before stabilizing for some time and eventually slow down. The maturity of the innovation causes the slowdown of adoption, caused by users switching to alternative

innovation. According to the DOI theory, an innovation's diffusion rate will always increase mostly due to most decision-makers within the social systems beginning to accept the innovations (Rogers, 1995). The diffusion rate of the innovations grows less over time because only fewer social systems will make attempts to adopt them (Adarsh et al., 2016).

In-house technical skills. Participants had to consider the expertise required to implement, operate, and maintain the OSS. A simple tool that employees were familiar with or one that would be easy to learn and implement enabled participants to eliminate the time and costs associated with training and outsourcing skills. Participant P2 answered, "…if the coding language is Python or Java, we want to make sure that our team knows some background Java or Python…Because...There's no retraining that I have to do or consultation to developers." The archival document from E2 read, "…internal technical skills guarantee lower maintenance costs for the software." In-house technical skills save the small-scale organization the cost of continually acquiring external expertise, which could be expensive. In-house technical skills also avert potential operational shut-downs occasioned by technology malfunctioning, whose costs could derail the organization's functioning. Managers of small-scale organizations must appreciate that such facilitating conditions as internal technical skills influence OSS usage behavior (Tak & Panwar, 2017). When the OSS's intended user is guaranteed in-house technical skills support, they develop a high behavioral intention toward the technology, maximizing the OSS use and, consequently, its cost-effectiveness. If the

small-scale organization manager realizes that the organization has adequate in-house technical skills support, they should plan to adopt the project (Rahi & Mazuri, 2018).

In-house technical skills are associated with DOI in the sense that both have mutual interplay. According to Vona and Consoli (2015), individuals with high education's greater learning capacity enhances the adoption of innovations, particularly in the early stages when often the knowledge associated with new technology is not only tacit but ill-defined as well. With time, as learning reduces the minimal skill threshold, utilization of the innovation begins expanding. Moreover, new versions of this stylized skill-innovation influence the differentiation of human capital types resulting in the adoption of essential innovations, while existing ones also undergo enhancements (Vona & Consoli, 2015). The implication is that small-scale organizations must guarantee in-house technical skills for them to adopt OSS effectively. In-house technical skills combine individual knowledge, innate abilities, formal education, and experiential learning among the small-scale organization employees. Practically, when skilled employees interact and share their correlated understanding amongst themselves, they influence positive social habits that will likely spur OSS adoption (Vona & Consoli, 2015).

Theme 3: Providing Support Services

Providing support services was the third theme from the research analysis. The constitution of this theme comprised three subthemes, among them knowledge-sharing

forums, process simplification, and regular specialized training. The illustration in Table 4 highlights the three subthemes under providing support services.

Table 4

Subthemes Under Providing Support Services

	Participants		Documents	
Subthemes	Count	% of References	Count	References
Knowledge sharing forums	5	62.5	13	100
Process simplification	5	62.5	12	104
Regular specialized training	6	37.5	10	78

Note. % of response means proportion of responses by participants for each subtheme. References means the frequency by which each subtheme was mentioned or alluded to in the documents

Knowledge sharing forums. The respondents' primary support was by providing access to community-based support forums such as GitHub, SourceForge, and AnsibleFest. These online resources provided a platform for collaborative solution development to common problems. The open-source software related challenges that employees faced were not unique to them. These were the same challenges faced by other users who discovered and shared solutions on the community forums. In cases where developers had not developed a solution, users could raise the issue with the developers. Participant 2 said, “We'll have forums where users, developers or managers can go and research a specific problem or if it's not known, then we can submit an inquiry to let the developers of the open-source. That's the main thing that I provide the employee using

the software." Archival documents from E2 indicated that users from different departments organized regular meetings to exchange ideas and learn from colleagues' experiences. Another critical support strategy is holding regular internal meetings. Open-source software evolves very fast since the online community of users and developers is always discovering new things, suggesting solutions, and continuously updating the software. Participants reported that they held weekly all hand and brown bag meetings. They held presentations on new topics and the employees used the same platform to raise any issues they had been experiencing and provide suggestions on managing them. Participant 3 said, "We have a meeting that we set, like every week for like new technologies…We'll ask one of our team members to kind of look for new topics in like DevOps and databases, and configuration management, and automation and we'll talk about that."

Knowledge sharing is an aspect of DOI theory because diffusion represents the process where an innovation is conveyed among the individuals of a given social system. This diffusion of the innovations happens through certain channels of communication. According to Tanye (2016), conveying the innovations implies communicating the new ideas about a technology. This means that for a small-scale organization to adopt OSS effectively, there must be an element of knowledge sharing amongst the technology users. Knowledge sharing forums allow the small-scale organizations to contntly reach out to the OSS developers in case there is a need for urgent service (Xiao et al., 2018). The knowledge sharing forums also allow the managers in the small-scale organizations

to request for improvements and customization of the software to suit the organization's needs (Annarelli et al., 2017).

Process simplification. Simplifying the process of operating open-source software reduced the level of support required by the employees. One approach to process simplification was standardization. The participating institutions had guidelines documented in runbooks and standard operating procedures to allow engineers to orient and execute the processes quickly. Participant 3 said, "You have a run book that allows any onboard engineer to know exactly the steps to proceed with the scan. They know like major bugs, with open-source, there are going to be bugs. Then we have SOP." Archival documents from E1 indicated, "The acquisition and implementation of new software must be guided by a standardized procedure that confirms easy user interaction to avoid complex experiences." Some participants automated the processes to make it simple for the engineers to learn and execute operations. For example, participant 3 said, "…we also concentrated more on the automation…we limited it to one button. You press one button, and it will be scanning all the libraries…So it's not a complicated process, and a lot of engineers pick it up quickly."

It was essential to ensure that employees were familiar with the open-source software that the companies intended to adopt, and this limited the amount of support required. Participant 6 said, "…we tend to make sure that employees have some knowledge in those open-source software. And then there won't be support as a company or as an organization we are offering us." Archival document from E1 mentioned the

need for the organization to limits its choices on simple OSS requiring little support from developers to avoid regular interference with the organization running. Participants were also keen to adopt an almost complete software. Participant 2 stated, “I make sure that the tool to be used it's semi-complete…if it's semi, there's not a lot of support that is needed so that we can rely solely on the open-source community on the forums and all that type of website.”

A simplicity-driven system will likely receive favor from users as compared to one that is complex. The question of effort expectancy arises when discussing process simplification because low effort expectancy will positively influence OSS's adoption in an organization (Rahi et al., 2019). Deciding to adopt non-complex technology is advisable for managers in small-scale organizations because this will likely motivate them to embrace it. Providing support services ensures that technology becomes less complicated, which increases the staff's intention to use it (Yen-Ting & Hofer, 2015).

Process simplification links with DOI because the theory holds that the spread of innovative ideas depends on such elements as the innovation itself, communication channels, social system, and time. These elements promote the diffusion of innovation because they make it simple. One of the main principles of DOI holds that innovation must be perceived to be consistent with the existing values, the needs of the intended adopters, and past experiences. The social acceptability of innovation is also critical as it determines its implementation.

Regular specialized training. Participants sponsored in-house engineers to

specialized training to ensure that they kept current with new industry developments. This way, they would provide a meaningful contribution to the company. Participant 5 stated, "… every quarter or on an annual basis, we had trained specifically targeted to developers. And in that training, then at the end of it was an assessment to be sure that they had read it all their requirements." Regular training increases the technical capacity of the organization, which guarantees maximum support whenever needed.

Regular specialized training is tied to the DOI theory by technicians and experts directly in spreading innovation. According to Rupietta and Backes-Gellner (2018), organizations promoting apprenticeship training succeed in equipping their workers to help them introduce and efficiently use new technologies they choose to adopt. Regular specialized training helps align the employees' techniques with the necessary skill required to operate new technology, thus increasing the organization's capacity to adopt it. Small-scale organizations that ensure specialized training for their employees empower their workforce to gain immense knowledge that closely relates to the innovation frontier, thereby fostering innovation (Rupietta & Backes-Gellner, 2018). The DOI theory holds that diffusion of innovation happens when a new evidence-based approach results in improved technology. When small-scale organizations facilitate regular specialized training for their staff members, they attain advancement or improvement in support services (Adarsh et al., 2016).

Theme 4: Staff Knowledge

Staff knowledge was the fourth theme from the research analysis. The constitution of this theme comprised one subtheme, expertise in the target tool. The illustration in Table 5 highlights the subtheme under staff knowledge.

Table 5

Subtheme Under Staff Knowledge

	Participants		Documents	
Subtheme	Count	% of References	Count	References
Expertise in the target tool	6	87.5	11	81

Note. % of response means proportion of responses by participants for each subtheme. References means the frequency by which each subtheme was mentioned or alluded to in the documents

Participants adopted a tool that the employees were familiar with and hence simple to learn and implement. The primary purpose of open-source software was to deliver a service. Hence, employees needed to spend more time operating the tool than learning the tool. A good example was familiarity with the coding language. For a company whose in-house developers were familiar with Python, adopting a python-based tool over a Java-based tool would save them time and cost of training and ensure that the team quickly picked and implemented the tool. Participant 2 said, "…my team…they know a lot of Python, they know a little bit of Java, so the tool is Python-based…Because my team has that background in, in Python. There's no retraining that I have to do or consultation to developers in Java so that my team can be helped out in that regard." Archived document from E3 mentioned the need for all acquired OSS to be mastered by

the organization's IT personnel to ensure easy resolution of problems whenever experienced. A user's ability to utilize new OSS should be the priority of an adopting organization to hasten performance expectancy, social influence, and effort expectancy (Venkatesh et al., 2016). Managers in small-scale organizations planning to acquire new OSS must align the users' behavioral intention with the expectations of the software. The organization can establish technical infrastructures toward supporting the system (Tak & Panwar, 2017).

Rogers' DOI holds that innovators are experts with significant ability to comprehend and practice intricate technical knowledge necessary for introducing innovation into a given social system. In Rogers' theory, the overall social system's interconnected systems engage in joint problem-solving to pursue the established common goal. The employees with particular expertise in the target tool form part of the system seeking to solve the problem. The presence of skills or expertise in the target tool influences individuals' attitudes toward innovation, which also speeds up innovation adoption.

Applications to Professional Practice

Identifying the most successful strategy practices that mid-level ISMs in small-scale organizations use to adopt OSS is vital in helping them achieve efficiency. The study findings reveal that the most crucial strategy involves potential best practices that enhance decision-making to achieve effective OSS. Findings from studies may guide mid-level ISMs to cut down the organization's costs before adopting the OSS (Taha et al.,

2018). The small-scale organizations find the question of cost to be quite exigent, mainly due to their lower latency to benefit from economies of scale advantages.

The findings can lead to the introduction of prospective applications to professional practice by identifying the gap between successful strategies and OSS adoption to enhance organizational efficiency. Askarany (2016) observed that organizations would likely adopt new techniques if there is guaranteed value addition or improved organizational performance such as profit, quality, or added value. Furthermore, Askarany (2016) noted that the small-scale organization's management must evaluate the benefits of the OSS they are seeking to adopt based on its costs, its comparative advantage over the software currently adopted, and its complexity. Some of the participants showed the need for establishing a systematic strategy for adopting OSS in small-scale organizations in an efficient way.

The responses to interview questions 1 and 2 indicated a need to balance the OSS's characteristics and organizational needs. According to Dutta and Omolayole (2016), OSS adoption strategies should consider the characteristics of innovations, including cost, comparative advantage, and complexity. Among the challenges affecting OSS implementation include OSS's cost, its relative advantage, necessary service and support, and staff knowledge and familiarity (Felderer & Ramler, 2016). Small-scale organizations have to determine answers to these questions to succeed in effectively implementing their OSS strategy.

This study's findings might offer supplementary information for middle-level

ISMs in small-scale organizations to establish new strategies for OSS adoption. OSS facilitates the free sharing of ideas that promote creative, scientific, and technological advancement since it does away with existent barriers between innovators. It helps increase the software capacity in a more customized way that benefits the organization absolutely, based on the creativity of the person modifying the original software. Essentially, the findings attributed to this research may provide the middle-level ISMs with a greater opportunity to regenerate unique software that may be enormously beneficial to the organization because its customization may serve the organization's expectations.

The study's findings may add additional information into the industry and educational research by reinforcing middle-level ISMs' role in adopting OSS within small-scale organizations. My study's findings align with the tenets of DOI theory in the sense that middle-level ISMs may play a key role in OSS adoption. The middle-level ISMs in small-scale organizations can be the determining factor in OSS adoption in the organization. Participants in the research advised the best practices to establish the best OSS adoption strategies that increase organizational efficiency.

Implications for Social Change

One major challenge facing small-scale organizations is the inability to get adequate resources for their IT needs (Nevo & Chengalur-Smith, 2017). Small-scale organizations do not reach their full potential because they lack adequate IT resources limits their operations. Positive social change attributed to this study includes an

expanded working opportunity through which the small-scale organization employees may get an opportunity to develop further their creativity by introducing modifications to the software to suit different circumstances. Moreover, this study may result in organizations availing affordable products and services to their customers, which would imply achieving a competitive advantage out of the improved services to their customers. At the individual level, this study's findings may turn out beneficial to those who acquire products or services from organizations implementing OSS. The costs related to OSS are comparatively low, meaning that organizations implementing OSS are likely to incur low operations costs that may benefit lower prices. Using OSS may guarantee affordability for the consumers of the products and services in the society, thus ensuring that they enjoy the benefit of such products and services. Secondly, since the OSS may also provide a competitive advantage to the organization, the organization may have an increased opportunity to offer improved services to their customers. Consumers may benefit from high-quality products and services that are of value when organizations implement OSS solutions.

Recommendations for Action

The four themes reviewed in this study form the key strategies that ISMs in small-scale organizations need to consider when adopting OSS. The first step that the ISMs in small-scale organizations should take when adopting OSS is ensuring that the new software guarantees its comparative advantage. In particular, the OSS should incur zero to little maintenance cost and be easy to use within the organization. The ISMs also

ascertain and ensure that the level of support needed to operate the software is always available.

ISMs in small-scale organizations also need to pay close attention to the cost to ensure that they can control it even as it acquires the OSS. The ISMs can ensure control of the costs by focusing on mature OSS that has already been tried and tested. Mature OSS is easy to customize to suit the organization's specific needs because many other users have contributed toward bettering it by sharing ideas with the developers. The ISMs must also ensure the presence of in-house technical skills further helps the organization control costs as it minimizes the need to involve expensive external expertise.

ISMs in small-scale organizations must also ensure support services through such interventions as knowledge sharing forums and process simplification efforts. The dynamic nature of information technology means that new ideas and skills keep emerging constantly. ISMs should facilitate regular specialized training for its employees to ensure that the organization is continually building internal capacity to handle OSS. This capacity will prevent the organization from needing costly external skills to address its OSS needs.

This study's findings will likely help small-scale organizations in the city of Frederick, MD, to determine the right strategies for adopting OSS for their operations. These small-scale organizations have a relatively smaller resource base that requires them to ensure their acquired OSS guarantees value for money. Given that many of these

small-scale organizations face the same challenges of limited resources, the inspiration to use this study's findings can increase significantly.

This study's findings on the proposed strategies for adopting OSS can result in other new ideas that ISMs can find useful when seeking new OSS for their small-scale organizations. I will disseminate these research findings using various ways, including published journals, social media, and the internet, and conferences. Furthermore, I will use social networks to organize training sessions and seminars where I will better the insights of small-scale organizations about the strategies to employ when adopting OSS in the city of Frederick, Maryland.

Recommendations for Further Study

The purpose of this research was to explore the strategies used by middle-level ISMs to adopt OSS in their small-scale organizations within the city of Frederick, Maryland. The research findings underscore the significance of adopting OSS, especially in the context of small-scale organizations that may lack adequate resources to procure conventional software. Further research in the future will help to identify comprehensive results. This research, thus, recommends the following for further research:

1. The participants involved in this study were six drawn from three organizations. This sample's representativeness is small, given that there are many small-scale organizations in the city of Frederick, Maryland. Therefore, expanding the sample size to include more participants and organizations can help achieve comprehensive outcomes.

2. The focus of this study was on small-scale organizations based in Frederick, Maryland. There is a need to carry out studies about strategies used by middle-level ISMs in other cities.

3. The findings of this research capture the perspective of middle-level IT managers who were the research participants. A different perspective of other IT leaders, stakeholders, and other elements influencing the adoption of OSS in small-scale organizations deserves additional exploration.

4. The valuation of the strategies used by ISMs in small, medium, and large-scale organizations to adopt OSS can differ about human, financial, and political resources. Therefore, making a comparison with different organization types can help achieve comprehensive outcomes.

5. Specific factors characterizing developed countries, such as cultural, indigenous, and political events, are significant in influencing the adoption of OSS. Therefore, there is a need to explore suitable strategies for these factors.

6. Owing to developed countries' relative conditions, exploring strategies for the adoption of OSS in small-scale organizations in other developed countries can provide more comprehensive results.

Reflections

This study sought to outline the strategies that ISMs in small-scale organizations in Frederick, Maryland, employ in adopting OSS. I examined the strategies that the ISMs in the small-scale organizations use when adopting OSS. My DIT study program’s goals

were to carry out doctoral-level scientific research, gather scientific data, and analyze it. I employed other experiences in strategies, techniques, and practices to collect the data and analyze it.

The design of this doctoral research study targeted educating about strategies that IT managers use when determining the right technology for their organizations. Through conducting this research, I got an excellent opportunity to understand the process of OSS acquisition in small-scale organizations. I reviewed related organizational documents and their objectives, which enabled me to get precise results. I learned that the strategies used by small-scale organizations in adopting OSS in small-scale organizations in the city of Frederick, Maryland, often followed specific considerations suitable for the city. These considerations are somewhat different in other cities. Understanding these considerations was imperative and could improve my knowledge in this field.

Throughout this research process, I endeavored to protect against bias. I tried my best to avoid letting my IT experience and knowledge influence my decisions, especially when collecting and analyzing data. A researcher can minimize research bias by avoiding personal perception and doubt (Probst, 2015). I used my experience as a DIT student to get a better understanding of OSS adoption strategies. My IT field experience further helped me understand the decision-making structure of technology acquisition in small-scale organizations. I interacted more with the participants in this study and learned more about the other strategies that middle-level ISMs use to guide their decision-making about OSS.

At the onset of my DIT program, my view of the research process in terms of its importance was quite limited. The DIT program has provided me with a more in-depth insight into the research process, including understanding the research methodology and strategies. This insight guided me in producing comprehensive results in this study. My experience during this study highlighted the complexity of the data collection process, which I had downplayed. This study made me realize and appreciate the complex nature of determining the appropriate OSS for small-scale organizations. I now understand how ISMs play a vital role in designing strategies for adopting OSS, especially in small-scale organizations. I put my best effort into studying the participants' opinions and experiences to present these findings and recommendations in the most organized and scientific way.

Study Conclusions

Technological development and the high cost of conventional software have enhanced most small-scale organizations' need to consider OSS as an alternative. In this qualitative multiple case study, I undertook to explore the strategies middle-level ISMs use to adopt OSS in their small-scale organizations. My conducting of this study has added to the available literature on strategies to adopt OSS in small-scale organizations. The relative advantage is a major consideration that the ISMs prioritize when adopting OSS owing to limited resources in small-scale organizations. Relative advantage derives from cost efficiency, ease of use, and the level of support required for the OSS. ISMs also consider cost control by opting for mature OSS tested and tried in the market.

Additionally, the ISMs control cost by establishing in-house technical skills to enable them to handle technical issues arising from the software. Another essential aspect that ISMs consider is support services, where they rely on knowledge-sharing forums, process simplification, and regular specialized training to determine its practicality.

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Appendix A: Interview Protocol and Interview Questions

Interview Protocol

A. Self-introduction to the participant.

B. React to concerns of the participant, verify receipt, and respond to consent form

C. Confirm and acknowledge the recording of the interview

D. Switch on the recording device

E. Appreciate the participant for agreeing to take part in the study.

F. Start the interview from question #1 and follow through sequentially to the final question.

G. End the interview and talk about member checking with the participant.

H. Show gratitude to the participant for taking part in the study. Confirm that the participant has received the contact information to make follow up in case of questions and concerns.

I. End protocol.

Interview Questions

1. How have you implemented OSS in your organization?

2. How did you do to control the cost of implementing OSS in your organization?

3. How do you evaluate the relative advantage of OSS?

4. What OSS service and support do you offer to the employees?

5. What staff knowledge and familiarity aspects do you prioritize before adopting OSS?

6. How do you encourage the use of OSS in your organization?

7. How do you find additional information on OSS adoption that you would wish to explain further before finishing the interview?

Appendix B: Participant Recruitment Letter

Date:

Subject: Request Seeing your Participation in a Research Study

Dear (Recipient):

My name is Balla Barro, a student at Walden University pursuing a doctoral study for the degree of Doctor of Information Technology. I am undertaking a research study on strategies employed by middle-level information system managers in small-scale organizations in adopting open-source software. I am keen on middle-level information system managers in small-scale organizations in the city of Frederick, Maryland.

Online interviews (i.e Zoom, Skype) will provide helpful insight toward effective strategies implemented in the adoption of open-source software in organizations. I approximate that your interview session will last for an average of 20 minutes only. Once I complete this study, I will send the research findings to you as a participant. If you are a middle-level information system manager working in a small-scale organization, kindly contact me within 7 days of receiving this mail. I have attached a consent form together with this letter, giving further explanation on the study. You may sign on the attached consent form to declare your participation.

I am optimistic of your response soon.

Sincerely.