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Network Function Virtualization Technology Adoption Strategies

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Walden University
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Abstract

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MS, University of Ibadan, 2006

BS, Ogun State University, 1999

Doctoral Study Submitted in Partial Fulfillment

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Abstract

Network function virtualization (NFV) is a novel system adopted by service providers and organizations, which has become a critical organizational success factor. Chief information officers (CIOs) aim to adopt NFV to consolidate and optimize network processes unavailable in conventional methods. Grounded in the diffusion of innovation theory (DOI), the purpose of this multiple case research study was to explore strategies chief information officers utilized to adopt NFV technology. Participants include two CIOs, one chief security information officer (CSIO), one chief technical officer (CTO), and two senior information technology (IT) executives. Data were collected through semistructured telephone interviews and eight organizational documents. Through thematic analysis, four significant themes became apparent: organizational awareness, no hindrances to NFV technology adoption, documentation and implementation plan, and operational costs and efficiency. A key recommendation is for CIOs, CSIOs, CTOs, and senior IT managers to adopt the capability to document globally accepted processes and procedures for seamless adoption of NFV technology. The implications for positive social change include the potential to reduce energy consumption, preserving natural resources, and reducing environmental pollution due to the emission of dangerous gases that cause environmental degradation.

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Dedication

I dedicate this academic exercise to my late father, AbdulRaheem Adegoke Ishola Shittu, who instigated me to pursue telecommunication, IT, and insisted I become well educated in my chosen career. I also dedicate this academic work to my beloved spouse Adunola Morounfolu for her total submission and support, encouragement, and understanding while I was traversing this journey of perseverance.

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Section 1: Foundation of the Study

Background of the Problem

Network function virtualization (NFV) is a new networking innovation designed to address the constant need for network providers to rebuild current traditional network architecture to improve the throughput. NFV may reduce capital expenditures (CapEx) and operating expenses (OpEx) to meet volatile and changing user demands (Yao et al., 2018). NFV uses physical hardware to deploy network services in a virtual template (Woldeyohannes et al., 2018). NFV allows the virtualization of traditional networks to consolidate and optimize processes unavailable in conventional systems (Cerrato et al., 2018).

Because NFV allows organizations the capabilities of providing network functions (NFs) virtually, it eliminates the need for physical hardware (Woldeyohannes et al., 2018). By decoupling NFs from some specific vendor locked-in hardware, NFV also significantly enhances network flexibility, fault tolerance, and network resource utilization (Yao et al., 2018). However, only 14% of information technology (IT) organizations have adopted NFV in a production network such as network providers and organizations (Telecommunication and Engineering Centre, 2017). Though NFV has been widely accepted at an unprecedented rate, there are still some challenges about the actualization of the goals of NFV technology adoption, which comprise testing and validation, resource management, latency, security, and instantiation (Mijumbi et al., 2016).

Problem Statement

NFV adoption may reduce administration tasks, CapEx, and OpEx (Basile et al., 2019). Further, research indicated that the global NFV market would grow from $2.7 billion to $15.5 billion in 2020 and that 80% of overall networking equipment would transform into virtualization (Pattaranantakul et al., 2018). The general IT problem is that some organizations lag in the adoption of NFV technology. The specific IT problem is that some senior IT executives in organizations lack strategies to adopt NFV technology.

Purpose Statement

The purpose of this multiple case study was to explore the strategies utilized by chief information officers (CIOs) who have been involved in the adoption of NFV technology. The purposeful sample for this study was CIOs in network providers and organizations that have adopted and implemented NFV technology in the eastern United States. The social impact of this research study may start with an increased awareness of the global network paradigm shift to consolidate network resources and their dynamic utilization, which may provide better energy efficiency. The virtualization of the mobile network's core infrastructure may result in a 22% reduction in energy consumption and an energy efficiency enhancement of 32% (Mijumbi et al., 2016). Reduced energy consumption may have a positive impact on global climate change.

Nature of the Study

I used the qualitative research method to explore the essential strategies some senior network providers and organization IT executives have used to adopt NFV technology. This method is ideal for tracking innovative phenomenal in real-time as they

unfold (Reinecke et al., 2016). I pursued a deeper understanding of the critical strategies of the business, technical, economic, and security that impacted their decision to adopt NFV technology. Conversely, the quantitative approach relies on acquiring empirical data through cautious seclusion, assessments, and appraisals of variables, reiterating predictability and control over time (Park & Park, 2016). Because quantitative research study relies on empirical data accumulation and analysis, quantitative research methodology was not ideal for this research study. Additionally, mixed methods present meaningful integration of quantitative and qualitative data sets, which are often not achievable (O'Halloran et al., 2018). Hence, I only used the qualitative methodology instead of mixed methods because I did not test empirical hypotheses.

For this study, I used the multiple case study design to explore the key strategies that CIOs and some senior IT executives in organizations used to adopt NFV technology. This design enables researchers to answer *what*, *how*, and *why* types of questions while considering how an innovation was affected by the context within which it was anchored (Vu & Feinstein, 2017). NFV networking concepts and adoption strategies entail complex phenomena, as several procedures, processes, and underlying factors affect NFV technology adoption.

Other qualitative research designs considered but not chosen are (a) ethnography, (b) phenomenology, and (c) narrative. Researchers use ethnography for more in-depth observation and understanding of groups of individuals, being conscious of the influences of historical and cultural factors in their particular social interactions (Jones & Smith, 2017). I did not choose the ethnography because the focus of the study was not on the

historical and cultural factors of the respondents. Phenomenological research is an in-depth investigation of what experiences are discerned by people. It concerns everyday human lived experiences to determine people's perception and the meaning they make out of their skills of others (Bliss, 2016). I did not choose a phenomenological design because fundamental strategies and procedures utilized by respondents were reviewed, not their perceptions of the skills used in adopting NFV technologies in their organizations. Finally, a narrative design reiterates people's narratives, either about a collection of events or themselves. It is a design that emphasizes the character of individuals instead of searching for themes that emanate from an account or a phenomenon (Mohajan, 2018). I did not select a narrative design because the focus was not on the character of the IT executives but searching for the themes from their strategies of adoption of NFV technologies.

Research Question

What strategies do CIOs and some senior organization IT managers utilize in the adoption of NFV technology in their organizations?

Interview Questions

1. How do you create awareness of NFV technology in your organization?
2. When did your organization first use NFV technology and how do your organization use NFV technology?
3. How do you determine effective procedures for proof of concept of NFV technology?
4. How did you gain organizational approval to adopting NFV technology in your

organization?

5. How do you identify and ameliorate the hindrances to NFV technology adoption?
6. How did you create positive opinion about the benefits of NFV technology in your organization?
7. How did you overcome cultural issues preventing adoption of NFV technology?
8. To what extent, if any, does NFV technology provide values that are traditionally derived from the legacy networks
9. How did you identify progress and define completion of NFV technology adoption?
10. How do you track the progress and define completion of NFV technology adoption?
11. What methods did you utilize to identify, define, and document critical procedures to transiting traditional network infrastructure in NFV infrastructure in NFV technology adoption?
12. How do you find and establish successful leadership and organizational support for NFV technology adoption?
13. What other important information do you have to add?

Conceptual Framework

Diffusion of innovations (DOI) theory served as the framework that I used to explore the strategies used by CIOs and some senior organization IT executives in adopting NFV technology. Rogers (1962) defined DOI theory as a technique in communication to interpret how, over a period, a new concept gains momentum and

diffuses through a specific social system. It describes how novelty is spread among the members of this social system (Dibra, 2015; Rogers, 2003), such as how they align, trust, and dismiss or reject the change.

Rogers (2003) stated that the rate of adoption and decision to adopt an innovation is impacted by several attributes: (a) relative advantages, (b) compatibility, (c) complexity (simplicity), (d) trialability, and (e) observability. These characteristics or attributes of innovation could enhance the possibility of innovation adoption (Rogers, 2003). Relative advantage is the degree to which change surpasses the ideas of the stale innovation. Compatibility is the consistency of innovation with the potential adopters' needs, earlier experiences, values, and beliefs. Complexity or simplicity is the extent to which a change is difficult or easy to use, discerned, or applied to utilization. Trialability is the period used in testing the innovation. Observability is the visibility of the innovation's usefulness and its impacts to potential adopters (Blythe et al., 2017). To understand the senior IT executives' involvement in NFV technology adoption, I used these five innovation characteristics to examine how these characteristics have influenced the IT executives' decision to adopt NFV technology.

Definition of Terms

Network functions (NFs): Refers to routers, firewalls, deep packet inspection, network address translator, intrusion prevention and detection systems, and load balancers deployed by data center in the network to protect networks and enhance application performance (Cui et al., 2018).

Network services: Refers to the complete end-end network functionality provided

to users by network operations and data centers comprising of diverse service functions chained in ordered manner (Ghasem & Zhiquan, 2018).

Network functions virtualization (NFV): Refers to complementary paradigm that separates NFs from the physical network middleboxes into a software platform running on standard commercial-off-the-shelf servers as virtual network functions (VNFs; Saraiva de Sousa et al., 2018).

NFV infrastructure: The NFV infrastructure in NFV network architecture comprise of both physical and virtual nodes, such as high-volume commodity servers, storage systems, virtual machines, routers, firewalls, and switches on which the network services are provisioned (Kourtis et al., 2017). NFV infrastructure is comprised of virtual resources that are abstracted and logically separated from the underlying physical hardware resources through a virtualization layer (Nguyen et al., 2017).

NFV management and orchestration: NFV management and network orchestration gives networks the capability for orchestrating and managing VNFs through VNF managers and NFV infrastructure through a virtualized infrastructure manager. It permits the integration of the external operational and business support systems (Nguyen et al., 2017).

Service function: Simply a traditional network function defined by the European Telecommunication Standard Institute as VNF for example firewall, intrusion detection system, and network address transfer (Cerrato et al., 2018).

Virtual network functions (VNFs): NFV concepts allows NFs to be separated from the underlying physical proprietary hardware and become virtualized software instances

referred to as VNFs (Wang et al., 2018). VNFs refer to the virtualized implementation of traditional NFs with detailed definition of the underlying functional behaviors and their associated interfaces (Farris et al., 2019).

Virtual machines: Refer to the generalization of the concept of a virtual computing memory that allows diverse operating systems to co-exist simultaneously on the same machine, independent of each other (Shinde, et al., 2019). Virtual machines are used to provide network services such as virtualization, clustering, routing, switching, deep packet inspection and radio access continuously based on ever-changing customer demands (Aneri & Sumathy, 2017).

Assumptions, Limitations, and Delimitations

Assumptions

Assumptions are beliefs, expectations, or considerations taken for granted about a worldly phenomenon with limited or no evidence to substantiate the ideas. Assumptions may be well articulated or unarticulated and may be valid or invalid (Nkwake & Morrow, 2016). One assumption was that the participants were knowledgeable, capable, and willing to discuss the strategies used in their adoption of NFV technology. The second fundamental assumption was that semistructured interviews enabled me to extract rich-textual data to address the research question. I also assumed that the documents from the organizations contained the information needed to draw a valid and reliable conclusion. A crucial third assumption was that the participants were ready to share information and were truthful in sharing the knowledge of the strategies used in adopting NFV technology.

Limitations

Limitations are elements over which I had no control but could have affected the outcome of the study (see Greener, 2018). Identifying and stating limitations and biases in research studies clarifies that the researcher has genuinely considered potential areas of exclusion, which impacts the outcome of their results (Greener, 2018). For example, one fundamental limitation was the genuineness of the responses to the semistructured interview questions, vulnerabilities of the IT executives during interviews, and the authenticity of the NFV adoption strategy documents presented during my physical interactions with some organization IT executives.

A second limitation was the degree of participants' varying experiences in NFV technology adoption strategies. The study was limited to senior IT executives involved (indirectly or directly) in their organization's adoption of NFV technology, and their experiences differed from IT executives to IT executives. However, the data outcome may reflect these gaps and themes derived from the generic data outcomes.

A third limitation was how well the sampling method could provide a relational result. The choice of sampling procedure depends on the type and essence of the study (Etikan et al., 2016), such as questionnaires in multiple-case research. However, this limited outcomes to a specific sample (some senior IT executives) relevant organization in eastern parts of the United States, which reduces the generalizability of the results.

Qualitative research methodologies are diversified invalidation techniques but lack a universally accepted benchmark to access the validity of results (Hayashi et al., 2019). But strategies that can be used to enhance the validity of qualitative research

studies (Smith & McGannon, 2018). Considering the nature of this research study, I used the member checking approach of validating the results, which also addressed bias during data interpretation. Consequently, I ensured that the perspectives of the participants and the result of the study are used as an effective strategy by some senior IT executives of organizations who are yet to adopt NFV technology. Therefore, the information gathered may be generalizable to appropriate organizations.

Delimitations

Delimitations are elements a researcher can control to delineate the boundaries of the research study, setting the limits so that the study's goals and objectives are possible to achieve (Theofanidis & Fountouki, 2018). The first delimitation was to exercise complete control over the selection of the participants, which comprised senior IT executives who have in-depth knowledge of NFV technology. They were experts in network virtualization. Second, the study was delimited to senior IT executives in organizations that have adopted NFV technology between 2015 and 2020. Third, I only chose senior IT executives in organizations planning, implementing, and maintaining NFV technology from 2012 to 2020. They are knowledgeable about NFV technology (Hameed et al., 2012). Fourth, the study focused only on NFV and not on other aspects. The last delimitation was that I carried out the research in the eastern United States.

Significance of the Study

Contribution to Information Technology Practice

NFV technology's capability to enable network function deployment without physical hardware and network disruption is a great value addition to networking. The

primary advantage of programmable networks such as NFV technology adoption resides in efficient resource utilization, enhanced service function availability, dynamic resource scaling, network function flexibility, and other benefits (Mamatas et al., 2016). The significant shift toward network softwarization may reduce the need for specialized infrastructure and operational costs, whereas the proposed NFV architectures offer significant efficiency and flexibility benefits (Mamatas et al., 2016). NFV technology adoption can lead to flexible network management, which is actualized at the software level and permits possible coexistence of multitenancy network configurations (Callegati et al., 2015). Further, NFV is currently the only solution to vendor lock-in and internet ossification plaguing the network operator and IT industry (Martini & Paganelli, 2016). Information resulting from this study may encourage some senior IT executives of reluctant organizations to adopt NFV technology, which may be useful for reference for the network operator and IT professionals and researchers.

Implications for Social Change

NFV technology allows the consolidation of network resources and their dynamic utilization virtually, thus providing organizations better energy efficiency (Mijumbi et al., 2016). The virtualization of the mobile network's core network infrastructure may result in a 22% reduction in energy consumption and an energy efficiency enhancement of 32% (Mijumbi et al., 2016). Energy consumption reduction may naturally decrease the concentration of greenhouse gas emissions in the atmosphere, which may mitigate extreme weather events such as hurricanes, heatwaves, droughts, floods, and rising sea levels (Rehman & Rashid, 2017). Reduction in energy consumption may also bring about

the preservation of resources, reduced environmental pollution due to the emission of dangerous gases that cause environmental degradation.

A Review of the Professional and Academic Literature

A literature review allows researchers to build on the existing body of knowledge and understand their outcomes to actualize the purpose of a study (Snyder, 2019). The research question was the focal point of the literature review: What strategies do some senior IT executives in operators and organizations utilize to adopt NFV technology in their organizations? DOI was the framework that I used to explore of the strategies used by CIOs and some senior organization IT executives in adopting NFV technology.

To develop my literature review, I searched peer-reviewed journal articles in the Walden University Library. Ulrich's Global Serials Directory was used to find peer-reviewed journals among the references. I reviewed a total of 252 resources in this study, of which 250 (99.21%) were peer-reviewed, and one (0.40%) is a government resource website. I reviewed a total of 247 (98.00%) peer-reviewed resources in my literature review. I have 232 (92.10%) peer-reviewed journal articles within 5 years of my expected doctoral completion year 2021. This literature review emphasizes six concepts: (a) the conceptual framework, DOI, (b) understanding NFV technology, (c) hindrances to NFV technology adoption, and (d) network softwarization, (e) adoption strategies, and (f) similar research studies.

DOI Theory

Overview of DOI

DOI comprises technological innovation, medium of communication, social

system, and diffusion period that together describe how each adoption represents diffusion (Rogers, 1962). DOI theory has been used to explain IT adoption and is concerned with how a new technological innovation progresses from conception to utilization (Alkhalil et al., 2017). DOI represents the most definite theoretical emphasis on innovation adaptation and is widely used to explore a variety of technological innovation adoption (Al-Rahmi et al., 2019). The five characteristics of DOI—relative advantage, compatibility, complexity, trialability, and observability (Rogers, 1962)—are the factors determining the successful adoption of new innovative technologies (Syahadiyanti & Subriadi, 2018). These characteristics may not be the five most valued recognized characteristics for a particular set of respondents; thus, the solution is to invoke the main attributes of innovations from the respondents (Rogers, 1962). DOI also presents three significant categories of factors that influence decisions to adopt innovations: innovation characteristics, organizational characteristics, and individual characteristics (Alkhalil et al., 2017).

Rogers's DOI theory emerged in the early 1960s by extending the traditional understanding of diffusion communication, traversing oral communication to network externalities and social signals (Liu et al., 2018a). DOI has had diverse applications throughout various disciplines. Several mathematical techniques are available for innovation diffusion, including Rogers's model. DOI and the technology acceptance model (TAM) primarily deal with acceptance of IT and information system (IS) and has evolved into multiple complementary, competing models to study adoption strategies (Al-Rahmi et al., 2019). Both TAM and DOI emphasize a similar premise, which states

that adopters assess innovations to understand their character or argue that changes having desirable features are more likely to be adopted (Al-Rahmi et al., 2019).

DOI is increasingly applied to technology, educational, public health, and agricultural interventions (Dearing, 2009). Decisions about the integration of technological innovation are prevalent at a top executive level (C-level) of organizations, such as an organization's CIO and some senior IT executives (Straub, 2009). Understanding adoption patterns illustrate a successful implementation. Hence, understanding such aspects of the strategies employed such as why one organization adopts an innovation and others have not and the influence of social context on technology innovation. In this study, I also strived to understand how social networking influenced the CIOs and some senior IT executives' decisions in adopting NFV technology. In addition, the study also addressed what characteristics of innovation adoption influenced CIOs' decision to adopt NFV technology.

Characteristics of DOI

DOI refers to a process in which an idea is communicated through specific channels over a period traversed by members of a society under review (Dube & Gumbo, 2017). An idea is a technological innovation discerned as new by a group of people, organization, or individual (Dube & Gumbo, 2017). Communication channels present how information about the technical approach is diffused from the source to the receiver. In contrast, time refers to the rate of adoption or the time taken by divergent individuals to adopt the technological idea. The scale of approval depends on the characteristics and ascertained the need for the technical view (Rogers, 2003). The change-decision process

comprised five stages: the knowledge, persuasion, decision, implementation, and confirmation stages (Dube & Gumbo, 2017). At the persuasion stage, the individual or organization develops an opinion, which can be either positive or negative about the technological idea through subjective evaluations of peers and colleagues (Dube & Gumbo, 2017). Then, at the decision stage, the organization may decide to adopt or reject the idea. Hence, at this point, adoption referred to the full utilization of an idea as the best most preferred cause of action available. At the same time, rejection means an organization or an individual decision not to adopt the idea at all (Dube & Gumbo, 2017). Rogers (2003) identified two types of rejection: later adoption or active rejection, which rejects an idea but eventually adopts the concept. The continued refusal or passive rejection refers to straight non-adoption while the individual does not consider adopting the idea. Mental information analysis and decision-making conclude the implementation stage, but the behavioral change starts, and the idea is put into practice (Rogers, 1962). Finally, the confirmation stage props the individual or organization to seek support for their decision (Dube & Gumbo, 2017).

Characteristics of DOI are determined at the persuasion level by relative advantage, compatibility, complexity, trialability, and observability (Amuzu-Sefordi et al., 2018; Dube & Gumbo, 2017; Min et al., 2018). Relative advantage highlights the degree to which a technological idea is comprehended as been better than the idea it supersedes, and compatibility refers to the extent to which a technical approach is grasped as consistent with the existing values, past experiences, and needs of potential adopters (Dube & Gumbo, 2017; Mannan et al., 2017). Compatibility significantly

impacts willingness to adopt an awareness of the innovation (Mannan et al., 2017). Complexity highlights the extent to which an idea is believed to be relatively difficult to understand and use (Rogers, 2003). A low level of complexity may lead to a greater adoption rate, while a high level of complexity may lead to rejection of the innovation (Mannan et al., 2017). In contrast, trialability refers to the area to which a design may be experimented with on a limited test scenario. Finally, observability highlights the extent to which the innovation results are visible to others (Rogers, 2003). Third, trialability highlights the extent to which a change may have experimented. Finally, observability reiterates the degree to which the innovations are visible to others (Mannan et al., 2017).

According to Rogers (2003), there is a need for a standard classification methodology for describing the comprehended characteristics of innovation in a generic term. Actualizing a standard classification scheme may save academia from carrying out research studies on new change as a particular case to predict an individual's adoption rate of the strategies utilized in the passage (Rogers, 1962). Such a general classification scheme might be an eventual objective of diffusion characteristics (Rogers, 2003). Since the standard classification scheme describes the discerned attributes of innovation, five different components of change are related. The five attributes of DOI highlights past research and academia's desire for maximum generality and clarity (Rogers, 1962).

Supporting Theories

Researchers have proposed divergent theories, concepts, and frameworks to explain adoption strategies and their antecedents such as the TAM, UTAUT, the TPB, and TRA (Ukpabi & Karjaluoto, 2017). Technological innovation research studies, which

primarily focus on acceptance of IT and information systems (IS), have evolved diverse complementary and competing for conceptual theories to study adoption (Al-Rahmi et al., 2019). For instance, there is strong credence to the integrative collaboration between the TAM and DOI theory (Al-Rahmi et al., 2019). Academia has used the TAM extensively to explore a variety of innovation adoption (Davis et al., 1989). The TAM and DOI share the same premise, which technological innovation adopters utilize in assessing innovations on the criteria of the characteristics. The adoption of IT and IS are estimated by DOI and the TAM, which are described as similar in some constructs while complementing each other (Davis et al., 1989). DOI and the TAM thus complement each other as in past research reporting satisfactory results.

The TAM employs a causal relationship between beliefs-attitude-behavior to decipher and pre-empt the acceptance of new technological innovation among potential users (Li et al., 2019). The TAM postulates that a proper understanding of technology's ease of use and the technology's usefulness are determinants of intentions to adopt the technological innovation and actual behaviors in adoption (Ritz et al., 2019). The more comfortable the usability of technological innovation, the more beneficial the change to the user (Ritz et al., 2019). The TAM is distinctively different from other concepts because TAM applies the theory of reasoned action (TRA) and the theory of planned behavior TPB concepts with a focus on predicting IT acceptance and usage (Ritz et al., 2019). The factors of the TAM comprise perceived ease of use, understanding of usefulness, perceived enjoyment, and behavioral intention. The TAM thus far is the most common and most influential theoretically predictive interpretation conceptual

framework in the existing body of knowledge on theoretical studies on the analysis and prediction of IT innovation adoption behavior (Li et al., 2019).

The TAM has been applied in various studies to decipher consumers' inert adoption behavior of IT innovations (Lee et al., 2019). Recently, the TAM has been used to analyze consumer adoption behavioral trends in IT and IS innovations (Lee et al., 2019). The TAM has been validated by academia for understanding user acceptance of technological innovations in a diverse context (Manis & Choi, 2019). Additionally, the large-scale empirical effects of the TAM in online shopping technological innovation support the TAM's credibility and validity in helping understand users' affirmation of novel transformation (Altarteer & Charissis, 2019). The TAM is a valuable mechanism for empirically analyzing the factors that indirectly or directly impact user attitudes and intentions to utilize new IT innovations (Altarteer & Charissis, 2019). The information on user activities assists advertisers in perceiving how the purchaser thinks, feels, and selects from available options, such as alternative products, brands, and so on (Tarabaz & Poddar, 2019). However, the TAM was developed with the sole objective of producing a conceptual framework for computer technology acceptance premised on the TRA (Binyamin et al., 2019). But regardless of potential limitations, the TAM has identified research applications in different settings, comprising but not limited to online learning, social media networking, virtual private networking, and smart mobile devices (Koul, & Eydgahi, 2018).

The unified theory of acceptance and use of technology (UTAUT) also evolved to describe the mechanism behind and factors affecting technological innovation adoption

like the TAM (Scherer et al., 2019). The UTAUT and the TAM evolved from well-grounded psychological theories, including the method of TRA and the TPB (Scherer et al., 2019). The setup of UTAUT is like the TAM, and the determinants share the same concept (Scherer et al., 2019). The UTAUT postulates that using a specific innovation is directly predicted by the user's intention to use the technological innovation and facilitating conditions (Nideröst et al., 2018). The UTAUT was developed with five main determinants of users' intention and four moderators of key relationships (Liebenberg et al., 2018). Additionally, four significant moderating variables were identified comprising gender, age, the voluntariness of use of innovation, and experience accumulating from the use of the change (Taherdoost, 2018). Furthermore, the user's preference is now indicated by performance expectancy. The TAM and UTAUT have emphasized usefulness/performance expectancy characteristics to explain most of the variance in individual innovation adoption decisions (Tamilmani et al., 2019).

In addition to the TAM and UTAU, the TRA has been used extensively to examine the intention of ethical behaviors, such as drug abuse, predicting and explaining cyberbully antecedent by college students, and studying moral practices of IT and son on (Mi et al., 2018). The TRA scrutinizes the relationship between attitudes and behavior (Tarabaz & Poddar, 2019). TRA identifies behavioral intention as the main predictor of action rather than attitudes. The TRA provides an account of behavior, emphasizing individual readiness and motivation to act (Paquine & Keating, 2017). The TRA states that attitude toward behavior and the influence other people have on a person's beliefs and behaviors are the main predictors of behavioral intentions (Tarabaz & Poddar, 2019).

The TRA is most effective when applied to behaviors under a person's intuitional control (Tarabaz & Poddar, 2019). But the TRA also highlights the most prevalent and comprehensive globally adopted behavior-theoretical perspective, including the TRA and the TPB concepts, emphasizing that intention to engage in behavior largely determines whether that behavior is executed (Paquine & Keating, 2017).

In IS literature, the TRA has only been used in identifying adopters' behaviors and attitudes in issues relating to web use, online commerce, data security, and trust. The TRA has not been well utilized in evaluating research such as technology diffusion and adoption in IS and IT generally. The TRA is about a monolithic factor that determines adopters' attitudes toward that behavior (Lai, 2017). I did not use TRA because my study was about how, why, and at what degree innovations diffuse through cultures, operating at the organizations and individual level (see Otieno et al., 2016), which the DOI addresses. The study was not about exploring the factor that influences the behavioral intentions of CIOs and some senior IT executives in adopting NFV technology.

A final supporting theory is the TPB, which utilizes the perceived behavioral control for an individual's actions that are not under intuitive control (Taherdoost, 2018). Studies have established that the TPB does not emphasize the external factors that could change people's purchasing behaviors (Tarabaz & Poddar, 2019). However, the TPB assumes that ethics remain static over some time. The TPB highlights a psychological conceptual framework for explaining and predicting a person's behavior. The framework comprises two levels of belief-based scales and direct ranges (Heuckmann et al., 2018). But the user's attitudes toward IT may not be relevant if a computer system is

inaccessible (Taherdoost, 2018). The revised TPB framework is referred to as the most desirable framework that influences the extent of an individual's free will to accept or not to accept the use of IT in the organization.

Contrasting Theories

Academia is immersed in a maintained stream of research studies on the innovation diffusion within the IS and managerial sciences terrains. Inherently, research studies in this area are ignited by either DOI proposed by Rogers (1962) or the predictive theories of the diffusion of technological innovation postulated by Bass (1969) (Ntwoku et al., 2017). Though Rogers's (1962) DOI theory is widely accepted by academia, most researchers concluded that a lack of empirical evidence impacts Rogers's technique. DOI theory cannot predict the membership of the technological innovator and early adopter reliably (Ntwoku et al., 2017). Also, it cannot verify the resultant generalization utilized as the basis for Rogers's adopter profiles in diverse industrial sectors (Ntwoku et al., 2017). Rogers's concept works well for new technological innovations or staled technological innovations, but not for variations of existing technology or enhancing an existing change (Ntwoku et al., 2017). In contrast to Rogers's diffusion concept, Bass's (1969) diffusion concept does not assume that innovators in one industrial sector could always be innovators in another technical terrain (Ntwoku et al., 2017).

Rogers's concept contends that the adoption curve is usually confirmed to the classical bell structured, standard distribution curve due to a learning curve effect due to personal experience within an identified social system. Consequently, it enforces a pre-established fixed proposition for each class of adopters permeating "2.5% innovators,

13.5% of trendsetters, 34% of the early majority, 34% of late bloomers, and 16% of laggards" (Ntwoku et al., 2017, p. 298) no matter the industrial terrain. Rogers's concept is complex and difficult to ascertain because of the above limitations, and critics believe that Rogers's idea can only be valid as a redundancy system of post-hoc classification. In conclusion, critics see Rogers's theory as being of little use for predicting future diffusion patterns. Rogers's DOI is poor at predicting the structure of the adoption curve or the timing and the degree of adoption peak (Ntwoku et al., 2017). Unlike Rogers's diffusion concept, Baas's diffusion concept does not use the standard deviations from the mean as a way of classifying adopters (Ntwoku et al., 2017).

Bass's (1969) diffusion concept is contrary to Rogers's (1962) DOI, which does not assume that innovators in one industry could always be innovators in the other industrial sectors. Bass does not utilize the standard deviations from the mean as a modus operandi of adopters' classification (Ntwoku et al., 2017). The Bass (1969) diffusion concept is one of the fundamental ideas in the DOI (Wang et al., 2017). Bass (1969) proved the one-time purchasing concept through research into the diffusion process of 11 kinds of durable goods. As a result of the simple structure and the explicit economic meanings of the parameters, the Bass diffusion concept is widely applied in innovation prediction.

Nonetheless, the classical bass diffusion concept enumerates some strict assumptions, so Bass generates more research to extricate these problematic assumptions (Wang et al., 2017). Bass's concept does not postulate that the adoption path is a normal distribution (Ntwoku et al., 2017). Consequently, generalized pre-established adopter

profiles are inconsequential when utilizing the bass concept. The underlying bass concept is based on a bouquet of essential assumptions (Li et al., 2017a).

Bass diffusion concept is premised on three-parameter estimation. In contrast to Rogers's technique, the parameters are not redundant as in Rogers's but are somewhat based on measures extrinsic to the concept (Ntwoku et al., 2017). The relationships between the three parameters are clearly defined concerning the mathematical functions of the idea. Nonetheless, like Rogers's concept, the Bass concept postulates that the adoption path takes a sigmoid shape (Ntwoku et al., 2017). The Bass diffusion concept applies to most innovations, new business concepts, and products but challenging to obtain an adequate sample (Wang et al., 2017). The Bass diffusion concept is a conceptual framework for predicting the market share of technological innovation, innovation's adoption, and diffusion (Lai, 2017). The Bass diffusion concept's primary assumption highlights the adoption of an innovator as independent of other social system members (Lai, 2017). Bass diffusion concept works well for significant brand innovations or discontinuous innovations and continuous innovation types (Ntwoku et al., 2017).

Information system is seen as the study of complementary networks of IT and software, which people and organizations utilize to gather, filter processes, create and disseminate data (Nehemia-Maletzky, & Iyamu, 2017). Information system is vital to enabling and supporting organizations in executing their organizational activities and strategies to achieve their set goals and objectives. Whereas IS and IT are characterized by constant change and attendant innovation development driven by business demands

for efficiency and practical purposes (Nehemia-Maletzky & Iyamu, 2017). According to Eze and Chinedu-Eze (2017), several types of research argued that over two-thirds of the information communication technology (ICT) innovations adoption projects fail due to less focus on human actors, who influenced and are influenced by the innovations but rather on the technology itself. All traditional adoption theories focused on deterministic conceptions, which see ICT as the only determinant of organizational structure and behavior of corporate members that shape the social worldviews (Eze & Chinedu-Eze, 2017).

ICT diffusion and accomplishment are more social structures consisting of socio-technical alliances that form adoption behavioral patterns, which involve much broader circumstances (Eze & Chinedu-Eze, 2017). The multi-layer settings consist of structural arrangements, culture, division of labor and specialization, standardization, operating process, the pattern of communication, ideology, statutory regulations, competitive forces, vendors' strategies, and understanding of the technology, as well as the socio-economic conditions (Eze & Chinedu-Eze, 2017).

Actor-network theory (ANT) is a theoretical, conceptual approach that offers conceptual tools that can be used to elucidate the complex network of interacting actors who collectively define the success or failure of a technological intervention or innovation (Penteado et al., 2019). ANT theory is considered in academia to be a highly influential theory within the sociology of science, which seeks to decipher and integrate socio-technical development and evolution (Penteado et al., 2019).

Technology may possess objective functions acceptable today but may be

challenged tomorrow due to several meanings that actors attached to technological innovations (Eze & Chinedu-Eze, 2017). The main concepts of ANT comprise actor and network, where actors are human and non-human entities that possess the capability of changing the idle situation (Nehemia-Maletzky & Iyamu, 2017). ANT is regarded for advocating a flat ontology between humans and non-humans in a social system known as agnosticism (Nehemia-Maletzky & Iyamu, 2017). ANT offers an opportunity to examine non-human and human actors equally, without prejudices to either technology or social issues about the two (Nehemia-Maletzky & Iyamu, 2017). Equal importance is placed on people, technology, and processes in ANT theoretical concept (Nehemia-Maletzky & Iyamu, 2017). ANT and other relevant theoretical concepts identify the intersection of technology and social contexts in the adoption of the technological innovation process (Eze & Chinedu-Eze, 2017).

The diffusion and adoption of IT and technological innovations have been a significant concern for academia and practice. As a result, some conceptual frameworks have emerged and used to peruse IT and technological innovation adoption. These frameworks comprise ANT, UTAUT, TRA, and the TAM (Dwivedi et al., 2019). UTAUT lacks some relationships that may be futuristic and excluded some attributes that may be vital for exploring technological innovation adoption. TRA is unpopular in research studies involving technological innovation adoption and diffusion. TRA is prevalent in identifying users' behaviors and perceptions on reviews on web utilization, cybersecurity, privacy, online commerce, and domestic computer utilization (Otieno et al., 2016). This research study explores the strategies used in the adoption of a new

networking innovation and not to identify users' behaviors and perceptions of the latest technological innovation. Hence, the choice of DOI theory to explore the adoption strategies of NFV technology by CIOs and some senior IT executives.

Bass diffusion concept is a conceptual framework used in studies to predict the market share of new ideas, adoption, and DOI (Li et al., 2017b). The TPB theory assumes that adopters' behaviors remain static over some time. This shortcoming in the TPB conceptual framework leads to the need for a new research theory that suites innovation adoption (Tarabaz & Poddar, 2019). ANT advocates agnosticism between humans and non-humans in a social system (Nehemia-Maletzky & Iyamu, 2017). Otieno et al. (2016) state that the theoretical confusion of extended technology acceptance models (TAM2) and the constructs of TAM are bereft of social and organizational factors, which are critical in influencing technological innovation adoption makes TAM inappropriate for this study. DOI as a theory based on "how," "why," and "at what degree," a new technological innovation diffuse through cultures within the organization and individual is relevant in innovation adoption (Otieno et al., 2016).

Application of DOI to NFV Adoption

Diverse theoretical concepts have been used to explain technological innovation adoptions (Zhang et al., 2018). Available theories are TRA, TAM, TPB, DOI, social cognitive theory, and UTAUT. Amongst the theoretical concepts listed above, TAM has been one of the most prevalent. However, TAM only incorporates two technology adoption factors, like perceived usefulness and perceived ease of usefulness, including any other external factors, limiting the TAM model's ability to explain consumer

behavior. Several theoretical concepts describing technology adoption exist in the psychology and sociology field, such as DOI theory, social cognitive theory, TRA, TPB, TAM, and UTAUT. TAM turned out to be the most prevalent and cited by numerous researchers. However, TAM's limitations, relating to extensibility and explanation power, have been a significant disadvantage (Boonsiritomachai, & Karjaluoto, 2017). Social influence as an antecedent to understand better the users' adoption behavior towards adopting Uber mobile application through the functional characteristics of DOI was included in the study (Min et al., 2018).

In previous research studies, TAM was commonly adopted to explain user acceptance of technological innovations, but very much understand TAM sufficiently explained the adoption of diverse technological innovations (Min et al., 2018). As an extensive social and psychological theory, DOI attempts to assist in predicting how people make decisions to adopt a change by finding their adoption style and understanding the strategies used. Specifically, DOI presents five innovation characteristics that are antecedents to any adoption comprising of relative advantage or economic benefits, complexity (simplicity) or ease of use of the technological innovations, complexity being consistent with prevailing values, needs, and past experiences of potential adopters, observability or the assessment of the implications of adopting the change, and trialability or experimentation before the adoption of the technological innovations (Min et al., 2018). Adoption and application of DOI used to understand renewable energy technology adoption in sub-Saharan African communities (Amuzu-Sefordi et al., 2018). DOI identifies five characteristics of innovations that allow

an understanding of how disruptive innovations change social systems and how these changes, in turn, influence their adoption (Rogers, 1962).

The socio-technical framework reiterates the co-evolution and mutual adaptation of society and technology (Amuzu-Sefordi et al., 2018). New technological innovation adoption causes some degree of societal change. The framework also states that social behaviors also require some degree of innovation adaptation. The vast body of existing knowledge leaves little or no doubt about the importance of innovation of dynamics of economic growth and socio-economic development (Edwards-Schachter, 2018). Change is a multidimensional paradigm that comprised varied meanings and definitions from the perspectives of different disciplines; some of them co-exist in emergent fields such as innovation studies (Edwards-Schachter, 2018). The users' intention to use the innovation within the DOI theoretical framework was explored (Hamad et al., 2017). The study hypothesized that a positive perception of technological innovation services might translate into the new plan to use change. However, negative attitudes may lead to resistance to the use of that innovation.

Understanding NFV Technology

As stated in the previous section, Syahadiyanti and Subriadi (2018) also identified the five characteristics of DOI as the factors that determine the most effective strategies for adopting new innovative technologies. NFV is an emerging network paradigm that leverages virtualization technology to provide the traditional NFs and services on virtual machines. NFV provides a networking concept to adopt, design, implement and manage networking orchestration based on the decoupling of the NFV from vendor locked

hardware appliances and provisioning the network services on a software template (Lyanage et al., 2017). Year 2012 marks the beginning of the era of NFV, when the call for the adoption and implementation of NFV became a task for the European Telecommunication Standard Institute to an NFV industry research group (Gao et al., 2018). The desire to deploy and manage traditional network hardware infrastructure requires increased CapEx, and OpEx shifted the focus of organizations and data center operators towards NFV (Gao et al., 2018). The Industry Specification Group (ISG) has entrenched a technology trend that allows network softwarization, which leverages virtualization technology. The resultant concept is the NFV, which benefits network providers regarding scalability, reduced opex, flexibility, and energy efficiency (Katsikas et al., 2017).

NFV technology represents a new revolution of networking generation and in the provisioning of network-based services (Gonzalez et al., 2018). A network virtualization technology that NFV leverages constitutes a promising technology that allows separation of traditional network-level functions of the overall encapsulated web architecture by decoupling the features offered physical hardware (Zhao & Parhami, 2019). The expected benefits of NFV over traditional networks comprise reduced CapEx and OpEx for organizations by reducing hardware and automating service costs (Vasilios et al., 2018). Additionally, NFV brings flexibility in the implementation and operation of new infrastructure and associated application rhythms due to the creation of enhanced services and associated applications and new business models driven by user demands (Vasilios et al., 2018). The introduction of NFV technology brings a significant change in

networking technology, which is expected to create new opportunities in cost-effectiveness, operations, and service provisioning (Gonzalez et al., 2018).

The capabilities of organizations and data centers to meet ever-increasing new user application on the traditional network infrastructures remains challenging due to the incapability to meet the ever-increasing demands or services. Organizations must, therefore, continuously install, operate, and consistently perform maintenance on new vendor locked-in physical equipment (Pham & Chu, 2019). Traditional mobile and data center networks are besieged with an all-time increase in the number of users and services, thus hitting the next-generation requisites in not an envisaged period (Sharma et al., 2018). Current organizations and data centers are aspiring to resolve subsisting networks by exploiting the capacity and coverage features of next-generation systems connected to NFV, software-defined network (SDN), and network softwarization technologies (Sharma et al., 2018). NFV allows organizations and data center operators to deploy VNFs virtualized over commodity servers to handle these challenges. VNFs are deployable in data centers or NFV-capable network elements, such as routers and switches (Sharma et al., 2018). With virtualization, all network services and functions are provided as a service through the VNFs deployed on the virtual machines away from the physical network infrastructure on commodity servers and switches (Mamatas et al., 2016).

NFV decouples the software of the NFs from the physical network infrastructure and runs on a virtual infrastructure, thus bringing greater flexibility in resource management as an abstraction of NFs dynamically (Woldeyohannes et al., 2018). The

limitations of the traditional network infrastructure comprising non-flexibility of the NFs, high OpEx, and CapEx, and non-commensurate performance and reliability prompted the evolution of new network concepts in NFV and SDN (Wood et al., 2015). Providing new network services and functions demanded by users cost-effectively, efficiently, and more agility has become difficult, if not impossible (Saraiva de Sousa et al. (2018). To correct this challenge, the network service providers proposed the NFV paradigm.

Implementing middleboxes is gradually migrating to software platforms, availing network infrastructures additional flexibility and extensibility for the network than vendor locked-in hardware appliances (Woldeyohannes et al., 2018). Through NFV technology, all next-generation network services and functions are decoupled from the physical legacy network infrastructures onto a commercial-off-the-shelf commodity or infrastructure (Woldeyohannes et al., 2018). NFV paradigm changed the traditional network infrastructure topologies and designs operated through network softwarization, leveraging virtualization technologies and generical purpose processors (Saraiva de Sousa et al., 2018). NFV technology provides new ways in which data centers and organizations can actualize, implement, and manage new service delivery to their dynamic users (Saraiva de Sousa et al., 2018). Through virtualization technology and network programmability, NFV technology deploys programmable NFs to offer efficient resource utilization, optimized service function availability, dynamic resource scaling, flexibility, as well as adaptability (Basile et al., 2019).

NFV technology may provide significant benefits to organizations regarding increased flexibility, faster provisioning of new and revised network functionalities and

services, better network resource utilization (Gonzalez et al., 2018). Nguyen et al. (2017), NFV offers network providers the capability of relocating NFs and services away from standalone dedicated physical hardware to software appliances that run on commodity-off-the-shelf servers. With NFV, each traditional network function now runs on a virtual machine decomposed into smaller components known as virtual network components running on diverse virtual machines (Nguyen et al., 2017). The concept of NFV and network virtualization has been leveraged to provide an abstraction of VNFs on-demand on commercial off-the-shelf- hardware for customized traffic processing (Han et al., 2018).

Organizations and data center providers rely on vendor locked-in middleboxes to actualize NFs (Han et al., 2018). This technique, however, presents drawbacks of low cost-effectiveness, delayed time to market, challenging to manage and maintain. Hence, NFV evolved to decouple NFs and services from vendor locked-in hardware and realize the NFs in software mode by leveraging IT resource virtualization (Han et al., 2018). The NFV paradigm presents a vital evolution of network service provisioning methodologies, leveraging standard IT virtualization technology to unify various network hardware facilities onto servers that could deploy in data centers and end-user premises (Baldoni et al., 2016). NFV technology has dramatically assisted network architects and providers alike in transferring the cost of specialized hardware-based appliances' NFS to flexible and programmable customized pre-packaged software-based NFs (Rehman et al., 2019).

The main goal of NFV is to virtualize NFs, lower CapEx, and deploy them in the commercial-off-the-shelf hardware (Woldeyohannes et al., 2018). According to Baldoni

et al. (2016), in practice, legacy network infrastructure needs constant software upgrades and new physical hardware each time there is a new service of function to be deployed. Legacy networks are primarily proprietary and non-portable, which is very scarce and expensive. Furthermore, proprietary software licensing and agreements have also contributed to network rigidity or unimaginable condition (Baldoni et al., 2016). To resolve network sterility and rigidity, developed NFV technology to allow the decoupling of NFs from the physical middleboxes they run into a virtual platform as a service (Mijumbi et al., 2016). NFV technology possesses the capability to aid significant reductions in operational and CapEx while facilitating the deployment of new network services and functions with enhanced agility and increased time-to-market (Basile et al., 2019).

Data centers and organizations must continuously deploy a variety of intermediary middleboxes like proxies, wide area network optimizers, firewalls, and intrusion prevention and detection systems to guarantee the security and performance of data transfers. However, because the middleboxes are typically made of expensive vendor locked-in hardware and manually managed, they considerably increase network management's inflexibility (Xu et al., 2019). To reduce operational expenses, enhance network flexibility, and reduce network service delivery timeframe to meet the upward rise of data-intensive user demands, the adoption of NFV became imperative (Cattaneo et al., 2018). NFV technology may alleviate network ossification and inefficient network management inherent in traditional networks by decoupling NFs from the physical hardware to realize them in software form referred to as VNFs (Yi et al., 2018). NFV

provides flexible and softwarized network function (NF) provisioning and ease of scaling. Also, NFV adoption may reduce administrative expenses and response times (Basile et al., 2019).

NFV and SDN concept as emerging technologies present flexibility and programmability while playing a critical role in service deployment and introducing new network features, such as flexibility, scalability, and programmability (Zou et al., 2018). NFV technology offers recipes to the current network operator global issues, challenges, and limitations by leveraging virtualization technology to provide a new way to design, deploy and manage networks and services (Nguyen et al., 2019). NFV decouples the traditional NFs like firewalls, load balancing, and IDS from vendor locked-in hardware middleboxes onto commercial off-the-shelf virtual servers. NFV has brought an unprecedented change to the way NFs and services are delivered (Nguyen et al., 2019). NFV allows the organizations and data center operators to achieve the same level of flexibility and agility already available in the cloud computing terrain, if not more (Cerrato et al., 2018). NFV technology shift allows NFs, such as deep packet inspections, routers, firewalls, and radios, deployed as software-based functions (Nguyen et al., 2018a).

The next-generation networks need new concepts and architectures for the traditional systems to enhance the offered performance, improve network deployment flexibility, and reduce network-provisioning costs (Basta et al., 2017). To deal with the challenges of conventional networks, NFV emerged. Through NFV, network services are provisioned through software-based NFs and elements, such as routers, bridges, which

reside on top of general-purpose built servers instead of purposely building the hardware (Nguyen et al., 2018a). According to the European Telecommunication Standard Institute NFV architecture framework, NFV allows decoupling network services and functions from the proprietary legacy network infrastructure (Cattaneo et al. (2018). NFV leverages the concepts of IT virtualization to deploy NFs and removes the dependency on hardware, where mobile NFs are implemented as software functions on high-end commodity servers at data centers (Basta et al., 2017).

Organizations and data center operators are now faced with the desire to accommodate significant traffic growth. Still, they are hindered by many challenges, from space to locating new physical network equipment to increasing energy costs. The organizations also need the required skills to design, operate, and manage such complex vendor locked-in infrastructure (Nguyen et al., 2018b). NFV technology allows outsourcing NFs from traditional vendor locked-in hardware to a virtualization platform. NFV concept offers to improve scalability and flexibility of network management and orchestration significantly (Li et al., 2017b). NFV network infrastructures and complementary technologies have recently been enabled in branch offices and homes to embrace the ubiquitous internet-of-things (Ghai et al., 2019). Organizations and data centers are relieved of the need to rapidly deploy new proprietary hardware and software to satisfy different user-generation network service requests (Ghai et al., 2019).

Adoption Trends

Technological adoption and diffusion are driven by attributes that determine the degree of acceptance of change within a specific time frame (Rogers, 1962). The

prevalence of relative advantage, compatibility, simplicity, trialability, and observability affects novel adoption rates (Rogers, 2003). Traditional network infrastructures require a sophisticated implementation of proprietary legacy network middleboxes, resulting in high capital and operating expenditures, unlike NFV infrastructure. NFV is an emerging networking technology concept that provides increased elasticity and flexibility for organizations and data center operators, as network-related services can be scaled and dispersed as required (Nobach et al., 2017). Such operation in the mobile and data center network operations needs a seamless transfer of state to provide a service without any performance degradation (Nobach et al., 2017).

Next-generation networks require heterogeneous and highly complex network infrastructures to deliver the expected next-generation NFs and services (Neves et al., 2016). To meet the network requirements of next-generation networks, the traditional hybrid network infrastructures must transform into innovative network platforms that may leverage new networking concepts such as SDN and NFV capabilities (Neves et al., 2016). Consequent to the expectations of the next-generation networks, NFV and SDN technologies are leveraged to deploy the next-generation network services more flexibly and seamlessly. NFV evolutional trends align with the evolution of micro-operators who can now provide new-generation network services and functions (Tseng et al., 2018).

A next-generation network needs an integrated NFV/SDN to deploy dynamic mobile virtual NFs and services, thus increasing the prominence of the NFV concept (Basta et al., 2017). The continued reliance on the traditional network to deliver next-generation network services and functions may significantly increase OpEx, CapEx, and

network disruption (Martinez et al. (2017). The expected next-generation systems are expected to leverage the benefits of NFV, SDN, and network virtualization to allow flexibility in providing full-fledge NFs and services to end-users (Afolabi et al., 2018). Through NFV technologies, data center operators can migrate NFs away from costly hardware appliances to dynamically allocate virtualized instances on generic servers leveraging virtualization and cloud technologies (Moens & De Turck, 2016).

Network softwarization has gained prominence among organizations and data center operators due to the inherent capability of flexibility and increased dynamicity of emerging concepts it's been leveraged upon (Bruschi et al., 2017). NFV technology, among others, offers the capability of moving the network services and functions closer to users to guarantee low latency in service delivery (Bruschi et al., 2017). NFV technology has been proposed as a novel network concept to tackle those perennial challenges of Internet Service Providers (ISPs) and traditional network providers (Yao et al., 2018). NFV decouples networks of NFs from dedicated hardware to achieve higher flexibility in terms of network maintenance and management (Yao et al., 2018). NFV concept, in combination with SDN and cloud computing, provides organizations with promises of cost reduction, enhanced network flexibility and scalability, and a short time to market a new user application. The combination of SDN and NFV in production networks is today changing the way network architects design their systems to cope with the continued growth of data traffic, the massive number of new devices and network accessibilities, and to lay the foundation for the next-generation networking infrastructures (Nguyen et al., 2017).

Application of NFV

Network virtualization enabled a promising approach for sharing physical infrastructure among diverse users and services logically in an isolated manner. Leveraging on the network virtualization technology to decouple the physical network equipment from the future that run on them and provides the potential to address the challenges of services (Cattaneo et al., 2018). NFV technology has introduced a new business model in which organizations need to rent cloud services to infrastructure providers (InP) as most cost-effectively as possible (Yin et al., 2018). Cost-effectiveness can be feasible only if the cloud resources are rented in advance by allocating long-term virtual machines. NFV technology transforms legacy NFs into software. It presents them as VNFs with the capabilities to consume the same if not more hardware resources as possible (Yin et al., 2018). A diverse quantum of VNFs in a different form can share a single physical pool of hardware resources (Alenezi et al., 2019). NFV offers the emerging next generation networks the capability to support new demands on the system for dynamic management (Zhang et al., 2019). NFV supports a vibrant mix of a broader diversity of services with different non-functional characteristics, such as reliability and power consumption (Zhang et al., 2019).

NFV technology leverages the pre-existing original concept of implementing all arrays of network function virtually in software form utilizing the same underlying hardware resources. Currently, the VNFs created in software format can consume any amount of hardware resources as required (Alenezi et al., 2019). A diverse quantum of VNFs in a different form can share a single physical pool of hardware resources (Alenezi

et al., 2019). To efficiently support new next-generation services with low latency requirements under diverse strings of workload conditions, NFV-enabled mobile edge-cloud is adopted (Yang et al., 2018). NFV offers unique flexibility in hosting mobile edge-cloud services in any virtualized network node such as access points, routers, and so on. NFV offers next generation networks the capability to support new demands on the network for dynamic management to support a vibrant mix of a broader diversity of services with different non-functional characteristics such as reliability and power consumption (Zhang et al., 2019).

The emerging NFV network techniques provide excellent capabilities to implement network reconnaissance mechanisms to pre-empt and defend against attacks on next-generation networks (Aydeger et al., 2019). In recent times, organizations have witnessed increased diversified network attacks, igniting a trend towards evolving more agile networks that can anticipate and defend themselves (Aydeger et al., 2019). As a result, defense mechanisms have focused on changing the configuration of traditional and next-generation systems not only during an attack but also before the attack. NFV enables the deployment of conventional NFs and services as virtualized instances, running in commercial-off-the-shelf hardware, thus improving scalability capacity. NFV is an enabler, which provides business agility and seamless operation and management (Lopez et al., 2016). The emerging NFV promises new networking technologies that can solve all the security issues in the traditional and next-generation network through a process referred to as security service chaining composition (Liu et al., 2018b).

Hindrances to NFV Technology Adoption

Replaced complexity with simplicity to propose five innovation characteristics that may affect the trend or rate of adoption of new concepts as relative advantage, compatibility, simplicity, trialability, and observability (Cadarette et al., 2017). NFV ISG technology documents a network architecture, which allows separation of NFs away from the physical middleboxes. Some challenges are hindering the deployment of NFV in production networks such as latency, optimization (performance), security, management, and network orchestration, and metrics for measuring performance and availability of service (reliability) (Gupta et al., 2018). These challenges emanate from the constraints of deploying carrier-grade NFV infrastructure, as organizations and data center operators are confronted with more stringent service level agreements and statutory hurdles than a typical business infrastructure (Gupta et al., 2018). The NFV ISG created an environment for the network providers and other relevant stakeholders to collaborate to demonstrate technically proven solutions that could address the technical challenges for NFV deployment (Anabo et al., 2017). In summary, from the preceding that the infancy stage of the NFV concept is yet to give credible solutions to handling the hindrances, which future CIOs and some senior IT executives can leverage in the adoption of NFV technology in their organizations.

The recent adoption and implementation of NFV architectures have garnered unprecedented traction in the ICT terrains. The underlying virtualization technology brings significant benefits, such as flexibility, lower CapEx and OpEx, and seamless deployment of NFs (Woldeyohannes et al., 2018). NFV introduces additional layers,

which reduces the transparency into faults at layers. Hindrances to NFV technology also comprise cooperation and latency between layers (Li et al., 2019). Advances in the design and deployment of VNFs, VNF placement, and chaining persist as a significant challenge (Miotto et al., 2019). Recently, a more substantial percentage of organizations and data centers leverage NFV technology to reduce CapEx and OpEx (Li et al., 2019). Reduced CapEx and OpEx are achieved by outsourcing thousands of NFs to the cloud or virtual platforms. VNFs placement becomes an all-important but difficult challenge for the cloud or virtual service providers.

Adoption Strategies

Different theories, such as TPB, TAM, UTAUT, DOI, TOE, and institutional theories, are unified theories available to decipher adoption strategies by individuals and organizations. (Molinillo, & Japutra, 2017). The TPB, TAM, and UTAUT theories are prevalent in analyzing technology adoption. Nonetheless, TPB, TAM, and TOE are used to analyze technological innovation adoption strategies at individual levels (Molinillo, & Japutra, 2017). The three most used theories employed in analyzing adoption strategies at the organizational levels are DOI, TOE, and IT. Still, I adopted DOI as my conceptual framework and, as such, used it in this research study (Molinillo & Japutra, 2017). Technological innovations such as NFV and SDN are needed to transit traditional network capabilities into a next-generation network (Contreras et al. (2015). NFV and SDN make the conventional network to be programmable in such a manner that promises to be more flexible than the current managed network.

NFV and SDN offer network programmability and instantiation of network function on commercial-off-the-shelf commodity servers, breaking the monolithic techniques of functional software and hardware existing in vendor locked-in offerings (Contreras et al., 2015). However, organizations confront some challenges in adopting NFV in production networks comprising operational, organizational, and business that needs innovative strategies to address them in adopting NFV technology (Contreras et al., 2015). The evolution of NFV provides organizations the capability to decouple service deployment from network physical infrastructure and permits the dynamic establishment of service chains according to tenant and application needs on virtualized infrastructure (Khebbache et al., 2017).

The growing trends of digital transformation have brought unprecedented networking innovations, which recently catalyzed new networking concepts of cloud computing and virtualization (Yoo & Kim, 2018). Due to the continued revolution in the IT environment, organizations change their business models and consider cloud computing systems, which may avail them of organizational developments and business agility (Yoo & Kim, 2018). Technology, organization, and environment are decision areas of focus in evolving an adoption strategy or model for cloud computing (Yoo & Kim, 2018). Adopting ICT enables organizations to be more competitive and enhance their corporate performance, primarily when the organization utilizes ICT for marketing-related functions (Molinillo & Japutra, 2017). Organization's investments in ICT adoption are a function of their strategy and the organization's market positions (Molinillo & Japutra, 2017).

Higher numbers of research studies have been conducted to analyze the strategies and the factors influencing the adoption and user acceptance of technological innovations in organizations. However, researchers are yet to identify the most appropriate organizational innovation adoption theory to utilize. Until now, researchers have been using methods and theoretical models from diverse subject areas that are ideal for explaining the adopters' attitudes, strategies, and innovation adoption behavior of IS adoption (Hameed & Arachchilage, 2017). The drivers for organizational innovativeness permeate innovation characteristics, organizational characteristics, and environmental characteristics (Hameed & Arachchilage, 2017). Academia has described the strategy of technological innovation adoption into diverse sequences of phases. According to different research studies, the procedures comprise the initiation, adoption-decision, and implementation phases. The technological innovation adoption phases highlight pre-adoption (introduction), adoption-decision, and post-adoption stages in the IS literature (Hameed et al., 2012).

Past research studies on IT adoption have widely used DOI to study technological innovations by organizations. DOI is a prevailing theory for technology adoption, as DOI includes diverse technical characteristics comprising relative advantages, complexity (simplicity), compatibility, observability, and trialability, which may promote or weaken the adoption of novel technologies (Chandra, 2018). Aimed at filling a critical void, investigating the role of organizational level influences and decision factors in the adoption of emerging technologies (new ICT concepts like NFV, SDN, cloud computing, and digital library technology) was carried out to enhance services offered by digital

library programs (Oguz, 2016). The adoption of web services technologies is revelatory to the degree of organizational biases (organizational structure, management style, focus and direction, and external relationships) identified may apply to similar adoption decisions for critical technologies. I am using Rogers's DOI theory to explain the adoption strategies used by some IT-driven organizations' CIOs to adopt NFV. The focus was on the eastern part of the USA and concerning the strategies used to adopt different types of IT systems.

Diffusion of novel innovations highlights the social activity impacted by factors, such as characteristics of the unique changes (relative advantage and the decision-making unit (individual attributes) depending on the level of adoption (personal versus organizational) (Rogers, 2003). The prevalence of a high degree of relative advantage, compatibility, simplicity, trialability, and observability in innovation are more likely to be adopted faster than others (Rogers, 2003). Nonetheless, structural factors, such as innovation-specific characteristics like costs, profitability, and social approval, must be considered, especially in organizational settings, which this research study focused on (Rogers, 2003). The major diffusion influences are organized into internal inputs are organizational structure, management style, focus, and direction (Oguz, 2016). Also, external relationships, which are a considerable technology ingredients adoption model, depict how major influences contribute to the decision-making strategy on digital library adoption strategy.

The technological innovation adoption decision strategy highlights the search for information created by a sequential procedure in which the innovation is motivated to

reduce uncertainty about the advantages and disadvantages of technological innovations (Miranda et al., 2016). The five phases comprising previous conditions for adoption, knowledge about the innovation, persuasion of the potential adopter by deepening the understanding about the innovation and seeking further information about the same innovation-decision to adopt or reject the innovation (Miranda et al., 2016). Implementation refers to when the adopter evaluates and decides the maintenance of the adoption or rejection of the innovation after the change. DOI is used to structure and report the decision-making process for the adoption of enterprise resource platform technology in the organization (Hameed & Arachchilage, 2017). A conceptual framework of IS security innovation in the organization emphasized technology, organization, environment, and user acceptance characteristics examined in the past IS innovation adoption literature (Hameed & Arachchilage, 2017).

DOI theory avails a bouquet of technological innovation characteristics that may affect the adoption decision (Hameed & Arachchilage, 2017). With the emphasis on relative advantage, compatibility, complexity, trialability, and observability in terms of technology attributes (Hameed & Arachchilage, 2017). Organizations need to ultimately analyze the adoption strategies of cloud computing for an organization's successful digital transformation to articulate the priorities of decision factors and characteristics (Hameed & Arachchilage, 2017). IT innovation adoption can be prompted by a management decision believing that innovation may enhance organizational performance (Miranda et al., 2016). The innovation adoption strategies iteratively comprise five stages: knowledge as the bedrock of the decision-making unit with socio-economic,

personality variables, and communication behavior characteristics (Miranda et al., 2016). Persuasion as perceived attributes of the innovation comes with DOI's five attributes. The decision to adopt or reject the change out rightly; the implementation stage entails sustained adoption and continued rejection, and the confirmation stage comprises later adoption or discontinuance.

Organizational level adoption judgment, followed by the users' verdict regarding innovation, exemplifies two stages of evaluation from the initiation phase until the acquisition of the technological changes (Miranda et al., 2016). The innovation adoption process comprises five main aspects: knowledge, persuasion, decision, implementation, and confirmation of acceptance and rejection (Daradkeh, 2017). First, the knowledge phase offers prospective adopters the opportunity to learn more about technological innovation to develop some level of understanding of the functionality of technological innovation (Daradkeh, 2017). Second, the persuasion phase allows prospective adopters the capability to either arrive at a favorable or unfavorable conclusion about the change, thus influencing their decision to either accept or reject the innovation outrightly (Daradkeh, 2017). Third, the persuasion phase permits the prospective adopters to evaluate the information about technological innovation to decipher the advantages and disadvantages of technology concerning their individual needs and requirements (Daradkeh, 2017). Fourth, the implementation phase highlights technical innovation utilization. Finally, the confirmation phase occurs when the prospective adopters decide to continue or discontinue the use of technological innovation (Daradkeh, 2017). Higher perception of the priorities of decision factors and the characteristics to adopt cloud-

computing systems is comprehensible when organizations ultimately analyze the adoption strategies and processes of cloud computing for organizational successful digital evolution (Yoo & Kim, 2018).

Similar Research Studies

There exists in academia research studies utilizing qualitative research studies in technology adoption. Qualitative research description is critical where data is directly needed from those samples under scrutiny and with limited time and means (Bradshaw et al., 2017). Qualitative research studies lie within the ambiance of the naturalistic approach, which creates an understanding of an event while perusing the meanings the respondents ascribe to them (Bradshaw et al., 2017). Since this research study aimed to explore CIOs' strategies, and some senior IT executives in IT-related organizations used to adopt NFV, I used qualitative research. This study was based on a qualitative multi-case study research methodology to explore the strategies used in adopting NFV technology in organizations using a DOI theory conceptual framework.

DOI theory was used as an explanatory framework to explore variables that are likely to influence technology adoption (Iles et al., 2017). DOI theory identifies diverse phases of adoption individuals traverse from awareness, opinion formation, adoption decision, adoption action, and decision enforcement or implementation. Also identified are internal and external factors affecting the adoption of technological innovations. Jacox et al. (2019) enrolled twenty-four privately practicing orthodontists in qualitative semi-structured one-on-one interviews. I used semi-structured interviews to promote an open-ended environment that permitted respondents to voice personal views and raise

topics during interview sessions. The research study was to identify factors in technology adoption and innovations perceived to impact practice. Understanding the technology adoption strategy or process could guide changes to enhance treatment and ease the transition into the digital workflow (Jacox et al., 2019). This study differs from my research on identifying strategies used by some senior IT executives to explore NFV technology adoption strategies. Because in their research, Jacox et al. (2019) enrolled twenty-four privately practicing orthodontists in the University of North Carolina, school of dentistry, or Harvard School of Dental Medicine.

Marak et al. (2018) examined the adoption and diffusion of 3D printing technology in selected industries in India using DOI theory as a conceptual framework to find a relative advantage, ease of use, and trialability to be critical. However, compatibility and observability are of less importance. Their study utilized the framework of innovation and DOI theory to perform exploratory factor analysis, which generated four independent factors of adoption (Marak et al., 2018). Bell and Ruhanen (2016) used DOI theory to explore the diffusion and adoption of eco-innovation by Australian ecotourism businesses, mainly focusing on the role of stakeholders and change agents in influencing adoption decisions. I carried out in-depth semi-structured interviews to explore diffusion strategies and decipher key actors that influenced eco-innovation adoption and diffusion (Bell & Ruhanen, 2016). This study used DOI theory to examine the adoption of eco-innovations by Australian ecotourism organizations and differs from my research study exploring the strategy utilized by some senior IT executives of organizations in the eastern USA to adopt NFV technology.

Transition and Summary

This section comprises the foundation of the study, the research methodology, the purpose of research, and a review of the literature regarding exploring the strategies employed by some senior IT executives in network operators and relevant organizations using DOI theory as my conceptual framework. A qualitative multiple case study was used as the research method. At the same time, the literature review traversed the anatomy of DOI theory, understanding of NFV technology and hindrances to NFV adoption, network softwarization, adoption strategies, and similar research. NFV technology is a new networking concept, which allows the provisioning of network-based services virtually off the physical network infrastructure (Gonzalez et al., 2018). NFV benefits network providers in scalability, reduced opex, flexibility, and energy efficiency (Katsikas et al., 2017). While NFV has been widely accepted at an unprecedented rate, there still exist some challenges about fulfilling some of the objectives of NFV technology adoption (Mijumbi et al., 2016).

Rogers's DOI theory emerged in the early 1960s by extending the traditional understanding of diffusion communication to encompass social alliances of all kinds, traversing oral communication to network externalities and social signals (Liu et al., 2018b). The exploration of the strategies of adoption of NFV technology highlights the five characteristics of DOI. In his seminal work, Diffusion of Innovations, Rogers (1962) put forth five characteristics of DOI, comprising relative advantage, compatibility, complexity, trialability, and observability. Section 2 comprised the purpose of research, study methodology, sampling, and data analysis technique to explore NFV technology

adoption strategies. Section 3 featured the application of the study to the IT field with emphasis on Social Change impacts, the presentation of research outcome, reflections, and the research conclusions.

Section 2: The Project

Purpose Statement

The purpose of this multiple case study was to explore the strategies utilized by chief information officers (CIOs) who have successfully adopted NFV technology. The purposeful sample for this study was CIOs, chief technical officers (CTOs), chief security information officers (CSIOs) in network providers and organizations who have adopted and implemented NFV technology in at least six organizations in the eastern United States. The social impact of this research study may start with an increased awareness of the global network paradigm shift to consolidate network resources and their dynamic utilization, which may provide better energy efficiency and impact global climate change (see Mijumbi et al., 2016).

Role of the Researcher

I assumed the role of principal mechanism for the data collection. Humans create meaning through sensitivity, responsiveness, and flexibility, making researchers the ideal instrument for research studies (Peredaryenko & Kraus, 2013). I developed semistructured interview questions, collected the data from the interviews with the participants, organized the data, and analyzed the resultant data. Qualitative researchers' interests lie in the depth of human experiences and all the personal biased peculiarities characteristics of participants' experiences and meanings associated with the phenomena under research study (van den Berg & Struwig, 2017). But researchers need to be aware of their contributions to the construction of meanings and lived experiences throughout the research process (Palaganas et al., 2017). Therefore, I remained focused and engaged

in the research topic throughout the study. I ensured that the research outcome accurately reflected participants' views. I adhered and followed in detail with the interview protocol (Appendix B) detailing participants' privacy, consent, the importance of the study, and adherence to the Belmont Report's beneficence proclamation.

Researchers are an integral part of the process, and the outcome in which separation from the research study is almost impossible. Thus, it is important for researchers to be unbiased and reflexive about their mindsets, relationship dynamics, and analytical perception of the topic and the phenomenon (Galdas, 2017). I have worked in ICT for a total of 29 years. My lack of prior technical experience in adoption and implementation strategies allowed me to de-emphasize my prejudice on this research topic. My curiosity in exploring the NFV technology adoption strategies was the main reason that propelled me to research this topic, as NFV may possess the potential to enhance networking agility, flexibility, and reduced CapEx and OpEx. I had no prior professional engagements with the participants from the prospective organizations before this research. Additionally, before asking the participants to participate in my research study, I obtained Walden University Institutional Review Board (IRB) approval. The researcher–participant relationship is also important for collecting participants' responses (Harvey, 2017). The research outcome is a version of participants' experiences in adopting NFV technology, comprising a structured interpretation of the collated feedback and responses from the participants through my multiple interactions and engagements with the participants.

As the primary instrument for collecting data, my adherence to the requirements embedded in the *Belmont Report* regarding ethical research was done to assure the protection of all respondents (National Commission for the Protection of Human Subjects of Biomedical and Behavioral Research, 1979). The *Belmont Report* highlights three ethical principles, which are critical to research involving human subjects, comprising respect for persons, beneficence, and justice (Freisen et al., 2017). The report suggests that respect for persons should be the guiding principle underlying informed consent, that beneficence should emphasize risk-benefit analysis, and justice must be the focal principle behind subject selection (Friesen et al., 2017). In adhering to the report, I stated all relevant information in subject consent forms to appraise the participants' eligibility and readiness. The negative impacts of not applying the *Belmont Report*'s principles include coercion, harm, and unnecessary involvement of vulnerable and burdened human subjects (Anabo et al., 2017). I also obtained certification from the National Institute of Health Office of Extramural Research (see Appendix A).

Bias in social research is also an undesirable phenomenon because it causes deformation throughout the entire research process (Borowska-Beszta, 2017). Qualitative research highlights four common types of researcher prejudices or biases: research questions, sampling, conceptual framework, and expected result biases (Wadams & Park, 2018). The identified preferences can misrepresent the participants' actual experiences in qualitative research studies (Wadams & Park, 2018). I paid particular attention to preventing biases in developing research questions, sample selection, data collection, and analysis. However, due to explicit or implicit value assumptions in the conduct of any

research method, biases or prejudices may occur. Value assumptions may be evident in one or a different part of the research study such as the framing of the research question, the choice of conceptual framework, the selection of samples, the nature of the interview questions, variety of data sources, and data analysis methods (Mackieson et al., 2018). To mitigate the biases in my research study, I was wary of my influence on the phenomena as a professional and how the research process could affect me.

As the researcher, I administered semistructured interview questions to collect data. Active listening, reflections, flexible researcher–participant relationships, and insight into the co-constructed stories between participants and researchers are critical through the interview sessions (Mitchell et al., 2018). Additionally, interview protocols facilitate the interview process, ensuring the collection of accurate information within the stipulated time frame (Yeong et al., 2018). I followed the interview protocol (see Appendix B) for an in-depth qualitative research study utilizing semi-structured interviews with the CIOs, CSIO, CTO, and two or more senior IT senior executives who have been part of the successful adoption and implementation of NFV technology in their organizations. The interview protocol highlights 14 phases among the introduction and authentication of participants' consents, privacy, purpose, the importance of the study, beneficence proclamation, and confidentiality (see Appendix B; see also McGrath et al., 2019). The interview protocol enabled me to listen attentively to each participant's responses reflexively to give me an insight into their real-life stories regarding the adoption of NFV technology in the respective organizations. I continuously reflected on my engagement with my data collection and analysis of the collected data. I transcribed

data immediately after the interview sessions. I checked through post-interview reviews and classifications to ascertain the trustworthiness and ensured new data analysis.

Participants

Researchers have a duty to selecting relevant participants (Nyumba et al., 2018), ensuring fair distribution of benefits and burdens without any prejudices (Mathur et al., 2019). For this qualitative multiple case study, I selected eligible participants from the population of CIOs, CTOs. CSIOs, and some senior IT executives in organizations with large IT infrastructures and network operators in the eastern United States. Participant selection was based on their real-life involvement in successful NFV technology adoption and implementation in various organizations. Researchers may employ diverse techniques to recruit suitable participants, including local and international professional networks and contacts (Nyumba et al., 2018). I used my professional networks, such as LinkedIn, professional partners, and the Institute of Electrical Electronics Engineers (IEEE) to identify CIOs, CTOs, CSIOs, and senior IT executives who have successfully adopted the NFV concept before recruiting them. The participants were full-time employees with technical expertise and knowledge of the NFV technology adoption strategy. I used my professional networks and associations like the IEEE to identify organizations, and their CEOs, whom I contacted through email, and professional affiliates to recruit partner organizations after IRB approval. These CEOs connected me with their appropriate CTOs, CIOs, CSIOs, and senior IT executives who have experience in NFV technology adoption.

The researcher–participant relationship is key to research studies because the integrity and validity of the study are dependent on this link. This relationship shows that the findings reflect strong loyalty and commitment to participants and their lived stories (Karnieli et al., 2009). I strived to equalize the distribution of power and encourage vulnerability and mutual trust among the participants and myself, following the interview protocol (Appendix B). The anonymity of their interview responses was communicated to the participants from the beginning. I also made them aware that the study strived to provide some social and professional benefits to the participants. For a high level of validity in this study, I adhered to ethical research norms (Bahrami et al., 2016). Researchers are expected to establish procedures and policies necessary for a research study to be worthy of acceptance by academia (Connelly, 2016). To guarantee the credibility and trustworthiness of the collected data, I established the interview protocol (Appendix B) that guided me in engaging the participants.

Research Method and Design

Method

Qualitative research is a method of understanding human beings' unique, dynamic, and holistic behavior (Kalu & Bwala, 2017). A quantitative method in contrast is a numerical approach that entails critical measurements of constructs. Additionally, the quantitative method requires statistical analysis to decipher the pre-determined postulations (Murshed & Zhang, 2016). The quantitative research methodology strives to retrieve a precise and reliable measurement that permits statistical data analysis (Queiros et al., 2017). However, I did not engage in statistical data analysis, so quantitative

research methodology was inappropriate.

The fundamentals of qualitative study have a direct relationship with the participants in their real world to understand their perceptions of the phenomena. Hence, this study utilized qualitative research because it connected with the participants in their natural world. Qualitative research allows the development of an inductive level of detail from in-depth involvement in participants' actual lived-in experiences (Mohajan, 2018). Qualitative research is ideal for understanding the factors that affect the acceptability and feasibility of innovations (Toews et al., 2017). I utilized qualitative research methods to explore the participants' experiences, using semistructured interview questions to enable respondents to disseminate their personal life experiences and perceptions.

Mixed methods research involves both quantitative and qualitative data collection and analysis (National Institute of Health Office of Behavioral and Social Sciences, 2018). Mixed methods research combines qualitative and quantitative methods in a single research study to provide a broader and complete overview of a problem (Almeida, 2018). Mixed methods research highlights a critical part of working through a transformative research technique where community participation is required at the start, throughout, and at the end of each research study (Molina-Azorin, & Fetters, 2019). There was no need for numerical data, so the mixed method was also inappropriate for this research. The qualitative research method was appropriate for achieving the main objective of this study because this research entailed understanding and deciphering the meanings and perceptions of the participants regarding the phenomenon under review.

Research Design

Case study research enables a holistic perception of a phenomenon in the natural, actual life setting and from the participants' perspectives (Breet & Bantjes, 2017; Kerins et al., 2019). The number of cases may define case studies, single or multiple case studies, and by their purpose comprising exploratory, descriptive, and explanatory (Hercegovac et al., 2019). Multiple case studies involve more than one case that each possess diverse individual contrasting or similar contexts and results (Nunes & Russo, 2019). A multiple case study affords researchers a more in-depth understanding of the phenomenon by comparing the differences and similarities of the emerging themes (Kerins et al., 2019). I selected a qualitative multiple case research design to gather a more in-depth perception of the NFV technology adoption strategies utilized by CIOs, CTOs, CSIOs, and senior IT executives.

Other qualitative research designs considered but not chosen are (a) ethnography, (b) phenomenology, and (c) narrative design study. Ethnography allows close examination of cultural phenomena, invariance to most quantitative methods (Freedman, 2016). Ethnographers get immersed in the daily life of the studied culture, usually for an extended period and space, using personal experience, interviews, informal conversations, and documents and generated items as multiple sources of information for analysis (Freedman, 2016). Ethnography highlights the kinds of stories, narrations, and different routes in which knowledge is generated. Thus, the outcomes of the learning are presented, making ethnography more than a literary endeavor (Carter, 2018). However, ethnography is limited to generating suggestions (Currie, 2016). This study was not about

generating empirical knowledge, and I did not intend to get involved with the participants in their cultural setting but rather explored the strategies the participants utilized to adopt the NFV technology. Hence, ethnography was most inappropriate for this study.

I also considered phenomenology as a research design for this study, which presents diverse designs addressing questions based on participants' lived experiences. As a philosophical concept, phenomenology is used to understand and represent the lived world of participants (Bush et al., 2019). Phenomenology is the study of what unique meaning participants attach to the phenomenon reflected in participants' lived experiences (van Manen, 2017b). Participants' lived experiences, though vital to this study, would not allow for collecting organizational documents and artifacts. Additionally, phenomenology does not rely on numerical data and examples (van Manen, 2017b). Hence, phenomenology was inappropriate for this study.

Finally, I considered a narrative design, which focused on the temporal quality of the lives and stories of participants to articulate with the individual, personal experiences (Bradbury, 2017). The narrative study is used when the researcher's desire is for a more holistic exploration of the chosen phenomenon traversing the depth and breadth of such an event (Lindsay & Schwind, 2016). This study strived to explore the strategies CIOs, CTOs, CSIO, and senior IT executives in-network providers and organizations utilized to adopt NFV technology and not on the quality of life lived by the CIOs. The semistructured questions were not designed to get participants to share experiences of the phenomenon but rather to share the strategies used in adopting NFV technology. Most importantly, this study did not aspire to affirm, challenge, and extend the participants'

stories. Hence, I did not consider the narrative design.

As another consideration in the research design, I continuously acquired data from multiple sources until I reached data saturation. During a series of interviews where little or no new themes, codes, or ideas evolve is known as saturation (Weller et al., 2018). The point of data saturation is when continued data collection and analysis persist to the end when additional input from new participants no longer impacts the researcher's perception of the phenomenon (Tran et al., 2017). In qualitative research, the most common way of meeting saturation benchmark is the sequential application of semistructured interviews with *what*, *how*, and *when* questions (Nascimento et al., 2018). Systematic analysis and sampling theory resolve the challenges of saturation, and sample size in diverse research that depends on qualitative data (Weller et al., 2018). I implemented six interviews to acquire relevant information until no new information evolved. I continued to acquire data until the data reached saturation when new perspectives and explanations on the phenomenon were no longer forthcoming.

Population and Sampling

Population Description

The population for this study comprised CIOs, CTOs, CSIOs, and senior IT executives who have successfully adopted and implemented NFV technology, located in the eastern United States. Participants' recruitment, which is part of the sampling strategy in a qualitative study, began after IRB approval. The sample included at least two CIOs, one CSIO, one CTO, and two senior IT executives who have been involved in the adoption of NFV technology. I identified and selected the CIOs, CSIO, CTOs, and some

senior IT executives through my professional and social networks such as LinkedIn, and Twitter advertising, IEEE, WhatsApp. Also, I perused the NFV technology updates' publications to search for the CIOs and some senior IT executives experienced in adopting the NFV technology in the eastern part of the United States.

Sampling Method

Qualitative research includes two notable sampling methods: (a) probability sampling and (b) non-probability sampling methods. The non-probability sampling method comprises snowball, quota, and purposive sampling, depending on the researcher's choice, accessibility, and the general population. Purposive sampling is a non-probability sampling mainly used in qualitative studies focusing on in-depth interviews (Setia, 2016). Purposive sampling allows researchers to select information-rich cases to study the in-depth understanding of the phenomenon (Benoot et al., 2016). Purposive sampling was most appropriate for this study to enabled me to retrieve information-rich data from experts in the field of the NFV concept. Therefore, I focused on the snowball-sampling method also. Critics of the snowball sampling method posited that potential participant with minimal professional networks might be underscored, as they are less likely to be broached for participation in the interview (Kirchher & Charles, 2018). Therefore, in order not to abruptly reach the end of referrals of samples, the snowball-sampling method is inappropriate for this study. The quota sampling method refers to a non-probability sampling method. Researchers use categorized sample groups and select participants from each group utilizing pre-determined quotas (Ragab & Arisha, 2018). Researchers may find it difficult to conclude with a stratified population due to the

possibility of sampling bias in the quota sampling method (Berndt, 2020). To avoid sampling bias and difficulties in completing the research, I did not use the quota-sampling method for this research.

To access information-rich cases, I used purposive sampling to select the respondents with comprehension and understanding of the phenomenon to respond to the specific research questions. Purposive sampling is a non-probability sampling technique researchers utilize to select knowledgeable samples to participate in research (Eshtaiwi et al., 2018). Purposive sampling, participants are chosen to accommodate a variance of demographic and technical characteristics to retrieve different categories of opinions. In this study, some senior IT executives comprising CIOs, CSIOs, and CTOs hold the required information-rich data critical to achieving the aim of this study (Manera et al., 2018). Hence, I used a purposive sampling technique in this research. Total population sampling, a subset of purposive sampling, is adopted in research studies of small sample sizes. Total population purposive sampling provides a researcher with a deeper understanding of the typical phenomenon under scrutiny (Amartey et al., 2019). For this study, I used purposive total population sampling. Total population sampling ensured that the selected participants possess the distinctive characteristics and knowledge appropriate and suitable for this research. The samples must have proficiency and experience in the adoption and implementation of NFV technology. I interviewed at least six qualified participants comprising CIOs, CTOs, and CISOs approved by partner organizations' CEOs. I identified through networks like IEEE, LinkedIn, Twitter advertising, SDXCentral, Gartner WhatsApp, and the entrepreneur's organization.

Sample Size

For this study, I used a sample size of at least six participants, comprising CIOs and senior IT executives. They have experience in the adoption or implementation of NFV technology. The study strived to retrieve data relating to the successful CIOs and senior IT executives' successful strategies to adopt NFV technology. When study samples have specific characteristics, sample size and study objectives are interwoven (Malterud et al., 2016). Furthermore, smaller sample sizes support narrow-focused research studies. Regarding a few qualitative studies investigating actual theoretical saturation, data saturation began to be evident at six in-depth interviews between three cases (Boddy, 2016). I engaged the CIOs, CTOs, CSIO, and senior IT executives to respond to my research question as it directly affects NFV technology adoption in six organizations. Pre-interview and post IRB approval. I ascertained the extent of participants' knowledge of the topic by engaging only those who have adopted and implemented NFV technology in their organizations. I included in the estimated population, at least six participants comprising of two CIOs, one CTOs, one CSIO, and two senior IT executives. I identified six participants through my professional networks such as IEEE, LinkedIn, Twitter advertising, WhatsApp, and the entrepreneurs' organization.

Participants' Selection Criteria

I reviewed population selection for the eligibility of the participants. Sample refers to a simple subset of participants drawn from the target population, which correlates with the whole set of subjects whose attributes are interesting to the researcher

(Martinez-Mesa et al., 2016). Eligibility criteria in selecting participants for sampling reduce the risk of introducing errors, which could occur if decisions on inclusion or exclusion of participants are selective, subjective, or inconsistent (Frampton et al., 2017). Participants' selection criteria referred to participants' current positions as CIOs, CTOs, and CISOs who have been involved in adopting NFV technology. Inclusion criteria highlight the critical features of the target population that the researchers used to answer the research question (Patino & Ferreira, 2018). The inclusion criteria for the participants are CIOs, CTOs, CISOs, and some IT executives who have been involved in NFV technology adoption and currently occupying an IT executive leadership position, working in organizations that have adopted and implemented NFV networking concepts. I asked the prospective participants whether they have adopted and implemented NFV technology in their organization to qualify them for further participation. Additionally, participants included those who were ready and willing to share experiences in adopting NFV technology and have been involved with the NFV networking concept.

Interview Setting

In collaboration with the participants, I created conducive timing for the interview sessions through online platforms comprising telephones or videoconferencing applications such as Zoom, Skype, etc. In partnership with each participant, I suggested a convenient date and timing suitable for the participants. Before conducting an interview, the researcher must be ready with the most vital tool, namely the recorder (Alsaawi, 2014). Sequentially, the researcher should provide a convenient environment for the meeting and make the participant feel comfortable and at ease. After the permission of

the participants to record the interview sessions, I conveniently recorded the interview sessions during telephone or video conferencing with the participants. In virtual face-to-face interviews through Zoom and Microsoft Teams, I recorded the interviews with the consent and approvals of the participants. I minimized and prevented interruptions and allow optimum time for the participant to respond to questions adequately. By establishing collaboration of trust and respect with participants, researchers can assist the participants in sharing emotions, thoughts, and specific experiences on the phenomenon (Seitz, 2016). I established rapport and trust with the participants in virtual face-to-face or online ambiance to create a personal relationship. The affinity allowed me to understand the participant's body language and gestures. During the interview preparation stage, the interview location was private, behind closed doors, rather than a public place (DeJonckheere & Vaughn, 2019). Most ideal for locating a room where the participant can speak privately without interruption and quiet enough to allow recording of the participant's responses (DeJonckheere & Vaughn, 2019).

Data Saturation Process

I used interview questions (Appendix C) and documents provided by participants to gather information from multiple cases and mainly CIOs, some senior IT executives such as CTOs, and CISOs. They are proficient in NFV technology adoption strategies. Purposive sampling saturation is the most common guiding principle to access the adequacy of data required in the cause of the interview (Hennink et al., 2019). Data saturation highlights the point in data acquisition when themes begin to appear persistent, and further data collection becomes redundant (Hennink et al., 2019). Using total

population sampling, a type of purposive sampling method. I engaged in interview sessions with all the available participants, collected organizational documents, and generated items relevant to the research topic and the phenomenon to reveal the successful strategies used in adopting NFV technology. Regarding trustworthiness and validity in qualitative research, data sets are measured to confirm that the information contains all data needed to decipher the research question (Lowe et al., 2018). Data saturation highlights the criteria used in establishing the sample size and the depth of the data acquired. The yardstick used for the sample size and method preference relies on the actualization of data saturation, where no new themes emerge (Mammen et al., 2018). I persisted in acquiring data from interview sessions and organization documents until no new ideas emerge, signaling saturation of data sets.

Ethical Research

In research inquiries, ethical considerations regarding human participants are crucial. To adhere to Walden University IRB requirements, I obtained the IRB approval before obtaining consent from the participants. I received the IRB approval number: 07-17-20-0513933 before embarking on data collection at the organizations. I requested all participants in my study to consent to an informed consent form to state their readiness to take part in the survey by affirming their consent following Walden University IRB procedures. The consent form provided clarity on the purpose of the research, confidentiality, benefits, risks, and participant's right to discontinue. Walden University IRB mandates researchers to complete the human research protection training course before data collection. I am a certified Protecting Human Research Participants

researcher. My National Institute of Health certificate number is 2148286 (see Appendix A).

The consent form provided clarity on the purpose of the research, risks, benefits, confidentiality, and participants' right to discontinue the interview. The World Health Organization guidance framework defined informed consent as the course of action required by researchers to ensure that human participants who were intervened or involved in a study informed of all risks. The participant was required to sign the consent form stating their willingness to participate in the survey to understand and acknowledge my statutory responsibility to protect their privacy. The participants were requested to respond through email by writing "I CONSENT." Researchers seeking informed consent should strive to converse genuinely and explicitly about research collaboration to respondents who are eligible to participate and give the respondents free will to decide (Simon et al. (2018). Participants are allowed to withdraw from the research process any time before or after signing the consent form. Participants were permitted to withdraw verbally or in writing. No participant withdrew from the study. I used purposive sampling to select and interview participants in this study, though withdrawal could not have hindered me since I identified and chose enough participants.

Research participants' motivation remains a contentious issue in research ethics and IRBs, and human research ethics committees. Participants were not offered any financial inducements in this study to avoid coercion and to avoid compromising the participants' data. The absence of financial incentives allowed the participants to withdraw from the study of their own volition at any time without prejudice and a

monetary penalty of obligation. The counter-productivity of providing individuals with financial incentives, showed that financial incentives may have the unintended outcome of reducing participation in some research areas (Zutlevics, 2016).

After IRB approval, I used my professional networks to reach out to potential CEOs of partner organizations; used some intermediaries to reach the appropriate partner organizations who approved access to the participants. The participants were CIOs, CTOs, CSIOs, and senior IT executives who are currently engaged in the running of the NFV technology. I contacted participants through my professional networks, social and business networks, IEEE, and the EO. I got all referrals through emails and telephone contacts. Individual participants interested in participating in the interview endorsed the consent form by responding to my email by typing "I CONSENT" and present any questions or concerns they have regarding the study, their participation, or myself. Before the meetings, I solicited other relevant organizations within my professional and social networks that may be willing to participate in the study. The referrals must be those organizations with participants that have been part of the strategic adoption of NFV technology. Participant's experience was necessary to achieve saturation of data in each of the organizations.

I used pseudo nomenclatures for both participants and their organizations. Pseudonyms avail protection of participants' privacy and organizations in the qualitative study, which is a crucial ethical consideration in inquiries involving humans (Brear, 2018). In addition, pseudonyms strive to reduce the potentials, or psychological, economic, or physical impairments participation may suffer from being associated with

their research data (Brear, 2018). The actual participants' names, along with their organizations, were synchronized with the pseudonyms. I encrypted the details of the participants in a spreadsheet accessible only by me. I assigned codes to participants to guarantee their privacy and confidentiality. The plethora of ethical research guidelines explicitly state that the default assumption for all academic research is that the organization's names and participants involved in studies should be anonymous (Walford, 2018). I stored all emanating private and confidential information comprising recorded interviews and organization documents containing the organizations' identities on data storage pass-worded for five years after the chief academic officer approval such that participants' confidentiality is protected. I used a flash drive to store information. The flash drive was encrypted, and stored, and other physical data collected during the data acquisition stage in a locked storage safe in my office. However, after five years, I will shred all physical and erase electronic copies of the research data, including consent forms, interview recordings, and transcribed data.

The interview sessions were carried out in a private, quiet, and confidential manner without divulging any personal details to anyone outside of the study participants in the organizational environment. Before data acquisition, all participants' organization CEOs received an invitation to participate in the study. An informed consent form detailing the anonymity and confidential information to protect participants (see Appendix C) was sent to the participants immediately after endorsing the letter of cooperation. The confidentiality of the organizational documents was sustained. Organizational documents were coded alphanumerically (e.g, JN1, JN2, etc.). Disclosure

of research material in most instances can be problematic and ignite dissensions (Surmiak, 2018). Furthermore, Surmiak (2018) states that researchers only utilize some data collected during the research study scientifically and anonymized, and in specific forms.

Data Collection

Instruments

The essential data acquisition tool in case studies is the researcher. The power of qualitative research resides in qualitative research's relational and empathetic nature, which allows a detailed description and understanding of a phenomenon because of the relationship between researchers and participants (Stahlke, 2018). The deep connection between participants and researchers affords researchers the opportunity for conversation and exploration of the event (Stahlke, 2018). The qualitative researcher's role is crucial in data collection. I exerted a significant impact on how data was collected, analyzed, and interpreted. In qualitative research, the data collection processes are provided and the information about who carried out data collection (Levitt et al., 2018). As an instrument for data collection, the researcher ensures that data are collected appropriately, systematically, and well organized (Twining et al., 2016). I assumed the role of the primary data acquisition tool and ensured that data are acquired appropriately and well organized. To guarantee the richness of the data collected from the participants, I took field notes to corroborate the data collected during the interview sessions.

I used semi-structured interviews as the fundamental approach for information acquisition in this research. I used individual semi-structured interviews to engage in

selected samples of the research study. I recorded the conversations to enable optimal focus on the interview contents and verbal prompts. Semi-structured interviews were used in a variety of formats and deployed over a bouquet of technologies. Either one-on-one through physical interactions or telephone interviews are research strategies researchers employed to gather information about participants' real-life experiences, perceptions, and beliefs about a particular research phenomenon of interest (Ryan et al., 2009). The semi-structured interview combines structured and unstructured interview formats in a single interview session (Dikko, 2016). Semi-structured interviews comprise a sequence of interview questions researchers ask participants during interview sessions, but with more freedom to change the rhythm, wordings, and timing of each item based on the individual needs of each separate interview (Dikko, 2016). The semi-structured interview format allows researchers to maximize rapport with the participants. Hence, increase interview mutually beneficial results (Brown, & Danaher, 2019).

I used an interview protocol (Appendix B) as a guide during the semi-structured interactive sessions. The interview protocol (Appendix B) captures the most detailed process of retrieving information from the participants as much as possible to establish mutual trust and respect during the interview process without deviating from the research question. Participants were engaged one-on-one during interview sessions to enable rapport and credibility. I developed relationships with the participants to integrate the participants' perceptions and understanding of the phenomenon with the research question. Semi-structured interview questions are being used, and other interviewing protocols explore a phenomenon in-depth, understand strategies, and identify potential

causes of identified correlation (Weller et al., 2018). Apart from the semi-structured interview questions (Appendix C), I adhered strictly to the interview protocols (Appendix B) before and during the entire data collection process. The interview protocol comprised conformity with the Belmont Reports' beneficence proclamation, which was vital to the ethical conduct of this study. Interview protocol refers to a script that assists researchers in ensuring that the interview is according to best practices (van de Wiel, 2017). The interview protocol comprises an introduction to the study, the semi-structured interview questions detailing the main queries and possible follow-up questions, the transitions between questions, and the conclusion (van de Wiel, 2017).

A qualitative researcher can enhance the validity and trustworthiness of the data collected from research interviews if, before the meeting, a researcher improves the reliability of the interview protocols (Castillo-Montoya, 2016). The interview protocol (Appendix B) included activating the voice recorder, stating the pseudonyms of the participants and their organizations, taking notes, and announcing the date and time. Also, the interview protocol started the interview, asked the participants to share any other inert information they have on the phenomenon. The meeting ended with the voice recorder switched off. The post-interview protocol entailed a member-checking process, follow-up interview schedules, acknowledging the participants, and availing them of my contact details. Member checking involved a second round of face-to-face or online interaction to review the information retrieved during the first interview session. I emailed the transcripts of the interviews to the participants to authenticate the captured discussions for member-checking. Actively involving the participants in checking and

confirming the research outcomes can reduce the inherent researcher prejudice (Birt et al., 2016). Member checking enabled data validation, verification, and accessibility of the trustworthiness of qualitative study outcomes. In qualitative multiple case studies, member checking can be useful for obtaining participant approval of research data (Thomas, 2017). In conclusion, participants reviewed the interpretation of the transcript to vet the authenticity of the research data. Member checking enhanced the validity, credibility, and trustworthiness of the outcome through the authentication of the transcripts.

I did member checking to check for errors, and I corrected errors as highlighted by the participants. If member checking revealed any contradictions between my interpretation and participants' interpretations, the interview transcripts could have been modified to agree with participants' views. To achieve transactional validity, I returned a summary of my interpretations of the interviews to the participants to verify that my understanding was valid. Member checking is one of many ways of actualizing transactional validity (Caretta & Perez, 2019). Technically, member checking involves stakeholder consultation at one or several points in the research stages (Madill & Sullivan, 2018). Interviews, audio recordings, and real-time interview transcriptions are means of achieving member checking. I used member checking to obtain participants' verification of the correctness of my understanding of the interviews. Member checking was initially referred to as a continuous data analysis process but focused on post-interview validation (Varpio et al., 2017). I engaged the participants before and after

interviews to ensure mutual understanding and acceptance of the transcripts and the report.

Data Collection Technique

Description

Interview protocols (Appendix B) guided the one-on-one semi-structured interviews. I conducted the interviews in a most conducive environment approved by the participants. Interview protocol (Appendix B) included participatory introductions of researcher-participants. I explained the objective of the study to the participants. I adhered to the process to establish rapport with the participants and create enduring relationships with the participants. The interviews were virtual, face-to-face, and online, using telephones and videoconferencing where applicable, or as agreed with the participants, and with the IRB approval. I certified all the tools before the interview sessions. Researchers must be aware that the research process is primarily about the participants and understand that the participants' beneficence and non-maleficence are important (Harvey, 2017). I informed the participants that I will destroy all emanating data from the interviews to protect their privacy, and I used pseudonyms throughout the study to maintain their obscureness.

Advantages of Data Collection Techniques

I conducted semi-structured virtual face-to-face interviews, an alternative online interview using a traditional telephone, and videoconferencing tools, such as Zoom, Microsoft Teams, and Skype as approved by IRB. Several studies show that interview mode and interview technologies have significantly impacted participants' non-response

and response dissemination (Bush, & Prather, 2019). The use of face-to-face interviews comprises various advantages over the traditional telephone, including decreased recall bias, facilitating validity in reporting, and the researchers' capabilities to acquire observational information-rich data regarding the environment (Coomber et al., 2018). The semi-structured face-to-face interview allows the researcher to acquire open-ended information-rich data to explore participant perception, comprehension, and believes about a particular phenomenon (DeJonckheere & Vaughn, 2019). Additionally, semi-structured interviews allow researchers to dig deeper into the participant's private and sensitive stances on the phenomenon. I prepared a list of semi-structured questions while exploring the phenomenon to retrieve sincere feedbacks from the participants.

Disadvantages of Data Collection Techniques

Semi-structured face-to-face interviews inhabit a focal position in history and contemporary research techniques, including educational research. Nonetheless, semi-structured face-to-face interviews often produce unexpected ambiguities and gives more considerable research dilemmas, including researcher-participant rapport obstructions (Brown & Danaher, 2019). The participants determined the timing and convenience of the interview dates in either a virtual face-to-face or online telephone format. A semi-structured interview demands more attention from the researcher to keep the discussion in tune with the overarching research question and foist more work afterward to transcribe and make sense of the interview data (Puyvelde, 2018). In semi-structured face-to-face interviews, researchers' underestimating the required resources to enlist participants, interview, transcribe or reproduce the interview responses, and analyze the data is another

disadvantage of face-to-face interview (DeJonckheere & Vaughn, 2019). With the participants' approval and any prevailing circumstances, I agreed with the participants in a variety of interview formats to deploy a range of technologies. Telephone interviews allow participants from different geographical spread to participate and are less burdensome for participants than face-to-face interviews (Gill, & Baillie, 2018). In interviews to offset the disadvantages of the semi-structured interviews, the interview occurred through online infrastructure comprising a telephone, and videoconferencing applications, such as Zoom, Microsoft Teams, and Skype.

Organization Documents

Most of the participants confirmed not having any organizational documents to share other than vendor documents as the organizational documents are classified. To complement the data collected from the semi-structured interviews, I reviewed eight organizational documents regarding the phenomenon. In this study, I approached the participants to provide the organizational documents relevant to the adoption and implementation of NFV technology as a secondary data source to corroborate the data collected from the interviews. Still, most were not allowed to share the classified organizational other than the specific vendor documents. I perused the available organizational documents to extract data to support the data acquired from the interview sessions. I entered the data from the documents into a computer-aided qualitative data analysis software application such as NVivo to manage, code, and identify the themes. The resultant themes from the documents were compared and synchronized with the

themes from the interview sessions until no new themes emerged from both the interviews and the organizational documents.

Accountability and Correctness of my Interpretation of Interviews

I interviewed each participant applying all the semi-structured questions until the participants have no new responses. Afterward, end the interview and terminated the audio recording. As stated in the interview protocol (Appendix B), I acknowledged the participants' gestures, their time. I reminded them of the confidentiality of the research process and how they may withdraw from the research without any obligations. I mentioned to the participants the likelihood of follow-up interactions to check and confirm my interpretations of the transcripts for accountability. I compared my translations and understanding of the data to enhance the fidelity and consistency of the research outcome.

Data Organization Techniques

I used data organization techniques for managing, analyzing, and interpreting the researched data output. I encrypted all email correspondences, consent forms, transcripts, and interview information in Microsoft Word and Excel program formats. I created a separate folder in an encrypted external storage device to organize participants' information, interview data, voice recordings, triangulation data, and organization documents. Consistency is the primary rule of data organization, as researchers must be well-focused and consistent with data. Researchers' data entry and organization must be regular from the beginning to reduce time spent on data harmonization (Broman, & Woo, 2018). I used Microsoft applications for information entry, management, and storage of

research data. I used consistent codes to identify categorical variables, missing values, variable names, subject identifiers, and logical data layout in multiple files. I used compatible file names, the International Standards Organization (ISO) 8601 date formats, consistent phrases in notes, and no extra spaces were allowed without contents.

I used pseudonyms for all organizations and individual participants to ensure anonymity. The importance of participant confidentiality as an ethical requirement of research is critical. Pseudonyms or false names protect anonymity (Allen & Wiles, 2016). Assigning codes, numbers, or aliases to participants and their organizations protected participant's anonymity. Participants' details were associated with the research findings in any way. I only knew Participants' identities. Anonymity and confidentiality are two research constructs that are theoretically distinct in qualitative research but are primary requirements (Scarth, 2016). Confidentiality refers to the management of personal data gathered in trust of confidence, such that dissemination can induce specific prejudice. I encrypted the emanating data in folders on external and internal storage devices. At the same time, I stored the paper documents in a secured locked filing cabinet during and after the study for five years. I coded, queried, and managed the data from the online documents using Microsoft Word manually and NVivo software application to identify the themes that are similar or distinct from the themes evolving from the interview data sets.

Data Analysis Technique

Multiple case designs involve data collection and interpretation. I collated and analyzed data from one-on-one semi-structured telephone interviews and online

documents to arrive at familiar themes. Thematic analysis refers to a method for identifying, analyzing, organizing, describing, and reporting ideas in data sets. An in-depth thematic analysis can produce credibility, trustworthiness, and insight into research findings (Nowell et al., 2017). I reviewed the data sets retrieved during the interview sessions to identify, organize, analyze, and describe the emerging themes from the study report to generate in-depth research reports that are credible. In thematic analysis, researchers seek to identify basic ideas about the phenomenon under scrutiny, to place their interpretation of the meaning of participant's responses. I perused the retrieved information to understand and represent the experiences and perceptions of participants as they encounter, engage, and live those experiences they related during the interview sessions. The thematic analysis highlights the process of identifying and analyzing, and reporting themes within data (Agyekum et al., 2019). I familiarized myself with the data collected, generated initial codes, and search for themes. The emanating items were reviewed, defined, and named. For the data analysis, I coded the interviews using MS word manually and NVivo application software. I coded the participants' responses in themes by identifying patterns in the themes. I gathered related themes in one slot to look for emerging recurring themes until no new themes different from the existing ones emerges.

I used coding to interpret explanations, themes, relationships, and primary interpretations of the emerging data. Coding refers to the analytical process of asking probing questions of the research study data, categorizing segments of data by a code, and using those codes to sort and evolve an understanding of what is happening in the

phenomenon under scrutiny (Maher et al., 2018). Computer assisted qualitative data analysis software such as Atlas.ti, NVivo, Hyperresearch, and MaxQda are useful in research data analysis (Parameswaran et al., 2019). I used NVivo for the data analysis and analyzed the audio data to preserve the voice of the participants. I uploaded data from the audio recording into NVivo software. In qualitative research, coding comprises processes that allow acquired data to be assembled, categorized, and thematically sorted, availing researchers an organized template for consolidating meanings (William & Moser, 2019). Coding was used to break down the data to fashion out something new and sensible. I used coding to tag data that are relevant to a particular category of themes. I used a coding method that utilized processes that revealed themes inherent in the data. I suggested substantive saturation towards categorizing data through which meanings can be negotiated, codified, and presented to the participants. I reviewed the organization documents to retrieve relevant information that tallies with the data emanating from the interview sessions. After that, I uploaded the data into the NVivo software application to manage, code, and identify new relevant themes. I compared and synchronized the themes from the interviews and the organization documents until no new themes emerged from both instruments.

In summary, my data analysis process involved collecting data from the semi-structured interview sessions, transcribed, and inputted into NVivo for further analysis. I perused the retrieved data for emerging themes and compared them with the new works of literature published during the proposal stage of this study. I developed the themes through my interpretation of the data retrieved from the interview sessions. I reviewed the

interview questions in parallel and established codes within NVivo to identify essential themes and keywords that correlate to Rogers's DOI theory, which is the conceptual framework and research questions.

Reliability and Validity

Overview of Reliability and Validity

Qualitative multiple case study involves data collection and analysis. I collated and analyzed data from one-on-one semi-structured telephone interviews and organization documents to arrive at familiar themes. Thematic analysis refers to a method for identifying, analyzing, organizing, describing, and reporting ideas in data sets. An in-depth thematic analysis can produce credibility, trustworthiness, and insight into research findings (Nowell et al., 2017). I reviewed the data sets retrieved during the interview sessions to identify, organize, analyze, and describe the emerging themes from the study report to generate in-depth research reports that are credible. In thematic analysis, researchers seek to identify basic ideas about the phenomenon under scrutiny, to place their interpretation of the meaning of participant's responses (Jamieson, 2016). I perused the retrieved information to understand and represent the experiences and perceptions of participants as they encounter, engage, and live those experiences they related during the interview sessions. The thematic analysis highlights the process of identifying and analyzing, and reporting themes within data (Agyekum et al., 2019). I familiarized myself with the data collected, generated initial codes, and search for themes. The emanating items were reviewed, defined, and named. For the data analysis, I coded the interviews using NVivo application software. I coded the participants' responses in themes by

identifying patterns in the themes. I gathered related themes in one slot to look for emerging recurring themes until no new themes different from the existing ones emerges.

I used multiple data sources to collect data in this study to develop a holistic understanding of the strategies used in adopting NFV technology. I used Methodological triangulation to achieve internal validation of the data outputs. Triangulations comprise data, investigator, methodological, and environmental triangulation types (Ashour, 2018). Triangulation offers a broad scope of methodological strategies and techniques, all targeted at enabling researchers to enhance the credibility, validity, and generalization of research outcomes to circumvent the inaccuracies and eliminate potential biases (Ashour, 2018). I used methodological triangulation using more than one data-gathering technique, such as semi-structured interviews, open-ended questions, and organization documents. Methodological triangulation involves using multiple ways to study a research problem. Across-method triangulation and within-method triangulation are subsets of Methodological triangulation. Across-method triangulation uses two or more data collection procedures from the same design approach (Joslin & Muller, 2016). I used telephone interviews and organization documents to achieve the credibility, accuracy, reliability, and validity of data.

I used coding to interpret explanations, themes, relationships, and primary interpretations of the emerging data. Coding refers to the analytical process of asking probing questions of the research study data, categorizing data segments by a code, and using those codes to sort and evolve an understanding of what is happening in the phenomenon under scrutiny (Maher et al., 2018). I was involved in the generated data

with great insight into what the data are reflecting. I used NVivo for the data analysis and analyzed the audio data to preserve the voice of the participants. I uploaded data from the audio recording into NVivo. In qualitative research, coding comprises processes that allow acquired data to be assembled, categorized, and thematically sorted, availing researchers an organized template for consolidating meanings (William & Moser, 2019). Coding was used to break down the data to fashion out something new and sensible. I used coding to tag data that are relevant to a particular category of themes. I used a coding method that utilized processes that revealed themes inherent in the data. I suggested substantive saturation towards categorizing data through which meanings can be negotiated, codified, and presented to the participants.

In summary, my data analysis process involved collecting data from the semi-structured telephone interview sessions, transcribed, and inputted into NVivo for further analysis. First, I perused the retrieved data for emerging themes and compared them with the new works of literature published during the proposal stage of this study. Second, I developed the themes through my interpretation of the data retrieved from the interview sessions. Finally, I reviewed the interview questions in parallel and established codes within NVivo to identify essential themes and keywords that correlate to Rogers's DOI theory: the conceptual framework and the research questions.

Dependability

I used Interview protocol and member checking to guarantee dependability in this research. Dependability highlights the notion of internal reliability, which promotes consistency and replication. Dependability highlights the researcher's ability to consider

all the changes, which may occur in a setting and how these changes affect the way the research is being concluded (Ibiamke & Ajekwe, 2017). I used member checking to re-assure completeness and unambiguity in my interpretation of the information collected. Dependability involves participants' evaluation and confirmation of research findings, the presentations, and recommendations of the study to ensure that the assessment supports the data received from the researcher (Anney, 2014). I used the interview protocol (see Appendix B) to establish consistency between participants' responses during one-on-one telephone interviews. Triangulation possesses the ability to enhance the study's validity, de-emphasize research bias, and provide multiple perspectives of the phenomenon under scrutiny (Renz et al., 2018). I used methodological triangulation to confirm my research findings and enhance the dependability of this research.

I included an audit trail to enhance the dependability of the entire study process. The audit trail highlights a commonly used technique for establishing reliability (dependability), credibility, and confirmability. The audit technique is the primary technique for determining confirmability. The audit trail enables data and interpretational confirmability (Ang et al., 2016). The audit trail provides guidelines for the auditee who keeps an audit procedure of the research study (De Kleijn and Leeuwen, 2018). Also, it guides the auditor who checks the research for visibility, comprehensibility, and acceptability. The audit trail or process avails the process of data acquisition and data analyses with a clear distinction between both. I created an audit trail that captures the entire research process, including data acquisition and analysis methods. All the processes and stages of the research were explicit, describing the purpose of the research

study, the design of the study, and the participants. Audit trails assist researchers in ascertaining that they are engaged in the investigations and the audiences for their education. They are aware of the researcher's reflexive subjectivities through meticulous documentation of the impact of the researcher's biases by the data (Kozlesk, 2017). I maintained records of all the steps taken throughout the research to enable an external audit of my data acquisition and analysis. My audit trail detailed the data collection, analysis of the data, the development of emerging themes, and the interpretation of the results.

Credibility

This multiple case study sought to actualize credibility by including CIOs and senior IT executives as participants in the research. Credibility highlights the extent to which the analysis represents the actual perceptions of the research participants (Moon et al., 2016). Thus, credibility highlights the aspect of truth-value in qualitative research. Strategies used by qualitative researchers to ensure credibility comprise longed engagement, triangulation, and member checking (Korstjens & Moser, 2018). The decision of this research was consistent with the purpose of the study. First, I used member checking to determine if the findings reflect their experiences. Credibility involves a sincere description of the research phenomenon of scrutiny and the generation of believable research outcomes (Liao & Hitchcock, 2018). Second, I promoted credibility using a systematic process throughout all phases of research. Credibility techniques can thus assist research auditors in assessing the authentication of data and conclusions. Third, I established a sustained engagement with the participants through

member checking to ensure that the study's outcome represents participants' original perceptions of the phenomenon. For this study, I interviewed two CIOs, one CSIO, one CTO, and two senior IT executives to draw themes about the strategies they used to adopt NFV technology.

Transferability

I included an in-depth description of the context and procedures of the entire study to ensure the replicability of the research. Transferability refers to the extent to which a researcher can make explicit contexts. I provided enough evidence and information about the background, participants, data harvesting techniques, and data analysis to guide other scholars in generally replicating this study. Exact replicability or transferability is when a previous or current study is transferable or replicated using the same population and the same procedures (Aguinis & Solarino, 2017). Thus, transferability highlights the degree to which research findings of past research are reproducible. I focused on the study regarding methodological approach, population and sampling technique, data coding, analysis, and all other procedures. Transferability is the researcher's ability to provide a vivid picture that is informed and synchronized with readers and other researchers in the same domain (Connelly, 2016). I supported this research transferability with a rich, detailed description of the context, location, and population interviewed and be transparent about data analysis and trustworthiness.

Confirmability

To ensure confirmability, I presented unbiased research outcomes. Confirmability highlights the aspect of neutrality and securing the inter-subjectivity of the data. All my

interpretations of the data were entrenched in the data and never on my predetermined preferences and biases. Confirmability refers to researchers' capability to demonstrate that the reports highlighted the conclusions in a manner that synchronized and, as a process, transferable or replicated (Moon et al., 2016). I reported the steps taken to manage and reflect on the effects of experiential preferences. Confirmability highlights the aspect of neutrality on the researcher's part and gives choices to the participants' viewpoints (Korstjens & Moser, 2018). I interpreted the data according to the raw data gathered from the participants. I kept detailed transcripts of all my decisions and the analysis as the research progressed and continued with member checking. I documented the interviews, the in-depth context of the participants' responses, and the background information of the participants. NVivo and other Qualitative Data Analysis Software (QDAS) solutions allow researchers to assign multiple codes to the same data streams (Robins, & Eisen, 2017). I used MS Word and NVivo to identify reoccurring themes in the data to indicate thematic saturation.

I used the acquired information from the virtual face-to-face and telephone interview sessions and relevant company handbooks to actualize data saturation. Data saturation evolves when no new information emerges from emerging themes and is also described as data adequacy. I used a flexible data analysis approach to achieve data saturation. Comprehensive interviews were carried out on the participants until no new information emerges (Hancock et al., 2016). Describe data saturation as the point at which new data becomes redundant of already acquired data (Saunders et al., 2017). When participants begin to repeat the same comments over and over, then data saturation

is achieved. I stopped collecting information and start data analysis when data saturation evolved. Data saturation refers to when all the relevant information needed to gain complete insights into a phenomenon develops (van Rijnsoever, 2017). I also used data triangulation to review organization documents to retrieve themes further.

Transition and Summary

In section 2, I enumerated the purpose of this study, the exploration of NFV technology adoption strategies. I used a multiple case study methodology to collect data. First, I used semi-structured interviews to acquire information; after that, I reviewed the organization documents to retrieve themes. Then, I perused the themes to identify the strategies used in adopting NFV technology by CIOs and some senior IT executives such as CTOs and CISOs. The CIOs, CISOs, and CTOs were proficient and took part in the strategies utilized in adopting the NFV technology in their past and current workplaces. Finally, I used the NVivo application in my data analysis.

Section 3: Application to Professional Practice and Implications for Change

Introduction

The purpose of this multiple case research study was to explore the strategies utilized by CIOs who have successfully adopted NFV technology. The purposeful sample for this study was CIOs, CTOs, CSIOs, and in-network providers who have adopted and implemented NFV technology in at least six organizations in the eastern United States. The data for this research study emanated from semistructured telephone and teleconferencing interviews and the documents suggested by participants. The final themes comprised: (a) organizational awareness, (b) no hindrances to NFV technology adoption, (c) documentation and implementation plan, and (d) operational costs and efficiency.

Presentation of the Findings

Overview of Study

I conducted semistructured virtual interviews with six participants to explore the strategies used to adopt NFV technology. In addition to the semistructured interviews, I reviewed eight organizational documents to gather information relating to the successful strategy utilized by the six participants regarding the research question. Finally, to further enhance data analysis and elucidation, I used member checking to validate the interview data (Birt et al., 2016; Thomas, 2017). As a post-interview process, member checking included follow-up interviews, acknowledgment of participants, and providing the participants of my contact details. After transcribing using NVivo, I emailed each

participant the transcript of that participant's interview and scheduled a second round of online discussions to review the information retrieved during the first sessions.

Methodological triangulation is the use of diverse ways to study a research problem, allowing researchers to enhance the credibility, validity, and generalization of research results to prevent inaccuracies and the elimination of potential biases (Ashour, 2018). Triangulation can boost the validity of the research study, de-accentuate research bias, and provide diverse viewpoints of the phenomenon under exploration (Renz et al., 2018). I used methodological triangulation using semistructured interviews, open-ended questions, and documents. I collected data mainly from two sources—the participants and the organizational documents.

Thematic analysis refers to identifying, analyzing, organizing, describing, and delineating ideas in repositories. A rigorous thematic analysis can induce credibility, trustworthiness, and detailed research findings (Nowell et al., 2017). I conducted thematic analysis on the interview transcripts, field notes, and the organizational documents to arrive at final themes: (a) organizational awareness, (b) no hindrances to NFV technology adoption, (c) documentation and implementation plan, and (d) operational costs and efficiency.

Theme 1: Organizational Awareness

All six participants identified organizational awareness as a recurrent theme, and two organizational documents attested to this theme. There is a need to establish a general view of the new technological paradigm's adoption process on the organizational, individual, and environmental appraisal (Panopoulos et al., 2018). Technology adoption

is influenced by internal factors comprising organizational structure, management style, focus, and organizational direction (Oguz, 2016). For the successful adoption of NFV technology, organizational awareness is critical to driving consensus among the employees. Global scrutiny of the NFV technology adoption process on employees, organization, and drivers of adoption during the interviews revealed management as the primary catalyst to organizational awareness. In simple terminology, organizational awareness refers to the awareness of the new technology paradigm and readiness to accept the new paradigm in NFV technology within an organization. Data from Table 1 shows the number of references relating to the trends of organizational awareness.

Table 1

Frequency of Theme 1: Organizational Awareness

Participants		Organizational documents	
Count	References	Count	References
6	12	2	6

The six participants achieved organizational awareness of the NFV paradigm through information dissemination of the critical benefits of the NFV technology to the stakeholders, executives, and employees. To create organizational awareness, key stakeholders and executives must inform employees about the key benefits of the innovation through seminars, bulletins, and awareness campaigns. Participant A shared, "These key benefits were communicated to internal stakeholders throughout the organization through newsletters, presentations, awareness campaigns, etc." Additionally, Participant A stated that "Our IT architecture teams have created several knowledge-based articles about NFV and have created organizational standards for the deployment

and use." In agreement, Participant B shared, "And we made the argument that going through full virtualization was the way to go." According to Participant C, "People understand that you need the information to be always available to you. People need a common place to share information." Participant D stated that "what we did internally, I would say, is to educate the organization about the NFV concept." Creation of internal memos and bulletins to emphasize the benefits of NFV technology to the stakeholders, executives, and employees indicate the need for organizational awareness for successful adoption of the NFV technology.

To further strengthen the theme, participants mentioned gathering corporate support of the transition of legacy networks into NFV technology. Participant E stated that "the fact that this was sponsored by senior management already helped explain to everybody that this is important." According to Participant F, "We say to overcome building blocks, and we have been able to persuade the executives that this something the company must invest in and must build our products and adopting NFV technology." Participant F further affirmed, "But then one more key stakeholder exposed to that is something that was reducing the amount of resistance against it." The resistance against the diffusion of new ideas was reduced by continuous exposures of the critical benefits of transiting into NFV technology until the entire board approves the transition. The persistence of the executive in the diffusion of the NFV paradigm translated into executive sponsorship that may be an effective strategy for seamless adoption of the NFV technology by prospective CIOs and some senior IT executives.

Organizational Documentation Supporting Theme 1

Two organizational documents corroborate Theme 1. Organizational Document NF1 demonstrated the need for increased business automation to actualize the full potential of NFV technology in production networks, which requires enhanced organization awareness in automation and network service orchestration. As a result of the organizational understanding of NFV paradigms, organizations have continued investments in NFV technology. Participant F agreed with Organizational Document NF1 that by designing strategy streams on adopting the NFV technology to the management, organizational awareness becomes a catalyst to adopting the NFV technology.

Organizational Document JN1 further corroborated increased adoption between 2019 and 2020 due to increased corporate awareness of NFV technology driven by the desire to automate and orchestrate services. Additionally, Organizational Document JN1 affirmed that organizational awareness of the benefits of NFV technology as a catalyst to developing and complementing the service providers and organizations' internal skills and knowledge required for the successful transformation from legacy networks to next-generation networks. Organizational awareness of innovations leads to investments in enhancing internal skills and knowledge needed by the IT infrastructure teams in their transition from legacy networks into the NFV infrastructure. Stakeholders enhanced knowledge and skillsets required to adopt and implement the NFV technology by the prospective CIOs and senior IT executives of lagging organizations.

Comparison to the Literature

According to research, organizational awareness highlights the impact of

technology adoption on internal components permeating corporate structure, management style, focus, and corporate direction (Oguz, 2016). Organizational awareness or corporate recognition refers to the new technological concept and readiness to adopt the NFV paradigm in corporate settings. Organizational awareness propels organizations' desire to implement next-generation communication and IT networks on virtualized infrastructures where NFs and services are on virtual machines instead of current vendor locked-in devices (Papavassiliou, 2020). For instance, IS and IT are driven by continuous advancements and inherent innovation development, propelled by business demands for efficiency and practical purposes (Nehemia-Maletzky & Iyamu, 2017). The evolving trends of digital transformation have presented new networking concepts like virtualization and cloud computing (Yoo & Kim, 2018). Organizations consider cloud computing systems that may improve organizational development and business agility (Yoo & Kim, 2018). The adoption of NFV technology allows organizations to be more competitive and increase their corporate performance, thus fueling executive sponsorship of adoption. The resolve regarding implementing new technology is typical at a top executive level (C-level) of organizations, such as CIOs and senior IT executives (Straub, 2009). Executive sponsorship of innovation is then a catalyst to employees' awareness and acceptance of the new technological concepts.

Research also supports the organizational awareness of NFV paradigm as the enabler of the next-generation network (Hermosilla et al., 2020). NFV's global attention is due to significant advantages, such as modular deployments, inherent flexibility, and operational cost reduction. Ability to dynamically deploy components without

geographical limitations enhanced NFV's awareness (Hermosilla et al., 2020). NFV technology allows organizations to separate NFs from network physical hardware, establishing network services according to customer needs on virtual infrastructure (Khebbache et al., 2017). Transiting from an architecture-dependent on diverse physical hardware equipped with vendor locked-in software appears to be the dominant choice for the organizations and the direction in prevailing and future communication and computing infrastructures (Papavassiliou, 2020). To remain profitable, service providers and organizations must transit into next-generation network infrastructures, such as NFV technology, which must be driven by the C-level executives to create organizational awareness among the stakeholders and employees. The NFV technology adoption drivers within the organizations use research and development organizations to create organizational awareness. IT innovation adoption is driven by management believing that new concepts increase organizational performance, which constitutes the executive buy-in to make the necessary organizational awareness among employees.

Ties to the Conceptual Framework

The theme synchronizes with the DOI theory, which is used to explore variables that are likely to influence technology diffusion (Iles et al., 2017). DOI comprises three significant genres of factors that influence decisions to adopt innovations, including characteristics of the organization, features of the invention, and characteristics of the individual (Alkhalil et al., 2017). The theory illustrates multiple phases of adoption; individuals navigate from awareness, opinion formation, adoption decision, adoption actions, and decision actualization. Characteristics of the organization are a factor that

propels the executive sponsorship of adoption of innovations, which enhances competitiveness and service efficiency. Internal inputs to NFV technology adoption permeate organizational structure, management style, and focus, and direction. External inputs are prevalent technology ingredients for adoption models that highlight how prominent influencers contribute to the decision-making strategy on innovation adoption strategy (Oguz, 2016). Internal and external factors drive the adoption of NFV technology in the organization ranging from executive sponsorship, business, and environmental factors. All six participants showed organizational awareness as a strategy that influenced the adoption of NFV technology, leveraging the administrative support of the innovation adoption. The six participants procured executive buy-in of the adoption of NFV technology, employing building strategy streams about NFV technology values to the organization's management and the key stakeholders.

A cross-section of the six participants also affirmed that IT architecture teams and other relevant stakeholders have created several knowledge-based articles about NFV and have created organizational standards the executives approved. Diverse challenges confront organizations in adopting NFV technology in production networks, including operational, organizational, and business, which needs innovative strategies to address them in adopting NFV technology (Contreras et al., 2015). Organizational-level adoption decisions, followed by the users' decisions regarding innovation, are two evaluation phases from the initiation stage until the technological innovation acquisition (Miranda et al., 2016). Once the business owners approve of the innovation adoption, the organizational awareness across the entire organization becomes a trend.

Theme 2: No Hindrances to NFV Technology Adoption

All six participants asserted no hindrances to NFV technology adoption as a trend, which three organizational documents supported. NFV presents network softwarization and instantiation of network services on physical hardware, de-emphasizing functional software and hardware residing in vendor locked-in, commercial-off-the-shelf equipment (Contreras et al., 2015). Organizational investments in product awareness, executive sponsorship, research and training, and detailed explanation of benefits of the NFV paradigm to the employees are necessary to address hindrances to NFV technology adoption. Data from Table 2 shows the number of references relating to the theme.

Table 2

Frequency of Theme 2: No Hindrances to NFV Technology Adoption

Participants		Organizational documents	
Count	References	Count	References
6	11	3	9

The findings support the need for transition of legacy networks into the next-generation network by organizations and service providers. This drive toward transiting physical hardware into virtual infrastructures presented no hindrances to NFV technology adoption across the six partner organizations. Participant A stated that "this was part of a larger digital transformation initiative in which we aimed to virtualize all of our infrastructures including compute, storage and network." Participant B shared, "We made the argument that going through full virtualization was the way to go. When we did analysis and kind of the analysis, redundancy and things like that and how easy it is to recover from the redundant intersection." According to Participant C, "What we did at

the beginning was to sit down and understand the service that we need and try to map it. Once we have done that, we didn't encounter any roadblock." Additionally, Participant D stated that "from our point of view, it was just the migration to new technology." In the same vein, Participant E shared, "the organization considered NFV technology a good solution for managing remote secured connections and critical accounts to manage network functions." Similarly, Participant F stated that "they are spreading to other parts of the organization. Then you create a critical mass of people who did this transformation before this kind of culture that could potentially block the adoption of NFV technology." The current volatile network users' demands for next-generation services leave service providers and organizations with no other choice than to adopt the NFV technology without hindrances to deliver network services to their end-users efficiently and cost-effectively. This trend may influence seamless adoption of the NFV technology in prospective or lagging organizations.

Organizational Documentation Supporting Theme 2

Three organizational documents affirmed the importance of this theme. First, Organizational Document NF1 showed that leading global network service providers and organizations' massive rollout of NFV technology might ignite seamless adoption for those reluctant organizations that come next without any hindrances to the NFV technology adoption. Second, organizational document JN1 supported organizational internal cultural transformation in adopting an innovative mentality. Participant F affirmed an internal shift fueled by service providers and organizations compelling the need to virtualize their network infrastructure to actualize creative mentality that

highlights global hindrances to the NFV technology adoption. The transition to virtualization may require a breakdown of entrenched hierarchies that prevents paradigm shifts and an increased collaborative environment across business units and external partners, thus removing hindrances to transition into NFV technology infrastructure. Organizational document JN1 further asserts that organizations' true holistic cultural and technical transformation requires a complete psychological shift across the spheres of the organizations. Finally, organizational document JN2 emphasized a holistic digital transformation as a continuous enhancement of technological resources to transition to NFV network infrastructure without any hindrances. In conclusion, the quest to catch up with the capability to avail end-users of next-generation services is a catalyst to the global adoption of NFV technology by service providers and organizations without hindrances to adopting the NFV technology.

Comparison to the Literature

The literature review agrees that during the adoption of NFV technology in organizations, hindrances are imminent. The theme that no hindrances to NFV technology adoption lay bare the strategies employed to lessen the hindrances. Organizations face some obstacles in adopting NFV technology permeating organizational, operational, and businesses that require new approaches to ameliorate them during the adoption process (Contreras et al., 2015). There are potential hindrances to adopting NFV technology in organizations, including culture, business structure, and collaboration. The NFV ISG forum allows the network providers and organizations to collaborate to demonstrate technically verified solutions to address the hindrances for

NFV implementation (Anabo et al., 2017). Lack of expertise within the organizational IT employees was an initial challenge in some organizations. Research and hands-on training on NFV technology influenced seamless adoption and implementation of NFV technology to prevent any form of hindrances. All six participants surmounted all the potential hindrances to NFV technology adoption in their organization, making no hindrances to NFV technology adoption as a recurring theme.

The literature affirms that NFV technology is still in adolescence with no proven strategies to dealing with the hindrances, which future CIOs and senior IT executives can utilize in the adoption of NFV technology in their organizations (Anabo et al., 2017). However, the literature has in recent times given credence to accelerated adoption of NFV technology due to the unprecedented benefits of NFV technology and the business dictates. The increased adoption and deployment of NFV technology have gathered extraordinary momentum in IT and telecommunication terrains (Woldeyohannes et al., 2018). Literature on next-generation networks affirmed NFV as critical to network operators and organizations' businesses. The NFV technology vendors have bridged the NFV adoption strategy gap by providing the adoption, deployment, and implementation guides for organizations to follow during the implementation and adoption of NFV technology. The vendor efforts at establishing technical synergies between the IT infrastructure team and their execution is a catalyst to increased awareness among the employees of partner organizations.

Organizations experience obstacles in adopting NFV technology comprising organizational, operational, and businesses that need the evolution of novel strategies to

prevent the adoption process (Contreras et al., 2015). The NFV ISG consortium permits network providers and organizations to collaborate to demonstrate technically proven solutions to address the hindrances to NFV technology adoption (Anabo et al. (2017). Globally within academia and the telecommunication industry, digital transformation enables a digital technology enhanced improvement of business activities (Furjan et al., 2020). Digital transformation allows the re-alignment of technological innovations and business models. The global utilization of NFV fuels the digital transformation initiative. The astronomical use of NFV technology, had signaled a significant shift in communication and network cloud-based services (Souza, 2020). This shift in communication and network cloud-based services strives on virtualization technology, which is the infrastructure driving NFV technology. The organizations' desire to actualize digital transformation to achieve next-generation service delivery drives executive buy-in and NFV paradigm awareness investments.

Ties to the Conceptual Framework

In this research study, DOI theory is most suitable to interpret the adoption strategies of NFV technology by CIOs and organizations. DOI is the most appropriate technology adoption theory to decrypt adoption strategies by individuals and organizations (Molinillo & Japutra, 2017). The theme: no hindrances to NFV technology adoption agrees with DOI theory. Technology adoption and acceptance are propelled by some characteristics that determine the degree of acceptance of change within a particular time slot (Rogers, 1962). Diffusion of new concepts highlights the social activity impacted by factors like relative advantage and individual attributes depending on the

extent of adoption (individual versus organization) (Rogers, 2003). For network providers and organizations to stay profitable, NFV technology adoption is inevitable because legacy network infrastructures need sophisticated implementation of proprietary traditional network equipment, which requires high CapEx and OpEx, unlike NFV infrastructure. The organization's ability to show the employees and the stakeholders the relative advantage of adopting NFV technology in the production network paved the way for no hindrances to NFV technology adoption in all six organizations.

In novel technology adoption, the preponderance of relative advantage, compatibility, simplicity, trialability, and observability impacts new paradigms' adoption occurrences (Rogers, 2003). All six participants confirmed no hindrances to NFV technology adoption as a trend in their organizations because NFV technology brings relative advantage over legacy network infrastructures in CapEx and OpEx. The decoupling of the traditional network functions away from the legacy hardware brings simplicity to service delivery and network efficiency. DOI theory presents various characteristics that may impact technology adoption decisions (Hameed & Arachchilage, 2017). Relative advantage, compatibility, trialability, and observability are vital characteristics of technology adoption (Hameed & Arachchilage, 2017). In synchronization with DOI theory's attributes of trialability, and observability, displayed during proof of concepts of NFV technology to management and stakeholders. Engaging stakeholders and all technical employees before introducing the NFV paradigm reduced the early resistance and fear of adopting new technology. Cultural turnaround early enough acted as a catalyst to employees' acceptance of the NFV technology with little or

no resistance.

Theme 3: Documentation and Implementation Plan

Documentation and implementation plan was another significant trend that cut across four participants and appeared in four organizational documents. Researchers must establish procedures and policies that are vital for research validity (Connelly, 2016). Documentation and implementation plan highlights the planning and configuration procedures for the adoption and deployment of NFV technology. The documentation and implementation plan offers how NFV technology was adopted and implemented by the organizations. Data from Table 3 shows the number of references relating to the themes of documentation and implementation plan.

Table 3

Frequency of Theme 3: Documentation and Implementation Plan

Participants		Organizational documents	
Count	References	Count	References
4	18	4	19

Indications from the collected data emanating from the semi-structured virtual interviews and organizational documents corroborate the theme of documentation and implementation plan as one of the vital strategies CIOs and senior IT executives utilized in adopting NFV technology. NFV paradigm, an innovation in networking, requires well-detailed technically proven standard procedures and processes of adoption and implementation in production networks. Documentation and implementation plan highlights a strategy of adopting the NFV technology, reiterating the creation of transition procedures and processes vital to the seamless adoption of the NFV

technology. As stated by Participant A, “We created a new logbook for the ongoing operation of NFV technology. Much of the documentation initially mirrored the documentation we had to replace our work. However, over time that documentation has been refined to meet the new paradigm.” In the same perspective, Participant B shared, “Staging the tests was that we turned over documentation, and we followed the mapping that we gave.” The importance of stage tests and documentation of the processes to verify the successful adoption and implementation of the NFV technology facilitates real-life proof of innovations concepts. According to Participant D,

> You don’t transition overnight from your legacy network to NFV technology. And so, you need to make a vast undertaking and change in the way you deploy equipment, the way you design your network, the skill sets you have in the organization, the way you manage it, the way you deploy software—everything changes.

To corroborate this assertion, Participant E shared, “first, it’s about planning very concrete steps and concrete procedures. How exactly will this transformation take place?” Transiting from legacy infrastructures requires phased procedures documented in collaboration with the NFV ISG consortium and the leading service providers to allow CIOs and senior IT executives access to critical systems and processes needed to adopt NFV technology. As gathered from the four participants, transiting from physical vendor locked-in equipment into the NFV infrastructure requires a massive undertaking in terms of innovation diffusion, adoption, and implementation procedures.

Organizational Documentation Supporting Theme 3

Four organizational documents supported documentation and implementation plan as a recurrent theme. Organizational document RH2 highlights procedure and processes for CPU assignments, memory allocation, and network interface controller configurations, which may differ in use cases and network topologies. In credence to the importance of documentation and implementation plan as a strategy, organizational document RH3 reiterates the importance of establishing software and hardware architecture subscription details necessary for NFV technology adoption. In agreement with the above, organizational document JN1 affirmed that solid planning capabilities driven by deep knowledge and industry best practices ensured seamless adoption with minimal risks. Establishment of proper controls and procedures to ensure the successful adoption and implementation of NFV technology was vital. As captured by organizational document JN2, the adherence to professional project management procedures aligns with risk management, project planning, documented reports tracking project tasks against schedules, and project implementation documentation. Participants D and F agreed that concrete steps are planned and taken during the NFV technology adoption and implementation stages. Adopting and implementing technological innovation involves pre-planned proofs of concept that permeate a well-detailed plan of action. The action plan highlights an established standard procedure and process documented to assist future adoptions by prospective CIOs and senior IT executives.

Comparison to the Literature

The cross-sectoral efforts on NFV began in October 2012, with frontline

communication service providers producing a joint white paper highlighting the NFV paradigm, benefits, and demanded industrial research efforts (Rehman et al., 2019). According to Rehman et al. (2019), in November 2012, leading CSPs comprising Verizon, China Telecoms, AT & T, and other notable ones developed an ISG for NFV technology within European Telecommunication Standard Institute, which has published the first five European Telecommunication Standard Institute Group Specification documents in October 2013. The need to design a documentation and implementation plan for adopting NFV technology by organizations agrees with the literature and the NFV ISG guidelines on the condition for specification documents for implementation. NFV technology adoption strategies highlight a complex oddity, as various procedures, processes, and vital factors impact NFV technology adoption. NFV concepts permit the virtualization of legacy networks to integrate and enhance processes that are in legacy systems (Cerrato et al., 2018). The documentation and implementation plan theme are in synch with the literature, which identifies procedures, and processes as critical ingredients to the successful adoption of NFV technology. Understanding the technology adoption processes could pilot transitions into new paradigms to enhance seamless transition into the digital workflow (Jacox et al., 2019). Documenting the implementation plan enabled the participants to stir process flow during the adoption and implementation of the NFV technology. The critical step identified by the participants was that the organizations must understand that transition from a legacy network to NFV technology is a vast undertaking for the IT infrastructure team, organization, and employees.

Documentation and implementation plan provides the transition guide for

adopting NFV technology, which is in tandem with the literature reviews, four participants, and four organizational documents. The NFV architectural framework reiterates documentation and implementation plan iterations, which strives to understand the design principles and the basic understanding of the relationships (Pattaranantakul et al., 2018). Refined documentation of procedures and processes of adoption is key to the successful adoption of NFV technology in the listed organizations that highlighted this theme. NFV paradigm is a networking innovation that permits instantiation of network-based services virtually off the legacy network infrastructure (Gonzalez et al., 2018). NFV offers benefits to organizations regarding scalability, reduced operational costs, flexibility, and energy efficiency (Katsikas et al., 2017). Because NFV technology is novel, documentation, and implementation plan guides organizations and network providers in adoption and implementation processes. The recurrence of documentation and implementation plan in four participants and four organizational documents agree with the literature on the necessity of having proper procedures to guide the adoption and implementation of NFV technology.

Ties to the Conceptual Framework

The research study, through the theme, consented to the DOI theory's diffusion process. DOI highlights a process recurrence communicating an innovation through specific media over a period treaded by members of a society under scrutiny (Dube & Gumbo, 2017). Relative advantage, compatibility, complexity, trialability, and observability are the five attributes that influence the rate of adoption of innovations (Mannan et al., 2017). Five major characteristics of DOI could express the main

attributes of the invention for the participants in a general framework (Rogers, 2003). The general framework for NFV technology adoption evolves through documentation and implementation plan documents. Relative advantage highlights the ascendancy of NFV technology over legacy systems, and the anatomy of its ascendancy is emphasized in the documentation and implementation plan framework (Rogers, 2003). Compatibility highlights the intimacy the NFV concept shares with the current next-generation network trends, perceptions, and necessities of prospective adopters.

The idea of relative advantage and compatibility are within the backdrop of existing practices (Rogers,1962). Complexity reiterates the tedious process of DOI by prospective adopters Rogers (1962). Documentation and implementation plan captures the process of adoption and implementation of NFV technology in the organizations. Documentation and implementation plan delineates the skill sets, design procedures, and the modus operandi of how the NFs and services deployed as software over third-party infrastructures. Observability reiterates the appraisal of inference of adopting the reconstruct or observability and trial before adopting the technological idea or trialability (Min et al., 2018). Observation of NFV technology's performance during the proof of concept highlights the documentation and implementation plan to guide in organizational adoption of NFV technology. Trialability agrees with the process of proof of concept, recorded in the documentation and implementation plan, and the extent to which it may have captured the transformation from the legacy network into NFV infrastructure in the proof of concept.

Theme 4: Operational Costs and Efficiency

Three participants supported operational costs and efficiency as a valuable thread, while five organizational documents showed operational costs and efficiency as a recurrent subject matter. The major transformation of legacy networks into softwarization may de-emphasize the need for a novel infrastructure and operating costs, while NFV technology presents enhanced network efficiency and flexibility (Mamatas et al., 2016). NFs and services are no longer delivered through physical hardware but through virtual off-the-premise infrastructures. Virtualization and softwarization of traditional NFs by NFV offered drastic operational cost reduction and network efficiency. Information from Table 4 shows the number of references relating to the themes of operational costs and efficiency.

Table 4

Frequency of Theme 4: Operational Costs and Efficiency

Participants		Organizational documents	
Count	References	Count	References
3	15	5	38

Information emanating from the semi-structured interview sessions and organizational documents authenticate the emergent theme of the operational costs and efficiency as a vital strategy three participants used in their adoption of NFV technology. Service providers and organizations spend huge costs on meeting up with the ever-volatile new service demand from the end-user. Transiting to providing network functions and services off the physical equipment reduces operational costs and enhances network efficiency. As noted by Participant B, “Really, it was more of a cost analysis

kind of a thing." "Spending more money to build a virtual environment instead of the old box." According to Participant E, "and from an operational standpoint, we were looking for specific efficiency because instead of using three or four different systems, different environments. Everything was consolidated and integrated onto a single platform." With all resources consolidated in a virtual machine located off-the-premises on a commercial-off-the-shelf platform, service orchestration becomes seamless with network agility, low operational expenses, and enhanced network efficiency. Deploying NFs and services through legacy networks can be an arduous task in handling the sterility or ossification of the vendor-locked-in physical hardware. Participant F stated that

> Striving towards achieving enhanced operational cost and efficiency is the business case that they need to invest in. Still, on the other side, the benefit of adopting NFV we say will save them the cost, the total cost of ownership, and a complete business case.

NFV paradigm is leveraged on open platform configuration to create the capability to enhance operational efficiency, assure competitiveness through swift innovation capability and cost-efficiency. As posited by the three participants, the operational costs and efficiency as a strategy may drive seamless adoption of NFV technology by prospective CIOs and senior IT executives in future organizations.

Organizational Documentation Supporting Theme 4

Five organizational documents reiterated the relevance of this theme. As highlighted by Organizational document RH1, the NFV paradigm chronicles virtualization of NFs on commercial-off-the-shelf and cloud-based infrastructure to

present enhanced flexibility, agility, simplicity, efficiency, and scalability than physical network infrastructure. The adoption of the NFV technology affords providers and organizations the benefits of accelerated time to market, swift orchestration of network agility and flexibility, reduced capital expenses, and reduced operational costs. Presentation of the NFV technology capability in lowering operating costs while enhancing the speed of orchestrating new offerings to service providers and organizations supported by organizational document RH2. In the same vein, Organizational document JN1 corroborates organizational document RH1, stating that the NFV infrastructure affords the service providers and organizations to de-emphasize investment costs. Organizations can optimize their highly scalable and flexible IP infrastructure layer for network efficiency reduced operational costs. Organizational document JN2 reiterates NFV to possess the capability to enable service providers and organizations the ability to enhance operational costs and efficiency, thus corroborating operating cost and efficiency as a strategy to assist prospective CIOs and senior IT executives to utilize in the adoption of NFV technology. In agreement with the previous on the importance of operational costs and efficiency as an essential theme, organizational document JN3 asserts that the benefit of workflow and systems automation inherent in the NFV concept de-emphasizes operating cost. The NFV technology also allows automation of services to iterate, moving from planning to testing swiftly and with little capital and OpEx to match the expected revenue.

Comparison to the Literature

The literature consents to the theme as it highlights operational costs and

efficiency as the propelling force behind the NFV technology adoption by organizations. The quest to implement and manage legacy network equipment and infrastructures requires increased CapEx and OpEx to change the perceptions of organizations and network operators towards NFV technology (Hameed et al., 2012). The NFV ISG has institutionalized network softwarization, which consolidates virtualization technology. The emerging innovation is NFV technology, which benefits organizations regarding scalability, cost efficiency, flexibility, and efficiency (Katsikas et al., 2017). The attendant benefits of NFV technology over legacy networks include reduced operational costs for network operators and organizations by reducing physical hardware and configuration services costs (Vasilios et al., 2018). The literature, the participants, and the organizational documents agree with operating costs and efficiency as a recurring trend. NFV paradigm offers flexibility in terms of deployment and operation of novel infrastructure and associated application patterns resulting from the creations of enhanced services and NFs and new business concepts driven by user demands (Vasilios et al., 2018).

NFV technology ushers in a significant shift in networking technology expected to create novel operational cost-effectiveness and network efficiency (Vasilios et al., 2018). The limitations of the legacy network infrastructure permeate the non-flexibility of NFs, high operational costs, and inadequate performance and reliability prompted the emergence of novel networking trends in NFV technology (Wood et al., 2015). NFV technology's ability to offer novel NFs and services demanded by users cost-effectively, efficiency, and with more agility has become near impossible, if not impossible, on

legacy network infrastructures. The network service providers and organizations proposed the NFV technology (Saraiva de Sousa et al., 2018). To decrease operational costs, strengthen network flexibility, and minimize network service delivery duration to intersect the increasing data-intensive user demands, the adoption of NFV technology becomes inevitable. The concept of NFV may attenuate network sterility and efficient network management that are innate in legacy networks by decoupling NFs from the traditional hardware to realize them in software form identified as VNFs (Yi et al., 2018).

According to Basile et al. (2019), NFV technology avails flexible and softwarized NFs provisioning and ease of scaling. Furthermore, NFV technology adoption may decrease operational costs and increase network efficiency. According to Pattaranantakul et al. (2018), there is a global perception of novel networking technologies such as NFV to present various advantages like reduced hardware cost implications, resource consumption optimization, and improving the operational efficiency and quality of service deployment. Three participants and two organizational documents clarified operational costs and efficiency as recurring topics of importance during data analysis and reporting. The emergence of the NFV concept presents a significant transformation in networking technology to create new opportunities in cost-effectiveness, operations, and service instantiations (Gonzalez et al., 2018). Operational efficiency revealed two potential benefits of NFV: (a) consolidation of network applications from diverse vendors run on a consolidated hardware platform and managing them centrally. And (b) NFV avails centralized management with a unified and network-wide view to quickly configure and monitor network services and update the policy rules (Pattaranantakul et

al., 2018).

Ties to the Conceptual Framework

The research study through the theme: Operational costs and efficiency agree with the constituents of relative advantage in DOI theory, including costs and social status motivation parts of change. Relative advantage reiterates the degree to which an innovation is believed and assured to be better than the idea it overrides (Mannan et al., 2017). Specifically, DOI theory offers five novel attributes that are precursive to any technology adoption, consisting of relative advantage or economic benefits, complexity (or ease of use of new technological concept), consistent with prevailing values and needs, and past experiences of prospective adopters. Observability, or the appraisal of the implications of adopting the new paradigm, and trialability or analysis before adopting the innovation (Min et al., 2018). Operational costs and efficiency as a recurring trend in three participants and two organizational documents agree with DOI theory's component of relative advantage, which reiterates the economic benefits the NFV technology adoption presents to organizations.

DOI theory highlights the attributes of relative advantage, which is the degree to which a technological concept is perceived to be better than the idea the change needs (Amuzu-Sefordi et al., 2018). Compatibility reiterates the degree to which a technical concept is in adherence to the prevalent trends, understandings, and must-haves of prospective adopters (Amuzu-Sefordi et al., 2018). The next-generation networking trend highlights network softwarization is a concept that enhances operational cost reduction and increased network efficiency. NFV technology adoption is following current

networking requirements that offer operational cost reduction and increased efficiency. The network providers and organization's quests to reducing operating costs and enhancing network efficiency have adhered to adopting NFV technology to enable them to meet user demands swiftly and cost-effectively.

Simplicity (complexity) highlights the degree to which a technological concept is perceived to be easy to comprehend and utilized or complicated to understand. Trialability reiterates the degree of exaggeration of technical concepts at the test or experimental phase. Observability highlights the degree to which the result of the change is noticeable to new adopters (Amuzu-Sefordi et al., 2018). The universality of the high level of relative advantage, compatibility, simplicity (complexity), trialability, and observability in a new concept is more likely to be adopted swiftly than others (Rogers, 2003). However, structural factors, comprising costs, profitability, and social approval, must be considered, especially in organizational environments, which this research has focused on (Rogers, 2003). The inherent innovation-specific attributes in the NFV concept comprising simplicity, efficiency, and scalability have been the buy-in for adoption by organizations.

Applications to Professional Practice

Corporate Recognition (Organizational Awareness)

A significant strategy utilized by CIOs in the adoption of NFV technology is corporate recognition. Corporate recognition or organizational awareness of NFV technology as novel and important technology is a strategy used in the adoption of NFV, derived from all six participants. The need to institutionalize a generic view of the new

technological idea's adoption process on organizational, employees and environmental appraisal is critical. For successful adoption of NFV technology, organizational awareness or corporate recognition is key to driving concurrence among the stakeholders. Organizational awareness or corporate recognition highlights the new technological concept and readiness to adopt the NFV paradigm within corporate settings. NFV technology adoption is strategic and vital to organizational competitiveness and enhanced corporate performance, igniting executive sponsorship to drive organizational awareness towards acceptance and implementation of NFV technology. To create organizational awareness, corporate recognition as a strategy becomes vital to develop stakeholder's and employees' adoption of NFV technology.

In practice, CIOs planning adoption of NFV technology may leverage corporate recognition and executive sponsorship of NFV technology adoption. Corporate sponsorship of NFV technology was the key to NFV adoption within the six organizations with benefit awareness. There was no need for persuasion of the employees within any prospective organization as the adoption of NFV technology is driven by business cases. Utilizing executive sponsorship of innovations in lagging organizations as a strategy may expedite the internal diffusion of NFV technology among the stakeholders and the employees. Using corporate recognition as a strategy affirmed the importance of employing the method of building strategy streams about NFV technology values to the management and the key stakeholders. Research process validation of the NFV technology adoption process on employees, organization, and drivers of adoption during

the interview sessions revealed management as the primary catalyst to organizational awareness.

Organizational Investments in Product Awareness and Executive Sponsorship

To overcome hindrances to NFV technology adoption, six participants averred that they had no hindrances to NFV technology adoption. Corporate funding in product awareness, executive sponsorship, research and education, and a detailed clarification of the benefits of the NFV concept to the stakeholders and employees became the impetus to surmounting inherent obstacles to the adoption of NFV technology. No hindrances to NFV technology adoption as a theme permeating all six participants revealed the strategies utilized by participants and their organizations to assuage the salient impediments to NFV technology adoption. Hindrances to novel ideas are common in every organization during the adoption and implementation of innovations stages. These hindrances to adopting novel technological ideas may include cultural, corporate structure, and stakeholders' collaboration. Lack of expertise within the organizational IT employees could be a challenge that can be closed through extensive training and an extensive certification program. This strategy can be applied in practice by organizations planning to adopt NFV technology, establishing extensive pre-adoption training and certification programs for all the stakeholders.

Digital transformation initiative highlights the aspirations of organizations to digitally transform provisioning of new values to the customers, where innovative technologies become means of engagement. NFV enhances NFs allocation and flexibility to implement novel network services, thus, allowing competitiveness and productivity. In

enterprises in practice, the CIOs must first get corporate funding in product awareness, executive sponsorship, research and education, and a detailed clarification of the benefits of the NFV concept to the stakeholders and employees. Corporate sponsorship of NFV was key to no hindrances to NFV adoption in the organizations and a plausible strategy in creating no hindrances to NFV technology adoption and can be used in practice by prospective organizations lagging in NFV technology adoption.

Procedures and Policy Documentation

Another vital strategy used by four participants reiterates establishing procedures and policy documents detailing the planning and configuration procedures for adopting and implementing NFV technology. The policy and procedures document elucidates a reference on the modus operandi of how NFV technology was adopted and implemented by the four organizations. The need to design a documentation and implementation strategy for adopting NFV technology by organizations agrees with the industry guidelines on the requirements for specification documents for adoption as described in NFV ISG standardization documents. Documentation and implementation plan identifies procedures and processes as vital ingredients to successful adoption of NFV technology by organizations. The strategy of establishing documentation and implementation plan to capture the procedures and processes of adoption during proof of concepts may assist prospective CIOs in their quests to adopting NFV technology.

As a strategy, four participants identified procedures and processes as vital ingredients to the successful adoption of NFV technology. The recurring trends in documentation and implementation plan agree with the practical realities of adopting

NFV technology by the partner organizations' CIOs, the necessity of having adequate procedures to guide the adoption and deployment of NFV technology. The adoption strategy for NFV technology is about planning established steps and necessary procedures to understand how the transformation evolved. Another process identified in the research study permeates showcasing the type of orchestration adopted, management, and mode of operation over some time during proof of concepts. The critical steps must be established in advance before, during, and after proof of concepts. The basic framework for NFV paradigm transition evolves through documentation and implementation plan documents as a strategy for successful adoption and implementation of NFV technology by prospective CIOs and professionals seeking to transform it into a new technological paradigm.

Operational Cost Benefit Analysis and Value Proposition

Three participants reiterated operational cost reduction and network efficiency as a trend, which propelled the corporate-wide interest in adopting NFV technology. NFV infrastructure delivers network services on a virtual commercial-off-the-shelf platform instead of physical devices. Softwarization of legacy NFs through the NFV paradigm offers rapid operational cost reduction and enhanced network efficiency. Softwarization of legacy NFs and services through the NFV paradigm offers immediate operational cost reduction and enhanced network efficiency. The strategy of carrying out a cost-benefit analysis before the adoption became the catalyst that ignited the interest of the executive buy-in. In the cause of this research study, I identified operational cost-benefit analysis as a strategy to procure C-level approval to adopting NFV technology. Another valuable

method under this theme was highlighting the value propositions of the NFV paradigm to the management and stakeholders to convince them of the value NFV technology adoption may bring to the organization.

Operational cost-benefit and value proposition may drive increased organizational adoption of NFV technology. My interactions with the participants affirmed the NFV orchestrator's importance in reducing operating costs and increase the velocity of new offerings for service providers. The main drivers of NFV open platform adoption are the ability to enhance operational efficiency, to remain competitive by innovating faster, and to be cost-effective. Furthermore, NFV technology adoption may decrease operating costs and increase network efficiency. In summary, the cost-benefit analysis and value proposition of NFV are strategies for adopting NFV technology by prospective CIOs and organizations. Information resulting from this study may provide CIOs and some senior IT executives of reluctant organizations with the critical process to adopt NFV technology. In addition, it may be helpful for reference for the network operator and IT professionals and researchers alike.

Implications for Social Change

By identifying successful strategies for adopting NFV technology, CIOs and senior IT executives of lagging organizations have access to a field-proven strategy that they may utilize in adopting NFV technology. The social change implications from this research study comprise enhancing organizations' capabilities to adopt and deploy NFs and services to their customers cost-effectively. One of the issues facing service providers and organizations is the ever-increasing volatile customer service demands,

which are becoming difficult and expensive to orchestrate from the existing sterile legacy network equipment. This qualitative multiple case study may fill a void in NFV paradigm-related literature by availing the comprehension of CIOs and senior IT executives on the successful NFV technology adoption strategies. When CIOs and senior IT executives of prospective organizations utilize such a strategy, they may further understand successful NFV technology adoption strategies. Furthermore, identifying successful NFV technology adoption strategies may equip CIOs, CSIOs, CTOs, and senior IT executives and NFV ISG consortium with the capability to document globally accepted processes and procedures for seamless adoption of NFV technology.

In another perspective to the implication of social change, the adoption of NFV technology may reduce the utilization of physical on-premises network equipment that equally needs a high quantum of power. Most NFs and services transform to commercial-off-the-shelf appliances in a virtualized platform. NFV paradigm presents the integration of network resources and their dynamic utilization virtually, thereby delivering service providers and organizations improved energy utilization (Mijumbi et al., 2016). According to Mijumbi et al. (2016), the virtualization of the service providers' core network infrastructure may result in a 22% energy usage reduction and energy efficiency increments of 32%. Energy usage reduction may naturally decrease the concentration of greenhouse gas atmospheric emissions (Rehman & Rashid, 2017). The environment may undoubtedly be affected. The decrease in greenhouse gas emissions may reduce extreme weather occurrences like hurricanes, tornadoes, famine, droughts, and floods due to rising sea levels (Rehman & Rashid, 2017). Reduced energy consumption may result in the

preservation of natural resources, reducing environmental pollution due to the emission of dangerous gases that may result in environmental degradation.

Recommendations for Action

CIOs, CSIOs, CTOs, and senior IT executives of service providers and organizations should immediately embark on the documentation of NFV technology adoption strategies used by the early adopters of NFV technology. The NFV ISG consortium, frontline service providers, and organizations should engage each other in documenting the procedures of NFV technology adoption by CIOs and made them available as industry-working documents for prospective organizations aspiring to adopt NFV technology. During interviews, the organizations lack in-house documented adoption strategies. They mostly rely on vendors' guides, such as the NFV product guide, NFV planning guide, and NFV configuration guide. Organizations with adopted NFV technology need to capture actual procedures, processes, and techniques used during the adoption phases.

NFV ISG consortium through European Telecommunication Standard Institute seems to be more concerned with standardization documentation relating to standards for vendors and telecommunication and IT professionals. There is a need for the NFV ISG consortium, European Telecommunication Standard Institute, and organizations that have adopted NFV technology to document a well-streamlined strategy document to adopt NFV technology collectively. During my research study, I discovered a total lack of organizational documents and strategies for adopting NFV technology, especially from the CIOs and senior IT executives, regarding well-documented procedures and processes

they used in adopting NFV technology in their organizations. These endeavors should include clear guidance as to producing and sustaining quality documentation of strategy requirements for each organization aspiring to adopt NFV technology. Quality documentation of NFV adoption strategies is achievable through seminars and workshops driven by the NFV ISG consortium and European Telecommunication Standard Institute.

I will present the findings emanating from this study through workshops, conferences, and seminars, especially those that target next-generation technologies, such as NFV, SDN, internet of things, and cloud computing and network programmability. I plan to write technical papers for presentation to peer-reviewing and industry-specific conferences. I also plan to participate in organizing seminars at the local and international chapters of IEEE as a senior member.

Recommendations for Further Study

This research study emphasized the exploration of strategies utilized by CIOs and senior IT executives in the adoption of NFV technology in their respective organizations. This research study's fundamental limitations highlight the participants' genuineness to the semi-structured interviews, their vulnerabilities during the interview sessions, and the authenticity of the documents presented. Recommendations for further research of the same topic interviewing similar participants in different organizations such as financial and data center providers in the same geographical region. Recommendations for further research of the same topic interviewing similar participants in different organizations such as financial and data center providers in the same geographical region. This further research may compare outcomes of similar research and this research study to ascertain

the genuineness of the participants' vulnerabilities in sharing their experiences and status of organizational documents. The crucial second limitation is that the study was limited by participants' varying experiences in NFV technology adoption strategies. Recommendations for further research permeate similar research focusing on similar extraction of participants in data centers and financial institutions in different USA regions to compare and generalize results. A third fundamental limitation highlights how well the sampling method provides a relational outcome. I recommend further research to continue this study with additional qualitative studies, improving sampling, de-emphasizing bias, and generalizing the research outcome since the integrated data traversed more than one organization's CIOs' experiences and understanding of the topic.

Since my focus was on the service providers and organizations' CIOs and senior IT executives' experiences in adopting NFV technology, I recommend embarking on the same research study, including participants from data centers and financial institutions. These participants may be IT infrastructure architects, virtualization infrastructure architects, and network end-users to ignite more feedback from network users and IT infrastructure managers. The next-generation network users, the NFV ISG consortium, and NFV architects adopting NFV technology may contribute field-proven knowledge and experiences. These experiences may contribute information to the prospective organization CIOs and senior IT executives require to adopt NFV technology in their organizations. Consequently, the feedback from the senior IT executives may result in multiple bouquets of comprehensions premised on their individual experiences and responsibilities that may contribute awareness to the organization about specific

challenges that hinder organizations from adopting NFV technology. The feedback may also avail strategies to surmounting those hindrances, which may contribute to the required processes needed to adopt NFV technology.

For organizations to remain profitable and meet the next-generation network user demands, they must transit legacy networks into softwarized networks to provide NFs and services off the physical vendor-locked-in types of equipment. Further research may document Field-proven NFV technology adoption strategies in collaboration with the NFV ISG consortium as the participants were not ready to share classified organizational documents or have no in-house organizational records. All six participants had no formal organization documents detailing the adoption of NFV technology, so I recommend further research using a different methodology and design to compare with this research. Finally, this research study has contributed to the literature on the NFV paradigm, but further research to unearth adopting NFV technology strategies may prove beneficial to telecommunication, IT, and academia.

Reflections

I have always nurtured the belief that actualizing a doctoral degree is a near impossibility. However, at this stage the mentorship of my chair has made it possible. The health issue I encountered at the tail end of the program almost diminished my desire to complete the program, but the cooperation and push from my mentor re-ignited the spirit to continue to push. As telecommunication and IT professional of three decades who has delivered cutting-edge technological solutions to service providers and organizations, I have encountered similar or more themes in all my encounters with novel

technological adoptions. At the onset of this research study, I expected to access organizational documents detailing the CIOs' processes and procedures in adopting and implementing NFV technology. Nonetheless, I discovered that none of the organizations have in-house developed documentation of approaches and techniques used during the adoption of NFV technology. Instead, I relied on vendor documents and guidance.

In canvassing for participants, I was shocked at the reluctance and hostility of the organizations towards allowing me access to their CIOs and senior IT executives. I hoped that the organizations' CEOs could be susceptible to partnering with me in the research study. Instead, I was turned down by over 100 organizations, thereby stalling research study progress for ten months! Some claimed legal policies and organization policies toward academic research work despite pledges of confidentiality. During and after the data collection. I discovered the reason behind the reluctance, as the fear of data breaches may hack their network infrastructures and other details. The partnering organizations have contributed to the practice of IT by accepting to be part of the study.

Study Conclusions

The NFV technology reiterates a vital technology that may drive the next-generation network. Organizations must transit from traditional network infrastructures into network virtualization infrastructure to meet volatile on-demand user service needs for profitability. Providing many on-demand user services comes with the continuous upgrading of vendor locked-in physical appliances at high operational costs and poor network efficiency—many organizations that are yet to transit to NFV technology face network sterility and high operational cost. The physical on-premises network

infrastructures utilize a high quantum of power to operate the physical vendor locked-in appliances, thus, adding to the operating cost and adverse effects on the environment. For organizations to continue to be profitable and competitive in-service delivery, they must transit to NFV network infrastructure utilizing the sets of adoption strategies of the NFV technology to continue to be profitable and competitive.

Organizations in the IT, telecommunication, and data center business terrains need field-proven adoption strategies of NFV technology. These strategies may enable the seamless transition of their networks from traditional networks into NFV infrastructure to have the capability to provide next-generation NFs and services provisioning cost-effectively. NFV technology may enable end-to-end integration of heterogeneous legacy appliances, software functions, and services presented at the optimal time with minimal time to market and are provided to their network users on a "software as a service" basis. NFV ISG and European Telecommunication Standard Institute need to engage the service providers, data centers, and organizations that have adopted NFV technology to create synergies to document strategies and procedures they have utilized during their adoption of NFV technology. The documentation of NFV technology adoption strategies may allow seamless adoption of NFV technology by lagging organizations with no access to the field-proven strategy of adopting NFV technology.

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Appendix A: Human Subject Research Certificate of Completion

Certificate of Completion

The National Institutes of Health (NIH) Office of Extramural Research certifies that **ABDLRAZAQ SHITTU** successfully completed the NIH Web-based training course "Protecting Human Research Participants".

Date of completion: 09/02/2016.

Certification Number: 2148286.

Appendix B: Interview Protocol

Topic: An Exploration of Network Function Virtualization Technology Adoption Strategies

Collected data source(s):

-Interview sessions (Telephone, Zoom or Skype)

-Retrieved organization document

-Audio Recording

Interview Protocol

Time and Date:		
Location:		
Participant (Pseudonyms) ID		
Phase 1	Introduction of the exercise	I will introduce myself to the participants and acknowledge their receptiveness.
Phase 2	Authenticating participants' consents received through emails, participants' privacy documents and endorsements	Before commencing the interview, re-affirm participants' consents.
Phase 3	Announcing the Purpose of the Study to the participants	The purpose of this research study is to explore the strategies utilized to successfully adopt NFV technology.
Phase 4	1. Enunciate why participation in the study is critical. 2. Request for any available organization document the participant can share	Your participation and response to the interviews, along with the organization documents will assist providing answers the research question and enable my partial fulfillment of the degree Doctor of Information Technology from Walden University.
Phase 5	Belmont Report's beneficence proclamation	I will emphasize risk-benefit analysis to the participants. Participants will be informed that their participation in the study is voluntary and without any financial incentives whatsoever. The report outcome will be shared within the academic and professional community to assist in the enhancement of the adoption of NFV technology.
Phase 6	Affirmation of use of pseudonyms as a means of privacy and protection of	The privacy of the participants will be protected to the use of pseudonyms for

	participants during and after the interview sessions. Permission to do audio recording will be sought.	each of the participants. The participant's consent will be soughted before audio recording commences and only pseudonyms of the participants will be used throughout the recordings. I will then turn ON the recorder.
Phase 7	Audio recorders will be turned ON	I am Abdlrazaq Shittu. I have here with me <participant pseudo-ID>, today is <Day, Date, Time>. ID, please confirm that I have explained the motivation and purpose of this study and that I have covered the motivation for your participation as well as the benefits and that I have your consents carry out this interview and to record this interview session and take notes as well ask you questions on the organization documents provided?
Phase 8	Articulate confidentiality statements regarding participants and the study.	Participants will be reminded that at any time during this interview session that they can stop me to ask questions or terminate the session and/or their participation in the interview without any obligations or penalty. Participants will be informed that information or data harvested during this interview will be treated as confidential. There will be no disclosure of any of this information and or data to participant's employer or any other individuals. Participants will be reminded of refraining from use of any specific names of individuals or organizations or institutions to adhere to privacy clause of this protocol. If participants make such information present unknowingly or knowingly, such information will be removed from the transcripts so that the personality mistakenly mentioned may not be identified in any way. To reiterate, all information collected in this interview will only be used in this study and for no other purpose. No identifying information or specific responses will be included in the final study. Any information gathered during this will be protected. Digital information will be kept for a five-year period on an

		encrypted and password protected drive, which will be permanently deleted after 5 years. Physical documents will be stored in a locked fireproof safe for a period of 5 years, at which time they will be burnt and destroyed totally.
Phase 9	Reaffirm if participants have questions or concerns again	Before we start the interview session the participant will be asked if they have any question?
Phase 10	Interview session will start	"Cover interview questions." See Appendix C).
Phase 11	Post interview reviews and clarifications on notes	
Phase 12	End Interview session	Participants will be asked if they had any other information they would like to share? Participants will be informed about the concept of member checking, which will be utilized to authenticate the initial interview responses.
Phase 13	Request Sharing of relevant participants' personal or organization documents	The conclusion of the end of the major interview session is announced. Participant will be politely asked if they can share any personal or organizational document relevant to the topic their role, and the interview.
Phase 14	Conclusion	Thank you again for your time. As part of this process, I will summarize the transcripts of this interview and email it to you to confirm.

Appendix C: Interview Questions

1. How do you create awareness of NFV technology in your organization?
2. When did your organization first use NFV technology and how do your organization use NFV technology?
3. How do you determine effective procedures for proof of concept of NFV technology?
4. How did you gain organizational approval to adopting NFV technology in your organization?
5. How do you identify and ameliorate the hindrances to NFV technology adoption?
6. How did you create positive opinion about the benefits of NFV technology in your organization?
7. How did you overcome cultural issues preventing adoption of NFV technology?
8. To what extent, if any does NFV technology provide values that are traditionally derived from the legacy networks
9. How did you identify progress and define completion of NFV technology adoption?
10. How do you track the progress and define completion of NFV technology adoption?
11. What methods did you utilize to identify, define, and document critical procedures to transiting traditional network infrastructure in NFV infrastructure in NFV technology adoption?
12. How do you find and establish successful leadership and organizational support

for NFV technology adoption?

13. What other important information do you have to add?