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Exploring Critical Success Factors for Implementing IT Modernization Systems in Michigan State Agencies

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Abstract

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by

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MA, Central Michigan University, 2012

BS, University of Douala, 2003

Submitted in Partial Fulfillment

of the Requirements for the Degree of

Doctor of Philosophy

Management

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Abstract

Since 2001, most government organizations' IT modernization programs had failed because of ineffective implementation strategies from IT leaders. The research problem was the absence of effective strategies to modernize IT legacy systems. The purpose of this qualitative single case study was to explore effective IT modernization strategies to revolutionize IT legacy systems. The researcher sought to answer how organizations create effective strategies to modernize IT legacy systems. The study used purposeful sampling, including 13 IT leaders, IT technicians, and customers based on their experience in implementing successful IT modernization programs' strategies. Data were collected using semi-structured interviews and agency documentation. Data were analyzed using the four-step thematic analysis approach, including data transcription, data organization, data coding, and data validation. The interpretation of data revealed four major themes: IT leader strategy, IT leader knowledge, IT infrastructure security and reliability, and IT cost savings. The findings revealed that IT leaders serve as the key actors in the IT modernization programs' network. Their knowledge is essential to a holistic IT transformation strategy to enhance risk-based decisions and communicate with customers. The implication for positive social change includes the potential to use innovative technologies to reduce cost, increase data security, and simplify IT applications to enhance Michiganders' quality of life in multiple aspects.

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Dedication

I dedicate this dissertation to my lovely wife, Nathalie Kamdem, and our lovely children, Gladys, Aubert, Fri, and Naomi. Your love, support, understanding, and patience during this journey were instrumental to completing this program. This work is equally dedicated to my late father Papa Andre Djoko, my sweet mother, Mefe Rose Tchudje, my siblings Eveline Tameu, Merlin Kenmogne, and late Bernadette Meli. I remain grateful to them all for teaching me the value of education at an early age and always staying by me. This achievement is also dedicated to my other relatives, nephews, nieces, and friends for their encouragement during this challenging process.

Finally, this dissertation is dedicated to my friends and professional current and former colleagues. Thank you for your unwavering support throughout this project. Thank you all for the momentum and love.

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I am giving all the Glory to God for blessing me with inspiration and strength throughout this journey. God provides all the resources needed from start to end of this project. Thank you, Yahweh, for making my dream a reality and for many other blessings and inspiration during the years ahead.

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I wish my father, Papa Djoko, and Papa Chedjou were here to share this incredible moment with us. Thank Dad and Mom for making me who I am today, unconditionally loving me, and providing all the building blocks to make my life memorable.

I am forever grateful to all those at the state of Michigan who helped shape my IT project management skills and to everyone else not mentioned here but contributed in some fashion to the successful completion of this dissertation.

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Chapter 1: Introduction to the Study

Over the last decade, the modernization of information systems has become critical for state organizations (Khalifa, 2017). When implemented efficiently, information technology (IT) modernization systems have demonstrated a 20–25% reduction of the IT operations and maintenance costs while increasing IT infrastructure security (GAO, 2016). In the absence of a clear organizational strategy, state agencies did not benefit from IT modernization (Charette, 2016). With the continuous growth in the number of users demanding high-quality IT services (Situngkir & Napitupulu, 2019), modernizing systems could help state departments expand the number of services they offer online as well as reduce the total cost of ownership. Recent research studies reveal some limitations and security vulnerabilities of legacy systems. Khanye et al. (2018) argued that legacy systems exhibit security vulnerabilities, thereby making them susceptible to cyber-attacks. Cyber-attacks consequently leaded to data breaches resulting in costly repairs, hence increasing the incentive for state organizations to upgrade their IT systems that are less risky and more cost-effective. I sought to demonstrate that a well-developed IT modernization strategy could be instrumental in the modernization process, while also highlighting several benefits of a new IT environment. The ultimate goal was to reinforce the transition of all state IT systems from legacy to modernization.

This qualitative single case study was designed to analyze strategies to implement IT modernization in an efficient manner. These strategies helped organizations in developing a cost-effective IT environment and lower IT modernization projects failure rates through the involvement of the IT leadership and the collaboration among all

project stakeholders. IT modernization strategy potential social change includes (a) more security for IT systems and citizen data; (b) lower IT operation and maintenance costs; and (c) improved quality of services. Chapter 1 includes the background of the problem, problem statement, the purpose of the study, research question, conceptual framework, nature of the study, definition of terms, assumptions, scope and delimitations, and limitations.

Background of the Study

Organization management of technological progress, new security norms, and operational cost-saving are becoming increasingly relevant topics for IT leadership (Charette, 2016). Senior IT executives in private and public companies have identified some key IT challenges, including the reduction of IT operation and maintenance costs, the improvement of security, the usability of data sharing across systems, the development and deployment process of new functionalities, and the support of a growing number of end-user devices and applications (Ray & Sharma, 2020). Possessing a good understanding of how modernization systems improved the citizens' satisfaction could be helpful in demonstrating the need for a strategy to modernize legacy systems (Situngkir & Napitupulu, 2019). In this fast-paced global economy, organizations need to boost their agility for responding quickly to business changes and customer demands. The current IT practices constitute persistent increases in citizens' demand for IT services; yet, decreased IT state and federal funding have created austerity in the government's IT budgetary allocations (GAO, 2017; Situngkir & Napitupulu, 2019). The

state agencies' IT architecture, currently built on a legacy system, cannot meet the demand.

Mateos et al. (2015) further highlighted the high maintenance cost for government agencies that use 35-year-old legacy systems, suggesting that older IT systems have higher ownership costs. Mateos et al. demonstrated the rationale behind implementing IT modernization systems; they addressed the increase in IT costs, system vulnerabilities, and the effective use of IT systems. Harris (2019) noted that 65 critical IT systems across various federal agencies, including the Medicaid system, are challenged by performance issues that raise the need to modernize IT systems. IT legacy systems' maintenance and operational costs average 80% of federal IT spent in 2019 (GAO, 2019). This cost highlights the urgency of building an IT modernization strategy to avoid similar unnecessary expenses in the future. Despite this urgent need, only 70% of federal agencies plan to upgrade their legacy systems (GAO, 2016). Surprisingly, no concrete strategy has been established to handle these systems' upgrades. Abdurrahman et al. (2017) explored the transformation and development of an innovative business based on IT systems improvement. The authors used a distinctive system engineering approach to demonstrate that systems upgraded to modernization systems are more reliable for diagnosing any technical issues, from identifying problems to determining various resolution approaches (Abdurrahman et al., 2017).

In addition, state agencies have become less proactive in managing their respective IT modernization systems for a number of reasons. For instance, state IT leadership has failed to harness disruptive technology instead of maintaining the ambient

status quo (Lin, 2019). Disruptive technology is described as a technology that is not comprehended or trusted by the current business model environment; this technology could threaten current practices if IT staff has little or no understanding of the differences. Siggelkow and Terwiesch (2019) suggested that organizations' IT models that do not fit the business model hamper future technology development. Harris (2019) recognized that the modernization process would fail or never have a successful ending without a well-developed implementation strategy.

Organizations with the capability to integrate and improve business processes following a defined strategy could consistently ameliorate their products and/or services (Paltayian et al., 2017). Michigan citizens might benefit from any service improvement resulting from the implementation of a successful and efficient program in the long term. Mathur and Asthana's (2016) study on the role of technological adoption on state services further demonstrated that government organizations with the ability to undertake extensive business redesign, such as the IT modernization, could improve the quality of their services by at least 20%. Such improvements in technology could offer better incentives, such as more services for citizens using online applications, thereby reducing their waiting time in the state offices (a source of frustration for customers).

The definition of the term 'legacy system' has been dynamic over the years, progressing from addressing only software development to encompassing more extensive IT infrastructure systems (Sandborn & Prabhakar, 2015). Mateos et al. (2015) identified the legacy system as an early version of IT infrastructure and third-generation software language, like the common business-oriented language (COBOL). These systems

developed over the last 2 to 3 decades have been, in some cases, reengineered multiple times to adapt to the business needs.

Mateos et al. (2015) argued that the architecture and technology on which these systems have been built are relatively inflexible and not designed to accommodate significantly altering upgrades. Likewise, Gholami et al. (2017) argued that legacy systems functionalities had been improved over the years with multiple changes with considerable consequences, such as the addition of mass complexity and challenges in understanding the systems. As a result, the resonances with the skillset necessary for maintenance were minimal, thus increasing IT systems' operational costs. In this environment characterized by everyday financial challenges, legacy became a gap between the taxpayer demand and the technical capability of IT systems. With the continuous change of IT security norms and the necessity to have a system capable of rapid changes, legacy systems became a burden owing to their complexity and inflexibility.

Problem Statement

On average, the existing IT configurations waste about 20-25% of overflow IT costs per year (Gosselin, 2018). Despite the availability of newer systems, some state agencies are still using the old, unstable paradigm of the traditional modernization approach characterized by the development of silos IT applications, unique infrastructures, and data storage to fulfill individual business needs (Irani et al., 2014). Establishing a clear strategy for the modernization of the legacy systems provided more

flexibility to organizations while lowering the modernization cost by 25% or more and increasing the quality-of-service delivery (Jetzek et al., 2014; Van Beneden, 2014).

The general management problem was the continuous increase in IT costs due to obsolete legacy systems, limiting IT investment in innovative systems, and value-added programs (Khanagha et al., 2013). The specific problem was the absence of effective strategies to modernize IT legacy systems (Harris, 2019; Lindström et al., 2013; Powner, 2017).

Purpose of the Study

The purpose of this qualitative single case study was to explore effective IT modernization strategies to upgrade IT legacy systems. I led a critical review of IT modernization strategies in states and federal government organizations. A single case study was appropriate for this research because this approach helped to conduct in-depth research of a single department with the largest and oldest IT infrastructure in the state of Michigan (Gallo et al., 2020). The selection of this research design enabled the understanding of the impact of real-life IT modernization strategies on the IT legacy systems' modernization.

Research Question

How do organizations create effective strategies to modernize IT legacy systems?

Conceptual Framework

The conceptual framework that grounds this study was actor-network theory. According to Bijker and Law (1992), actor-network theory depicts that the technology is a complex repertoire of actions between multiple actors handled in a heterogeneous

environment. This specific theory provided the rationale to justify government organizations' leadership dedication to elaborate IT modernization strategies (Walsham & Sahay, 2006). The theory stated that technologies embody multiple actors' political, economic, and professional implications that successfully implemented IT modernization (Bijker & Law, 1992). In this research, the framework helped understand how leadership implication to IT projects by elaborating strategies could improve IT modernization success rate in state governments.

The actor-network theory viewed the implication of leadership in technologies as an element of the network that defines technology (Bijker & Law, 1992). It also highlighted the correlation between social and natural sciences as non-dissociable actors in technology (Callon, 1986). While applying actor-network theory, the absence of human actors created an unsteadiness network in technology by eliminating the trade-off and compromising action between human and non-human actors (Law, 1992). Actor-network theory used heterogeneous forces existing in the network to shape and reshape technologies (Latour, 2005). This approach was relevant during IT modernization considering the agility and continuous adjustment of the process. Actor-network theory created a working environment where actors, human and non-human, negotiate their respective interests while leveraging their influence simultaneously (Stanforth, 2006).

This specific theory also provided materials and rational approaches that explicitly conceptualize technology as one of the theory actors (Walsham & Sahay, 2006). According to Latour (2005), actors include humans, individuals or groups or non-humans, technology, artifacts, and texts with the capability to change the circumstance(s)

of a given setting. Crawford et al. (2020) defined networks in this theory as a set of activities performed by actors involved in the network. These activities represented the flow of actions between actors that result in identifiable effects. The goals associated with the creation of actor-network accrued from a process called translation. Callon (1986) defined translation as a process that offers new perspectives and motivates interest while channeling people into different directions. One of the significant outcomes of this process was a slow movement of actors from 1 position to another.

Choosing actor-network theory over multiple governance theories, such as stakeholder theory and agency theory, was not about being right or wrong. Instead, this conceptual framework aimed to focus on a theory capable of enhancing knowledge on organizations with practical strategies to modernize their IT legacy systems. When well-elaborated strategies to modernize IT legacy systems existed and shared across the organizations' actors, the chances of successful implementation increase considerably. Walsham and Sahay (2006) used actor-network theory to analyze the geographical information system implementation in India. Teles and Joia (2011) applied the concept of actor-network theory to the contest of digital inclusion in a municipality's IT governance. According to their findings, this theory helped leadership to be more involved in IT strategies' elaboration. As a result, there was a synergy between all stakeholders, and the technology, thereby increasing the level of confidence at all levels of the project.

Nature of the Study

The nature of this study was a qualitative single case study. The single case study method was suitable for exploring the necessity of planned strategies to modernize legacy

systems (Yin, 2018). The single case study approach enabled in-depth research into one of the largest departments with the oldest IT platform in the state of Michigan (Gallo et al., 2020). This research method also helped address the limitation of available data by offering multiple data collection avenues, including the interview, observation, and documentation.

The particularity of the single case study method was to provide tools to conduct an in-depth study focusing on a single department at the state of Michigan that had the oldest and most significant IT network (Gallo et al., 2020). The selection of this research design enabled the understanding of real-life IT modernization strategies' impact on IT legacy systems. The single case study design appeared as an appropriate and practical approach to understand the IT modernization challenges of the state department in the natural life context (Gaveikaite et al., 2020). According to Yin (2018), the case study approach to qualitative analysis constituted a specific process of collecting, organizing, and analyzing data that directly and positively impact the results of this research.

The choice of participants for this study was critical; as Cleary et al. (2014) pointed out, the selection of participants had a clear justification and meet the specific objectives of the research question. This study sample comprised of 13 IT professionals, including the IT department leaders on different IT steering committees, to determine the overall IT strategies of their agencies and the state of Michigan in modernizing legacy systems. The target population for this research was agency experts providing support in different departments with IT modernization processes. The qualitative research approach

facilitated the selection of participants by identifying the most relevant candidates with the knowledge required for such a study (Satalkar et al., 2016).

Individual interviews, using the Zoom video call, were used to collect data about strategies for modernizing IT legacy systems in Michigan State government agencies. According to Opdenakker (2006), video interviews allow the interviewer(s) to associate non-verbal social cues, such as voice, intonation, and body language to the interviewees' verbal answers. Opdenakker argued that this extra information adds some value to the data collected and, as such, helps during the data analysis. Participants comprised of experts from other organizational departments, including Finance and Procurement, to ensure a broad knowledge base of the sample (Visser et al., 2017). Data were collected from participants using in-depth interviews (Cristina, 2016). Data were also gathered through the collection of notes in the field (Katz, 2015) and documentation reviews (Cristina, 2016). This triangulation of data sources helped establish the credibility of my analysis of the case studied (Yin, 2018). The data gathered from the mentioned sources was transcribed and analyzed using NVivo, a qualitative data analysis software.

Definitions

Hardware: Physical components of a computer system, including printers, screens, cables, smartphones (Osho & Onoja, 2015)

Information system (IS): The term information system denotes set organization hardware, software, data, procedures, and IT professionals working in the IT department and involved in information networks (Osho & Onoja, 2015).

Information technology (IT): Computer and communications software and hardware artifacts supporting a technological base process and human components and skills to create IT services (Lin, 2019).

IT modernization: A process during which information systems are migrated from the old legacy system to a new technology offering a more agile environment (Păcurar, 2017).

Legacy system: Old information systems, known as the early version of generation language, developed over the past 20-40 years (Khanye et al., 2018).

The total cost of ownership: Financial estimate, including direct and indirect IT costs, to help IT leadership evaluate all hardware and software spending(s) during the maintenance and operation of IT systems (GAO, 2019).

Assumptions

This study was conducted assuming that government organizations capable of elaborating IT modernization strategies aligning with their goals improved the quality of service delivered to their citizens. Significant studies conducted by previous researchers on this topic supported the relationship between process improvement and the quality of services (Osho & Onoja, 2015). Khanye et al. (2018) demonstrated that IT systems modernization from legacy to modernization systems reduced the maintenance and operational cost. The authors further argued that an innovative IT environment helped organizations demonstrate more productivity with lesser resources while increasing service quality. Some aspects of this thinking process were demonstrated. As such, a series of subordinate assumptions often accepted in the IT industry could be stated.

The first subordinate assumptions revealed the importance of people in the IT system as the engine of any modernization process. According to Heath et al. (2017), IT leadership built around a solid organizational structure that drives the requirements, ultimately leading to innovation strategies. The infrastructure, including hardware, software, and data warehouse, aligned with these overall strategies. Charette (2016) recognized that the critical success factor of IT modernization depended more on nontechnical and interpersonal skills than on technology. This assumption asserted that successful modernization of legacy systems required a combination of human behavior, organization change management, attitude, and leadership skills. Also, a well-elaborated strategy assisted IT teams plan any IT system reengineering lifecycle with less impact on the users (GAO, 2016).

Another assumption of this study was related to the premise that government organizations elaborated on a holistic IT strategy necessary for the continuous improvement of IT systems to enhance their services. The study assumed that the state of Michigan could avail the appropriate resources, including infrastructure platforms, funding, and experts, to support the modernization of legacy systems (Charette, 2016). I also assumed that each participant possesses critical knowledge of the state IT organization and processes. Lastly, I assumed that the data collection and analysis and the interpretation of the results obtained from the data analysis tool were accurate.

Scope and Delimitations

This research study focused on success factors for implementing IT modernization systems in the state of Michigan. It mainly focused on the necessity to

elaborate a holistic strategy for modernizing state systems from legacy environments with low risks and low failure rates. The goal was to gather information from the IT leadership to develop a better understanding of ways a well-elaborated IT strategy would help plan and improve IT modernization success factors (Charette, 2016). This study also focused on the disadvantages and risks of state agencies maintaining their systems in a legacy environment. The study also highlighted the modernization systems' agility, flexibility, and low maintenance cost (GAO, 2019). The purpose was to identify any strategies that could safely modernized the existing systems from legacy to new IT environment. The foundation of these strategies included an assortment of factors, such as technology, systems, and cultural environment that often impacted the modernization timeline from an old to a new environment. The duration of the study was approximately 2 months, while each participant was interviewed during face-to-face interactions via Zoom video conference, whereby the data were collected first and analyzed later.

The state of Michigan was a government organization with the capital located in Lansing. This organization offered different types of services to the state's citizens through various state departments. Although each state agency was responsible for its IT infrastructure management, the Department of Technology, Management, and Budget (DTMB) provided the technical expertise to maintain and operate all IT systems across the state government. The technical teams at DTMB worked alongside agencies, bringing onboard external partners to implement their IT strategy when necessary.

The IT leadership of agencies was responsible to elaborate on their IT strategies, based on their end-user needs. I selected the Michigan Department of Health and Human

Services (MDHHS) as the state agency to use for this particular single case study. The MDHHS was the largest department of the state of Michigan, providing medical health and human services to millions of Michigan state citizens. Conducting this complex business in legacy systems becomes a burden, given the high operational and maintenance costs associated with the security challenges of these older systems (Khanye et al., 2018). To address such issues, the department was engaged in numerous system modernization operations in the past. However, they were not successful. Understanding the reason for this failure could be done through future research. The ability to elaborate IT strategies that lead to a modernized IT environment, with minimal business disruption and a timely manner, turned out essential for state agencies exposed to multiple cyber-attacks (GAO, 2016).

Limitations

Although the information generated by the research was related to current studies on IT modernization systems, findings from the data analysis were limited to identifying the strategies favorable for a successful modernization to new technology. However, it was not the only concern raising from such programs. The spectrum of the research was limited to MDHHS. The study results might not apply to other government organizations considering their specificities (Mackenzie et al., 2020). A key challenge of the qualitative case study was separating my roles as a current state employee and a Walden University student. This research was conducted in the state of Michigan, wherein I currently work as an IT resource manager. The data collection, documentation, and analysis were another challenge that needed my attention during his study to avoid biasedness.

Despite using several approaches to avoid bias, it remained unrealistic to eliminate the bias factor due to the challenge associated with the separation of scholars and research participants from their background, experiences, and personal views, which influence the research process (Paerl, 2014). Another challenge common to studies that engaged new technologies was the limited literature discussing the advantages of IT modernization systems to governments' IT agencies. Most of the research participants were part of the upper management within their institutions. Hence, they were more likely to have busy schedules. This limitation created timely and successful meetings difficult; thus, acting as a barrier to the study. Due to the non-confidentiality of the data, it was not necessary to go through multiple layers of approval to gain authorized access to the information required for the study. Lastly, there was a dire need to acquire a qualitative design analysis tool, which constitutes an additional expense for the study (Fadzli et al., 2020).

Significance of the Study

The research filled the gap in understanding different critical factors for modernization strategies in state agencies. This empirical research was unique, as it explored an under-researched area of the use of new technologies (Harris, 2019) among governmental organizations that often relied on IT to provide excellent customer services (Weerawardena et al., 2014). The result of this study provided guidelines and appropriate suggestions for processes to successfully modernize the obsolete IT systems.

The study and findings were vital in exploring the role of data management in effective service delivery. With the gradual shift in organizational service delivery, from

paper-based to computer and Internet network-based service delivery, issues, such as data security and ease of access became critical competitive features across different organizations (Mackenzie et al., 2020). The government of the state of Michigan and its state departments served a large population of approximately 9 million citizens; hence, the need for stable IT systems to ensure critical elements of data protection, such as cyber security, easy and speedy access, data back-up, and costs of data management were well adhered to (Gingnell et al., 2014). While having skilled and qualified personnel working in the various IT offices was vital in offering the desired outcomes, the systems' features also play a role in ensuring effective provision of high-quality services.

The study further highlighted the key features in data storage and the features that differentiate the older legacy IT systems from the modernization IT systems, showing support for the reasons the state institutions in Michigan should seek to adopt new IT models. In exploring the success factors in IT systems' installation, Michigan State departments stand to improve the decision-making processes. Well-developed and up-to-date IT systems enabled IT professionals to collect, store, process, and interpret the data more easily and conveniently (Khanye et al., 2018). In addition, this study sought to showcase the role of IT systems in creating comprehensive monitoring features by screening the individual department's internal operations and the interactions with other stakeholders in the process, such as other state departments and customers. By highlighting the role of data collection and review, this study also sought to demonstrate how an efficient data storage system could assist in researching, interpreting, and predicting data/services trends, and reinforcing better and informed decision-making

processes across the state (Furda et al., 2018). Furthermore, monitoring assisted in offering better coordination among various departments, tracking changes, including security issues, and providing better supervisory activities, while promoting better planning, organization, and data on the areas where quality control was applicable.

As Furda et al. (2018) pointed out, IT systems were the modern digital structures that shape organizations' branding and public perception. My study highlighted how adopting the modernization of IT technologies significantly improved the legacy IT systems and how such systems could improve the human resources performances (Furda et al., 2018). Advanced and updated systems promoted better customer support while also enhancing the organization's human resources' performance levels. The National Academies of Sciences, Engineering, and Medicine (2017) noted that the population steadily rose; with the increased adoption of technology across the state, more customers became increasingly reliant on faster, efficient, and safe services. Therefore, modernized IT systems were placed in better positions to offer such conveniences. Through the faster, updated, and securer IT systems, the human resources could make a higher number of complex decisions, while also making it easier to track their own actions as well as consumers' actions/information through the systems.

The study and findings were instrumental to the organization's leadership, more so in the IT departments, as some of the keys of the study, such as encouraging adoption of modernization systems, required implementation with concrete support from the organizational hierarchy (Khanye et al., 2018). The IT leadership employed the study findings and recommendations to weigh the current IT environments and determine the

need for and adjustments necessary to the IT systems. The IT leadership lobbied for and strategized better for the IT systems to match the current and projected IT environmental demands globally (Haugen & Pelot, 2018).

Significance to Practice

The research findings helped in advancing the existing knowledge related to IT modernization theory by offering another perspective on the relationship between a well-elaborated IT modernization strategy and the IT modernization project success rate increase. More importantly, the study supported IT professionals by identifying the critical factors responsible for reducing IT modernization risks (Brodsky, 2016). This research also demonstrated how technology change could provide a more agile framework, critical to keeping up with systems refreshes and application updates imposed by new cybersecurity norms (Edison et al., 2018).

Significance to Theory

This research advanced the understanding of holistic IT strategies as success factors for efficient legacy system modernization. Government organizations had been challenged by a high failure rate of legacy systems transition to modernized IT platforms. According to GAO (2019), MDHHS had the most significant IT infrastructure across the state of Michigan, with more than 60% of the state IT systems. Hence, this agency had higher maintenance and operational costs in addition to the cyber risks involved. Thus, this qualitative single case study was helpful in understanding the reasons IT leadership lacks motivation to engage in systems upgrade despite the high costs involved. This research also aided in the evaluation of the impact that a well-elaborated strategy inflicted

in increasing IT modernization success rate while decreasing user disruption during the process (Hsieh, 2021).

Significance to Social Change

Technology upgrade had long been a burden for government organizations as it could directly impact the quality of relevant services and consumers. The results of this study closed this gap (Hsieh, 2021). A well-defined strategy could streamline the transition process from legacy systems to modernization systems through the minimization of the costly systems' upgrade failures. All state departments, including the Department of State and the Department of Health and Human Services, might benefit from this strategy. Systems upgrades improved the quality of services offered to citizens with implications on positive social change (Cardoso et al., 2018).

Summary and Transition

Chapter 1 highlighted the problem addressed by the research to the absence of defined strategies on how to transition state IT systems from legacy to modernization systems. The purpose, significance, nature, and background of the study were explored. This chapter also presented the research question as the driving element of the study. In addition, it confirmed the relationship between legacy systems and the higher cost(s) of IT maintenance and operation. The chapter also acknowledged modernization systems as a solution to reduce costs, improve security, and provide more flexibility to apply changes to IT systems. Finally, this chapter discussed the implications for social change that could result from a modernization environment. Chapter 2 contains the review of current literature related to the study.

Chapter 2: Literature Review

The specific problem was the absence of effective strategies to modernize IT legacy systems (Harris, 2019; Lindström et al., 2013; Powner, 2017). The purpose of this qualitative single case study was to explore effective IT modernization strategies for IT legacy systems' modernization. It needed to be understood that such modernizing strategies could turn out to be an inevitable option for federal and state governments to lower their IT costs while providing quality service(s) to their citizens (Khalifa, 2017). A holistic approach, including an overview of the IT system, was imperative to associate with identifying measurable goals (Situngkir & Napitupulu, 2019). Much of the literature in this area focused on the steps and schedules necessary to modernize IT systems. None of the researchers addressed the importance of a clearly defined strategy for organizations' IT system advancement (Charette, 2016). This study examined the roles played by state and agency leadership to address the literature gap as they all agreed on IT modernization as an unavoidable transformation process in the new IT environment dynamic.

Chapter 2 includes an overview of the literature search strategy, the conceptual framework, and a detailed overview of the IT modernization system's scholarly literature. Literature selection criteria includes seminal work regarding IT legacy systems modernization and the respective challenges and advantages in federal and state government. This literature review also includes the rationale for IT modernization at the state agencies' level. A brief history of the IT modernization system from the 1980s to

2020s introduces this discussion. The chapter begins with a description of the literature search strategy.

Literature Search Strategy

The databases that were used for gathering sources included *ABI/inform Complete, Sage Journals, Business Source Complete, ProQuest Dissertations and Theses,* and other journal sites, like *Elsevier*. The Google Scholar website was used to identify seminal works for guiding this research. All articles selected from Google Scholar were directly related to the history of IT modernization systems. A few references were collected from the Michigan Congressional Legislative Records and the White House Archives to understand the history of IT modernization from the perspectives of the state and federal governments.

The literature review also included IBM Technical Paper and Federal Agency Participation libraries. The searches conducted for the current study (related to IT modernization strategies and implementation in U.S. government organizations) resulted in multiple articles. This literature review also included sources to substantiate the choice of a single case study methodology for this research. As mentioned, this strategy helped in gathering and reviewing sources from academic researchers concerning IT modernization strategies.

The following list of key search terms helped in gathering relevant peer-reviewed journal research articles: *IT modernization, IT modernization strategy, IT modernization implementation, advantages of IT modernization, legacy system, legacy system challenges, IT cost, cybersecurity, IT modernization in state governments, single case*

study, and *actor-network theory*. Searching the National Archive's Presidential libraries helped in obtaining several dispositions, including executive orders, that have been put in place to increase IT security while reducing the IT cost across the government (through IT systems modernization processes; National Archives, 2016).

The ABI/Inform Complete and Business Source databases offered a large selection of articles in different fields of study and a half dozen features that helped in narrowing down the search to specific topics. The publication range was set between 2016 and 2021, whereby the peer-review was selected for all inquiries (independent of the keywords). A combination of IT modernization and legacy systems, IT cost, and IT budget terms helped in expanding nature of the search. Also, it narrowed down the 92 articles, 7% of which represented seminal works with historical context and the theoretical study framework. This search ended at the completion, submission, and approval of the research proposal.

Conceptual Framework

The modernization of IT systems from the legacy environment was an inherently complex topic of discussion in the United States' local and federal governments. The number of researchers who study IT system modernization helped in understanding the kind of attention this issue receives (Hsieh, 2021). In 1980, after evaluating the performance of legacy systems for 2 decades' worth of usage, the GAO report highlighted that the maintenance cost of aging computer systems was increasing significantly (GAO, 2016). The same report revealed a progressive limitation of legacy systems to increase IT productivity of a growing need in government operations. Despite

this warning, no known strategies had been implemented for the successful modernization of IT systems. This absence of a holistic approach resulted in a high number of IT modernization projects' failures. The United States Government Accountability Office (2016) reported hundreds of audits performed on failed government IT modernization during the last 3 decades.

The population in the United States was growing exponentially along with a multitude of Internet end-user devices present on the market, hence increasing the demand for applications and data protection from citizens (Charette, 2016). Within the current context characterized by increasing demand for services from the public and reducing IT budget, IT leadership and other government officials were looking for more cost-effective and secure systems. The theoretical foundation combining leadership efforts and technical resources used for this study was the actor-network theory (first mentioned in the literature by Latour in 2005).

Origin of The Actor-Network Theory

Latour's (2005) actor-network theory was built on Callon's (1986) and Law's (1992) concept of value-based chain theory and actor-network theory. Since then, multiple scholars and practitioners used this theory in IT research to highlight the correlation between human and nonhuman resources in a network. Shahin et al. (2014) argued that IT modernization projects and actor-network theory impacted financial performance, human capital, and labor. Other authors, such as Redman-Maclaren et al. (2014), defined actor-network theory as a bridge between the start of the IT modernization project and completion of the actor's training, the network, and the level

of commitment to the project's success. According to Littau (2016), actor-network theory demonstrated the dualism between subject and object in the current social sciences era. Using Latour's theory, the author highlighted humans' perpetual interaction with nonhumans to transform and build around us. In this relationship, neither human actors nor nonhuman actors own the exclusivity of the results. Instead, the network created by their relationship was the actant working to determine human and nonhuman roles. Latour's tendency to present humans as the center of all things was a challenge to humanism (Littau, 2016).

In actor-network theory, an actor is any human or nonhuman entity that can make its presence individually felt (Law, 1992) by the other actors. An actor is made up only of its interaction with other actors. Law and Callon (1988) noted that an actor consists of an association of heterogenous elements constituting a network. Callon (1986) argued that an actor could also be considered a black box at times, as we did not always need to see the details of the network of interactions inside it.

Actor-Network Literature and Research-Based Analysis

Understanding the relationship between all resources involved was informational. Multiple theories had been used to analyze and understand social and technological factors influencing IT project implementation success. Vaziri et al. (2020) revealed a lack of theory that combined all involved actors in the IT process. Actor-network theory appeared in studies as one of the theories with the potential of closing this gap by serving as a theoretical lens. According to Cavalheiro and Joia (2016), actor-network theory supported organizations and leaders to achieve mutually beneficial outcomes using

collaborative approaches. In their study related to e-government technology transfer in Brazil, the authors used actor-network theory to reveal the negotiation between all actors - human and technology - involved in the process. This study was conducted without considering the differences between people and objects (Callon, 1986). Iyamu and Mgudlwa (2018) made use of the actor-network theory as a theoretical framework to guide the transformation of big healthcare data from ontological to epistemological positions with the ultimate goal of improving patient care. The study also recognized the actor-network theory and how it aided in overcoming some challenges of healthcare big data analytics in technology, policy barriers, and practitioners. Actors identified in this healthcare research included patients, practitioners, facilities, and data. Throughout the study, Iyamu and Mgudlwa (2018) highlighted the actors' status change depending on their usefulness, purpose(s), and ability to make a difference.

Researchers used actor-network theory in non-IT studies as well. Dawson and Jons (2018) applied the actor-network theory as a supporting framework while discussing London's sports mega-event outcomes. Furthermore, the authors amalgamated the actor-network theory to legacy and leveraged theories to build a theoretical groundwork for understanding mega-events' outcomes better. Birke and Knierim (2020) used the actor-network theory's four moments of translation to demonstrate how technology and people came together to initiate the Agricultural Knowledge Centers and increase farmers' access to digital tools. The actor-network theory also helped in the identification of actors involved in the process and creation of a network that aligns interests among actors. Chinedu-Eze and Chinedu-Eze (2018) developed a framework around the actor-network

theory to elaborate on the small and medium enterprise involvement in Emerging Information and Immunization Technology (EICT). The authors expanded on human actors' notes, including managers, customers, government agencies, SMEs consultants, and nonhuman entities, like IT systems, on adopting an evolutionary and dynamic EICT in the enterprise. The common denominator in these articles was a list of human and nonhuman actors linked together in a network, wherein all subjects and objects had defined roles and interests.

Rationale Behind the Choice of Actor-Network Theory for This Study

The actor-network theory, also known as *the Sociology of Translation*, had been a popular approach in information system literature due to its conceptualization of technology as one of the actors in an actor-network analysis (Walsham & Sahay, 2006). According to Law (1992), the actor-network theory presents society as a socio-technical web, wherein technical objects participated in building heterogeneous networks to bring together actors of all types, whether human or nonhuman. Proponents of the theory argued that an organization network constructed with qualified human resources and IT systems in IT modernization positively leveraged performance (Yu et al., 2013). It was assumed that the modernization of legacy systems needed leadership to define strategic IT resources for the execution of the plan offered by the new IT platform. In short, the actor-network theory demonstrates that IT modernization implementation might not succeed if both social and natural sciences were not treated equally (Callon, 1986). According to Yoo et al. (2012), the actor-network theory offers researchers a powerful tool to analyze a technological artifact's development and usage as a socio-technological

process. The actor-network theory is highly applicable when different actors negotiate interests and gain influence in complex IT modernization systems (GAO, 2017).

Actor-Network Theory and Research Question

The actor-network theory related to the research question of this study in multiple aspects. According to Mendez et al. (2014), this theory could be used for communication, transparency, commitment, and trust to satisfy the relationship between organizations and their IT leaders, ultimately reducing IT modernization obstacles. As such, the actor-network theory constitutes a suitable approach to assist government agencies in adopting IT modernization strategies aligning with the technological shifts. Some authors argued that IT leaders should reconsider the importance of technology in a collaborative networking strategy that could positively influence the degree of success pertaining to IT modernization, thereby reducing cost and time. To achieve this goal, there was an urgent need for IT leaders to review their decision-making process and to include nonhuman actors in a well-decorated network to meet the organizational objectives (Mbohwa & Madanhire, 2016).

Using flexible techniques and management tools was necessary to build successful IT modernization systems. Studies showed that experienced IT leaders had a success rate of over 70% in executing IT modernization projects under budget (Losada et al., 2013). The actor-network theory facilitated the identification and comprehension of each actor’s point of interest in the network. By applying this approach, successful IT modernization systems helped reduce their implementation cost while decreasing overall

IT cost (Edison et al., 2018). As a result, the taxpayers' money was saved and there was considerable improvement in the IT services' quality of the government.

Literature Review

Various authors used qualitative, quantitative, and mixed-method approaches to explore IT modernization topics in the local, state, and federal governments. In doing so, researchers made multiple attempts to identify frameworks for the development of different theories in the IT field. In this literature review section, the focus was to identify and describe previous studies on IT modernization related to the constructs of interest with this topic, approach, research question, and scope.

History of Modernization

The term *modernization* in the present IT connotation was relatively new in the scholars' and practitioners' vocabulary. According to Eisenstadt (1966), modernization was characterized by 2 features: a type of change that could be structural differentiation, and a type of response to change defined by the capacity of institutions to absorb continually-damaging problems and demands. Other research associated modernization with increasing human control over its environment by constantly boosting economic and industrial development. To establish a basis from which the following literature review developed modernization in IT, I distinguished the 2 usages of this word (as mentioned above). Tipps (1973) argued that most modernization concepts fall into 2 categories: critical variables and dichotomies. Critical variables approached modernization more like a single type of social change, while dichotomous theories conceptualized modernization as a process, whereby traditional technologies acquired attributes of modernity (Tipps,

1973). IT modernization in this study was based on the dichotomy approach of modernization. The study defined IT modernization as the emigration of the information systems from the legacy environment (considered traditional) to a new IT environment (representing modernity) (GAO, 2016).

Overview of IT Modernization

Legacy applications had been a significant business problem for federal and state governments. According to Gholami et al. (2017), such applications implied a high IT ownership cost. Also, they required a unique legacy skillset that few people possessed. Another challenge was related to the modification of these applications to meet the ongoing business demands. For all such reasons, organizations from the public and private sectors progressively moved to new software technologies and architectures (Gholami et al., 2017). One way to accomplish this goal was to develop applications using recent languages that fully embrace new technologies. Although this approach allowed organizations to start and restart, it appears to be both expensive and risky. Charette (2016) argued that a growing number of organizations are choosing to modernize their existing infrastructure, software, and applications. Charette also highlighted the importance of basing the modernized system on an architecture built on open standards and deployed on open systems to benefit from the strategic business after modernization. According to Khalifa (2017), IT modernization could be defined as moving from something old to something new in the organization's IT environment. This process could go as far as changing the entire IT infrastructure. Păcurar (2017) argued that a successful IT modernization approach must include a holistic view across the entire

organization. The author mentioned the necessity to go beyond the traditional IT infrastructure to include facilities, processes operations, data center infrastructure, people, and geographic location (Păcurar, 2017). However, it was essential to first understand the connections between the legacy systems before engaging in any IT infrastructure change.

Challenges of Legacy Systems

Legacy systems presented multiple challenges in today's IT era characterized by a dynamic technological environment. According to GAO (2019), one of the most significant limitations of a legacy system was the government organizations' inability to stay synchronized and align with their goals. Although these systems helped maintain daily operations and processes, they restricted the state government from improving retention of IT costs due to the lack of flexibility and agility (Charette, 2016). Legacy infrastructure was highly likely to hinder the deployment of the needed applications or services, expose or induce risk through inconsistencies and lack of standards, and strain resources, people, and processes (Charette, 2016). Authors extensively evaluated several other technical challenges of legacy systems, thus emphasizing on the need to modernize the aging IT infrastructure.

A number of legacy applications and systems had been deployed long enough that they were about to enter periods of non-support (if they have not done so already) (Khanye et al., 2018). The knowledge needed to maintain such legacy applications was no longer imparted in the education system (Khanye et al., 2018). More than 30% of people possessing the skills were eligible to retire (GAO, 2016). Government regulations, such as Sarbanes-Oxley and Basel II, required that organization CIOs verified their

systems operate as they claim (GAO, 2016). To meet this requirement, some organizations used manual and efficient processes as they are unable to make any changes. Data center infrastructures were poorly estimated with limited access to size increment or reduction (Khanye et al., 2018). As a result, some data centers were capacity constrained, whereas others had a low utilization percentage. According to Tang et al. (2017), legacy servers in storage systems could not provide the same functionality and speed as offered by the modern systems. The author shared several benefits of modern storage systems, including the possibility to store a high volume of data, accessibility, and high level of data security (Tang et al., 2017).

Legacy systems implied high maintenance and operation costs. GAO (2016) shared that at least $61.2 billion was going to be spent on the operation and maintenance of IT infrastructure. Charette (2016) pointed out the rise in the operation and maintenance expenditure in federal and state organizations (from 68% in the fiscal year 2010 to 76% in the fiscal year 2017). This increase left less funding to these organizations to engage in any IT system modernization.

Pei Breivold (2020) revealed the challenges of adapting legacy systems to the context and service-oriented stream of the Internet of Things. According to the author, this limitation constituted a bias of the information system upgrade in some manufacturing industries. Pei Breivold categorized legacy challenges under three main groups: hardware, process control and supervision, and enterprise manufacturing execution. The Internet of Things, recently developed to provide intelligent business analytics, diagnostics' detection, and improvement of the performance at the device level,

were not compatible with legacy systems. Schulz (2015) recognized the presence of multiple hardware in the industrial environment that did not support the Internet-protocol communication. From the process control and supervision level, manufacturing companies are required to be agile and easily reconfigurable to adapt to new market needs. Legacy systems were static systems that could only be operated locally. This limitation explained their inadaptability to service-oriented control, connectivity to the cloud, and interoperability between heterogeneous systems (Pei Breivold, 2020). Lastly, the enterprise manufacturing execution level could not be implemented in legacy systems because the hardware and the process control were still set up following the traditional process. According to Alkhater et al. (2015), the entire manufacturing industry needed to be modernized for the future industrial system to be more efficient and adaptable to the new IT environment.

Systems' requirements were growing and changing to adapt to new demands. Madni and Sievers (2014) discussed the systems integration concept as an approach for organizations to rapidly adapt to the new IT environments. The authors revealed that the level of complexity increases considerably when the integration involved legacy systems (Madni & Sievers, 2014). This complexity increased even more after accumulating multiple modifications on the legacy system. According to Schulz (2015), one of the challenges of legacy system integration was the absence of system specifications. Without in-depth information on the system functionality and components, the risk of integration failure was significantly high.

In some cases, legacy system integration negatively impacted numerous essential business functionalities. Other challenges were noticeable when integrating legacy systems included an understanding of the original IT system development platform, identifying inputs and outputs, and most importantly, anticipating any malfunction resulting from changes. Junfeng et al. (2015) argued that the term *'legacy'* should not always have a negative connotation as these systems still provided business services to organizations in most cases. One of the most significant issues related to the legacy systems was the obsolescence that limits integration capability and upgrade (Funabiki et al., 2017).

Legacy systems offered some challenges to production lines upgrade in other industries as well. According to Flores-García et al. (2019), the implementation of discrete event simulation at the early stage caused multiple dysfunctions due to the obsolescence of legacy systems. Manufacturing companies needed to digitalize their production lines to increase flexibility and sustain productivity (Giffi et al., 2016). The ultimate approach was to build new production lines adapted to new technologies (Spring et al., 2017). The legacy production lines were phased out progressively as the team implemented the modernized manufacturing engineering systems.

Alexandrova and Rapanotti (2020) argued that legacy system replacement projects were becoming an essential proportion of IT projects in the digital government. The authors highlighted the limitation of existing business processes based on the technological limitation of the legacy systems. Funabiki et al. (2017) demonstrated that legacy technologies did not pose technical challenges to organizations alone. After

decades of usage, legacy systems became so ingrained in the organization's culture that they dictate the work processes and values. Kelly et al. (1999) recognized that such an exhaustive integration of legacy systems in the organizations posed a barrier to modernization characterized by the workforce resistance to technological changes. Potts et al. (1994) claimed that legacy systems were built around a government/bureaucratic environment and rigid legislature, thereby creating a complex structure that was difficult to disentangle business operation from the technology. Lloyd et al. (1999) recognized that the legacy system had locked-in, inefficient processes, hence causing a restriction on any changes that could improve the quality of services in different industries.

IT Modernization Opportunities and Benefits

The modernization of IT infrastructure from the legacy to new IT systems offered both business-related and technological benefits. Modernizing an IT infrastructure offered increased productivity, lower cost, and higher reliability and security (GAO, 2016). According to Otolo (2016), a well-designed and well-executed IT modernization program (synchronized across the enterprise) offered substantial business benefits. Siu (2019) stated that the federal and state governments must leverage service and technology innovations to provide better service to their citizens in ways that were both cost-effective and secure. Other authors highlighted that IT modernization helped organizations expand their capacity, make changes to meet future demands, and improve service quality and flexibility to reduce cost (Ebrahimi & Walsh, 2018). Automating a manual process and implementing new and diverse testing and scanning options could significantly change the users' daily operations. IT modernization program improved risk

management, thereby encouraging new processes, agility, and efficiency (Stroeva et al., 2019). According to Das et al. (2019), IT infrastructure modernization could unlock value through greater efficiency and improve performance by reimagining the business case and causing more effective task executions.

The decision to engage an organization in the IT modernization process could be challenging. Building a solid case that galvanized and aligned all stakeholders required to execute the change was essential for the IT leadership (Das et al., 2019). Siu (2019) identified seven areas that need organizations' focus, providing value in the short term. These areas include cost savings, modernization of the application portfolio, productivity improvement, security, IT stability, transparency and accountability, and faster speed of innovation.

Cost Savings

Federal and state governments had been facing some financial challenges for the past decade. As a result, IT budgets continued to be reduced, limiting IT leadership to the existing systems' maintenance and operation (GAO, 2016). In this financial stress, looking for sources of savings became imperative. Das et al. (2019) argued that consolidating organization data centers could result in a significant cost-saving source. However, this task could be extremely challenging. Some state governments did not have a transparent cost structure of their assets that are often spread across multiple locations. To address this challenge, the authors found some accounting practices based on assets inventories and per-unit cost (Das et al., 2018). Using these accounting approaches, federal and state governments' data centers could be refined into five categories: labor,

hardware, facilities, software, and infrastructure (Table 1). Tarnawska and Rosiek (2015) argued that the cost associated with this data storage could be significantly reduced by consolidating them in a single or couple of large enterprise data centers. Another approach was to migrate them to the cloud environment to manage needed spaces in a more flexible manner. This consolidation of the data centers could save up to 50% of the initial cost, although it requires time and effort (Stojanović, 2017).

Application Portfolio Transparency

The holistic approach implied by the IT modernization strategy required the innovation of the organization's implication portfolio. According to GAO (2019), public sectors often had a considerable number of data centers spread in multiple locations that served as a breeding ground for under-cemented applications. The application portfolios also include single-use and custom-built applications known for their high resource demand and potential security threat (Sorrentino et al., 2017). Through application rationalization, the data center's consolidation gave an opportunity to inventory and portfolio evaluation.

Stroeva et al. (2019) argued that 20-30% of applications offered the possibility of being phased out or consolidated to a *Software as a Service (SaaS)* solution during this process. Mingsiritham and Koraneekij (2020) recommended classifying applications into archetypes highlighting different configurations, maintenance requirements, and infrastructure. This categorization helped IT leadership decide what application needed transition to other infrastructure models (based on their unique descriptions). The rationalization of applications constituted a vital phase 2 estimate of the potential cost

savings and prepared the organization's portfolio for a successful modernization (Stroeva et al., 2019). Organization leadership and IT leaders agreed on this application definition, identifying stakeholders for each application and evaluating the time operating cost (Das et al., 2018).

Table 1

Categorization of the Public-Sector Datacenters Costs

	Share of total data-center cost	Description of cost categories	Actions for value capture
Labor	60-70%	• Performers of core infrastructure-maintenance activities (e.g., provisioning of new environments, incident management, change management)	• Reducing the number of roles • Repurposing resources for other functions
Software	12-25%	• Software license and maintenance contracts	• Reducing the number of licenses • Shifting to open source • Leveraging enterprise license agreements
Hardware	5-12%	• Server-and storage-refresh cost • Maintenance cost of hardware servicing	• Rightsizing the compute, memory, and storage needs • Timing the refresh cycle with migration to cloud
Facilities	5-10%	• Rent • Power • Building maintenance	• Terminating the lease • Repurposing the space or equipment
Infrastructure	5-10%	• Equipment • Network • Middleware	• Repurposing the space or equipment • Canceling any contracts or service agreements

Productivity Improvement

Improving customer satisfaction by offering more services in a timely manner remained the first goal of many organizations. Adopting agile principles at the organization level after the data center consolidation could significantly improve IT productivity (Vladimir & Nikita, 2018). Das et al. (2018) found that some private sector companies improved their productivity by adopting an agile operating model and automating their work up to 80%. Vijaya and Srinivasan (2020) maintained that reconciliation of servers and storage assists in automating some core IT tasks and involving cross-functional business teams as needed for complex activities.

State governments could also leverage the economies of scale provided by the IT modernization systems. New IT platforms offered the possibility to optimize staff distribution in such an environment to improve response times in production issues and lower system downtime (Vladimir & Nikita, 2018). The overall performance evaluation requires a baseline of the legacy system, including measurable targets that compared to the modernized system response time and quality (Charette, 2016). This comparative evaluation had demonstrated a tremendous positive change in private organizations after the modernization of their relevant IT system.

Security Enhancement

Maintaining the security of IT infrastructure and data was a primary challenge for many organizations today. Security threats were present throughout the lifecycle of IT systems identified in multiple forms. A recent study estimated the global impact of cybersecurity threats at $600 billion (GAO, 2019). Besides this financial evaluation, security threats included a range of impacts, like data loss and the decrease of system

availability (Lavric, 2019). Organizations were taking multiple actions to protect their IT network. Moving toward infrastructure modernization was one of the key steps that helped IT leaders evaluate security needs, balance risk with the cost, and take explicit actions to create a footprint that fits the organization and security needs (Lavric, 2019). The consolidation of data centers was an example of actions that enhance infrastructure security, both cyber and physical, by reducing the number of access points (Vijaya & Srinivasan, 2020). Das et al. (2018) admitted that a consolidation effort to add 1 federal agency reduced access points by 90%. With fewer access points to systems, it became easier to identify any intrusion and engage with the regular patching and system updates. Kim and Won (2020) demonstrated that these patches associated with the regular updates strengthened IT systems' security, reduced their vulnerability, and generated cost savings.

Improving Transparency and Accountability With the Modernization

The separation of IT entities and government agencies did not help place them at all mission centers. According to Charette (2016), this federated approach (appropriate to the legacy management concept) shadowed IT and increase the lack of accountability. The model also embedded IT in an inadequate organizational structure submitted to budget contracts that limit its actions. Despite a well-elaborated set of policies and standards, it was challenging to determine who had the ultimate responsibility for these several IT system safety and effectiveness (GAO, 2016).

The IT modernization governance model offered a different perspective for IT infrastructure within the organization. The centralized model oversight made out of a few

data centers and interfaces with cloud providers helped focus IT accountability on a limited number of senior leaders (Wu & Yun, 2018). Wu and Yun (2018) argued that this approach improved IT infrastructure management and offered more visibility to leadership for decision-making and future planning.

IT Performance Evaluation

Understanding IT infrastructure's performance had numerous benefits to both IT leadership and involved stakeholders in a given organization. Modernization came with the opportunity to offer IT performance metrics relevant to its service strategy and its overall goal and objectives (GAO, 2016). These metrics were captured using tools and government mechanisms to collect data needed to compare service operations performance and business needs (Hanyf & Silkan, 2020). According to Maatouk et al. (2020), service operation performance must be measured based on the value it delivers to each business unit, and not simply the achievement of technology uptime. Other authors admitted that relevant performance measurements also supported IT leadership target investments in areas that benefited the most (Hanyf & Silkan, 2020). This approach significantly increased the ROI while driving the service-level performance higher.

Farmers in the Botoșani county upgraded their farming processes from subsistence agriculture to industrial agriculture through the modernization of their work techniques (Cuciureanu, 2015). Initially characterized by manual equipment to labor and harvest, their local process was time-consuming and required a tremendous physical effort. Farmers' performance was based on their physical strength and the ability to work long hours. As a result, farmers' productivity decreased with time as they got older and

reduced their farms' sizes. The modernization of agriculture in this region helped in the development of new farming techniques based on modern equipment, amelioration of farmers' performance, and increase in productivity (Cuciureanu, 2015). Farmers were able to upgrade their living conditions, thereby resulting in their retirement extension. The high return on investment enabled them to increase profits and pay loans.

IT Modernization and Cybersecurity

The development of IT infrastructure technology and the increased volume of data communication between organizations necessitate improved security measures against cyber-attacks. GAO (2016) noted that cybersecurity was becoming a complex challenge in contemporary times, specifically to federal and local governments requiring multiple engagements and investment levels. Although cybersecurity was not a modern-day issue, it remained one of the biggest threats in the IT world, with a high number of data breaches on an annual basis. Berkowitz and Hahn (2003) highlighted research conducted in 1976 by Thomas Bruyne, a scientist for Boeing, at the early age of information security concerns. With the multiplication of data breaches in private and public sectors, citizens were invoking more information protection (Hagan, 2019). The current legacy system had demonstrated limitations to fulfill this need (GAO, 2016). Organizations' leadership was expecting IT modernization to be the ultimate approach for securing cyberspace.

Cybersecurity required a holistic view led by the federal government with active participation of both states and local governments. Given the international and interstate nature of cybercrimes, federal cybersecurity agencies were in charge of investigating

most cyber cases (National Cyber Strategy, 2018). Besides implementing a set of policies and activities to fight against cyber-attacks, upgrading IT infrastructure was recognized as a dynamic leadership decision to keep the relevant IT infrastructure safe and reliable (Department of Homeland Security, 2018). IT modernization assisted in this agenda by offering an agile and flexible environment capable of receiving regular security patches to protect IT systems (Christopher, 2020). Reducing the number of databases through the consolidation process could significantly reduce the number of cyberattacks by limiting the number of access points.

Osho and Onoja (2015) demonstrated that IT modernization increased cyber security risk in various aspects. In most cases, the authors noted, IT legacy systems were constructed as standalone IT systems with limited communication with external networks. This close communication loop resulted in fewer cyberattacks because old systems were barely visible from the outside world (Weber & Weber, 2020). Meanwhile, the world was going through a technological transformation with the modernization of IT infrastructures and the interconnectivity of software and hardware in a gigantesque network called *the Internet* (Osho & Onoja, 2015). This network allowed any criminal to misuse the system and intrude into any platform across the globe (Odumesi, 2014). Organizations were using the agility and flexibility of the modernized system to limit cybersecurity threats by upgrading and patching IT systems regularly (Li et al., 2021). This combination of regular patches on IT systems associated with policies developed around national cybersecurity strategies was the framework used by different organizations to address cyber security threats (Friend et al., 2020).

Data Sharing in IT Modernization

Government agencies stored a massive amount of data that often-needed quick access during online processing. IT infrastructure required database access computers faster than the old mainframes to keep up with this demand (Nurgalieva et al., 2020). Scalable and secure database machines delivered with a complete package of servers, storage, networking, and software in a new IT environment helped fill this gap (Basu & Guinchard, 2020). Consolidation facilitated data sharing among multiple applications and systems while improving their performance. Liu et al. (2016) recognized that newly manufactured servers delivered record-breaking performance while assisting leaderships with decision-making information and cost savings. Kim and Won (2020) further noted modern servers' ability to store vast volumes of data that were easily accessible; however, requiring high security levels. The Data Reference Model was one of the multiple approaches developed in government organizations to optimize data use.

The Data Reference Model composed an inventory of the federal government data and identified data that could be shared to fulfill agencies' mission requirements and business goals (Kwon & Jeong, 2018). At the State of Michigan, for instance, the same database was used at the Secretary of State offices to establish citizen driver licenses and identify organ donors (GAO, 2016). The Data Reference Model shaped a framework that facilitated a common language across the board, enabling conversations across government agencies, extending broader information, and sharing architecture. Implementing Data Reference Models added value to IT systems' data and architecture modernization. According to Kwon and Jeong (2018), this specific model assisted in

implementing repeatable processes, which were primary steps to enable data sharing between federal, state, and local agencies. The Data Reference Model supported standardization by imitating compatible requirements between agency data architectures to increase the existing data sharing structure (Awaysheh et al., 2020).

The Data Reference Model provided more results when associated with the Service Reference Model and the Technical Reference Model in the same architecture. Awaysheh et al. (2020) defined Service Reference Architecture as a business driver and functional framework that classified service components by business areas and performance objectives. The model identified IT investments and assets for each agency and the horizontal and vertical service components that supported each. The Service Reference Model also identified service capabilities that reused potential business components within government organizations (Awaysheh et al., 2020). Similarly, the Technical Reference Model was a component driver technical framework supporting and enabling service components and capabilities delivery under the standards and technologies categories (Kwon & Jeong, 2018). The model aligned government agencies' capital investments to available technical resources through a standardization process that increased inter-agency discovery, interoperability, and collaboration (Lim et al., 2018). Combining these models in the same IT infrastructure represented a more agile and modernized IT system, resulting in cost savings and flexibility.

IT Modernization Implementation Strategy

Presenting a solid business case was essential for IT modernization. However, a successful infrastructure modernization in government organizations required proper

execution (GAO, 2016). The report also noted that the complexity of the process and the higher number of stakeholders involved add significant risks to modernization programs. Other factors, including constant legislation changes, added another layer of risk to federal and state agencies (Yamashita, 2017). These factors explained costs' overviews and the multiple delays during IT projects execution, making them counterproductive in some cases. One way to mitigate these risks was to identify all the essential elements and build a rigorous plan to align them accordingly.

The selection of the right agency to start and identify the responses was one of the first steps. Wu and Yun (2018) argued that an IT modernization effort would not succeed if it did not have the leadership support at the highest level. To obtain this support, the project team should demonstrate to the Department Head how this modernization aligned with the organization's business value (Yamashita, 2017). The Department Head should also defend this proposal at the congressional and executive levels, obtaining their buy-in to facilitate the allocation of resources (GAO, 2016).

Building strategic relationships with key agency stockholders was critical for a successful IT modernization program. Stakeholders provided the support essential to harness talent and overcame or avoided risk throughout the project life cycle (Brook, 2020). Another aspect related to human resources was the constitution of the program team. IT modernization efforts required a multidisciplinary team with the appropriate technical expertise and soft skills (Singh et al., 2020). This group included developers, database administrators, infrastructure administrators, testers, and other professionals capable of building a solid network rapidly within the organization. Often, organizations

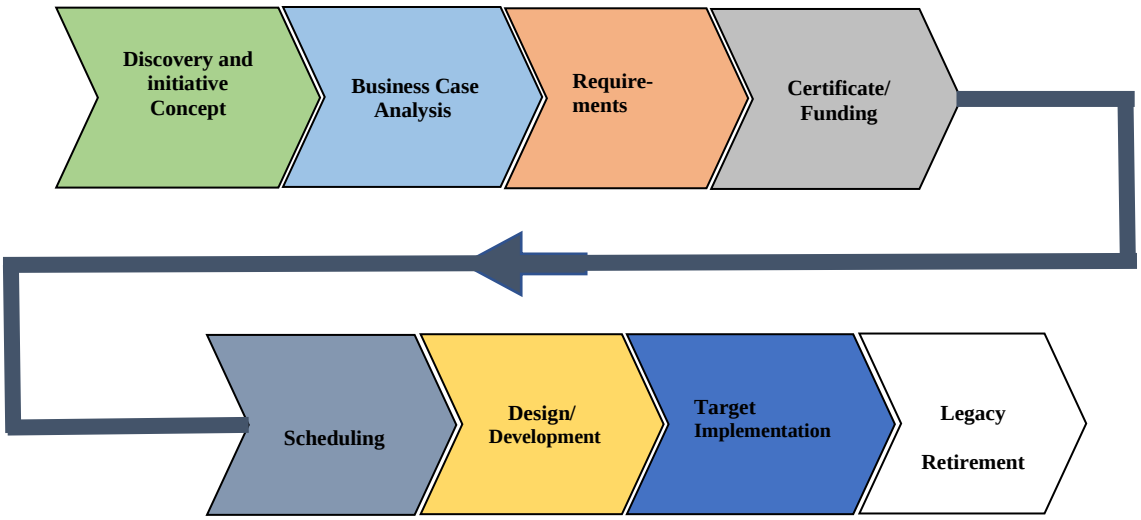
did not have all the resources available in-house. Yamashita (2017) admitted that federal or state employees had not handled some essential functions. Hence, it was in the agencies' best interest to source most of the work. The IT industry offered many experts who have accumulated credible experiences by going through the IT modernization process multiple times over the years. Some resources were expensive to acquire, but the ROI was very high in the end.

A successful IT modernization strategy included a straightforward step-by-step process with defined milestones and clear expectations from each phase. Brisset and West (2020) capitalized on past trials and errors to build the Reducing Legacy Systems (RLS), a methodology based on 8 phases (Figure 2). This process intended to provide a framework to modernize legacy systems successfully. The first step in this approach was the discovery and initiative concept phase, the principal objective was to familiarize with the legacy system. The business case analysis phase identified modernization options, compared them, and recommended the best option. Upon approval of the recommendations by the organization leadership, the team unfolded the work on the solution.

The business rules were carefully reviewed through the requirement phase; those not in alignment with the target solution were removed. The certification and funding phase covered the cost estimation for the approved requirements, confirmed the availability of funds, and secured them. The scheduling phase elaborated a plan to efficiently and effectively execute the remaining technical phases, including the design and development, the target implementation dates, and the legacy retirement

Figure 1

The Eight-Phase RLS Methodology



the decommissioning of the legacy system. According to Nathaniel (2019), following this process and including all actors at the early stage of IT modernization could increase the cost savings by 48% for the system modernization. Brisset and West (2020) identified some benefits of RLS, including elimination of duplicate capability and improvement in audit steadiness, interoperability, and cybersecurity.

Procurement

Procurement management was a crucial aspect to consider during IT modernization. For hosting solutions, agencies should consider both external and in-house options (Brook, 2020). The procurement team generally aligned its schedule and created a synergy that leveraged the modernization processes (Qu et al., 2020). Governments could take advantage of their size to negotiate customized applications at a fair price that fits the new environment's needs (GAO, 2016). Applying this concept to

Microsoft products included some additional features that reduced work during and after the modernization. The Contracting Officer should work closely with the project team to ensure that the respective purchases met the requirements (Mahendrawathi et al., 2017). According to Saxena and McDonagh (2020), the procurement team should adopt avatars around defined outcomes instead of time and material. Defined outcomes contract put more pressure on the vendor to deliver according to the requirements. On the other hand, time and material put more pressure on the buyer running to have the job done on time to avoid over cost (Saxena & McDonagh, 2020).

Communication

Elaborating on good communication was also critical for IT modernization strategies with a large number of stakeholders. GAO (2016) demonstrated that more than 60% of IT modernization projects in federal and state governments failed due to the lack of communication. Both bottom-up and top-down communication approaches were regularly considered between employees, customers, and political influencers (Hershock, 2017). The agency involved in the IT modernization process used all means of communication available, such as newsletters, emails, town halls, media, and in some cases, individual conversations (GAO, 2016). Good communication created transparency between stakeholders during the lifecycle of the project. Communication also helped the project team to require additional funding as the need arises (Hackett et al., 2020).

IT Modernization in Public Sector

IT modernization process in federal and state governments was challenging, especially when it came to public sectors. Following IT project's best practices and

taking the appropriate steps helped address some issues (GAO, 2016). First, it was essential to identify and regroup all key players and ensure that the agency's aspirations and values were understood. In addition, creating a set of requirements to help achieve the organizations' goals and objectives through modernization was equally important. It was also essential to determine the expectation, financially or non-financially, such as increased system agility and documents theory (Yamashita, 2017). Building a solid business case around the modernization program helped convince all stakeholders during the project life cycle. Lastly, collecting as much data as possible to build an infrastructure inventory of data centers, servers, applications with their respective descriptions was critical. According to Das (2018), these tactical first steps built a momentum for the IT modernization journey ahead.

IT modernization came with a technological and cultural transformation in public and private organizations. Brook (2020) demonstrated the positive impact of IT modernization on the European Union (EU) Law Enforcement. The author explained how IT modernization systems helped the EU move from traditional centralized notifications to a decentralized self-assessment regime. Ovidiu and Mihoreanu (2014) shared how traffic policy changes were easily communicated to citizens after implementing modernized systems. New EU policies were published online for citizens' consultation; traffic violation fines were paid instantly using credit cards followed by an email receipt sent to users. The previous legacy system did not offer any of the mentioned options despite considerable effort to integrate new functionalities.

Hussain and Mozumder (2018) discussed the need to modernize public libraries in the Issam state. The authors described multiple advantages that IT modernization offers to public libraries in this state, including the interconnection of libraries in a network. Creating such networks associated with the hardware upgrade offered more reading materials to the public in a better, dynamic environment (Hussain & Mozumder, 2018). Matoria et al. (2007) argued that the modernization of public libraries created a database of books and other reading materials, allowed sharing of individual library materials with others, and helped in creating a shared-experience platform among the library staff. The main idea was to use modernization systems to develop local library content with information resources centers.

IT Transformation Models

IT modernization had been implemented in a range of industries, thereby resulting in the identification of the best methodologies. Avedillo et al. (2015) highlighted 2 approaches: the *Two-Speed Approach* and the *Greenfield Approach* as effective methods for successfully transforming IT architecture. Both approaches had specific requirements. Their selection depended on the level of risk that the agency was willing to take during the process and the level of maturity and resources available (Jeannot, 2019; Pehrsson, 2020). Both models were discussed in the following paragraphs to highlight the conditions under which their application was valuable to guarantee IT modernization success (Jeannot, 2019; Pehrsson, 2020). Although Two-Speed and Greenfield models were subtly different, they accomplish the same goal, i.e., transforming organization IT systems while executing daily operations safely.

The Two-Speed Approach

The Two-Speed Approach was characterized by developing multiple fast interactions and launches of customer-facing, front-end applications (Jeannot, 2019). Meanwhile, the back-end systems handled all transactions, whereby the records' keeping remained unchanged. This approach allowed organizations to prioritize a few dedicated teams handling customer-facing applications for their transformation and quick product deliverance to their users (Farias & Widmer, 2018). While these users enjoyed the applications, the background work, including planning in designing the enterprise act architecture, took place (Cowley et al., 2018). The end goal of this process was to align both the front-end and back-end with the organization's strategic and operational needs.

A single case study demonstrated the effectiveness of this technique by highlighting how it improved the account opening process of a European bank. While remaining on the existing architecture, IT leadership created a new team which was then assigned to a prototype of an account registration process using a concurrent design technique (Farias & Widmer, 2018). After a successful development phase, the team deployed the codes in production, tested them with real-life data, and adjusted the application to meet the requirements to cut the registration steps from 15 to 5 (Avedillo et al., 2015). The new application allowed customers to open an account using a mobile device in only 5 minutes. These changes resulted in a deduction of waiting lines in the bank branch office and less filing of application paperwork (Avedillo et al., 2015).

One of the most significant risks during the IT modernization process was the continuation of offering services to users during the process (GAO, 2016). The Two-

Speed Model, characterized by the phased approach, helped mitigate these risks by allowing time to address any back-end challenges, including the data migration (Jeannot, 2019). Avedillo et al. (2015) recognized that it was complicated to operate a hybrid architecture with a combination of transactional platforms and other systems optimized for customer satisfaction. Some young developers could not fix legacy systems linked to new front-end interfaces in case of defects in the production environment.

The Two-Speed Approach required some discipline during the execution. According to Avedillo et al. (2015), this unique approach was critical to progressively connect individual improvement to the rest of old systems to check for stability and prevent the entire IT system from collapsing. Other authors highlighted organizations' tendency to focus more on the users front when they neglected the modernization of their core IT systems (Jeannot, 2019). As a result, multiple patches were put in place to connect both the old back-end and a newly developed front-end. In the long run, this practice became difficult to maintain and unprofitable. Customers enjoyed the new interface and what it offered, while IT teams were going above and beyond to maintain the inner system.

One way to avoid the migration of the back-end delay was to set clear milestones for IT systems transformation at the beginning of the project. Chernova et al. (2018) argued that a lack of investment strategy and a comprehensive plan could catch up with companies in a change cycle with no end. Business and IT teams must agree on what applications to change, their sequences, avoid moving too fast, and not compromising the entire organization's IT architecture. Developing multiple FastTrack tasks could easily

result in chaos (Weber & Weber, 2020). In conclusion, the Two-Speed approach appears less risky. However, it required more coordination between IT teams, businesses, and users to define the execution speed and the connection between systems.

The Greenfield Approach

In contrast to the two-speed IT modernization characterized by multiple steps, the Greenfield Approach consisted of replacing the core legacy IT systems at once. Pehrsson (2020) admitted that this approach was designed for organizations requiring a total transformation to include functionalities that legacy systems could not support. The current system was redeveloped from scratch using new languages and platforms (Lechowicz et al., 2019). Both back-end and front-end were developed at the same time. The team used existing systems' requirements as a baseline and works with the business. In fact, it used them to define the new environment features. This coordination between stakeholders explained the long lead time of this approach (Lechowicz et al., 2019).

Companies had multiple options to implement the Greenfield Approach. The build-from-scratch option gives the IT department several opportunities to choose the best hardware and software products available in the industry and integrate them accordingly (Kaddoura et al., 2019). One of the critical steps of such choices was to evaluate the software package adaptability to the Internet infrastructure system. According to Pepper et al. (2016), IT systems' sustainability and alignment with the business and customer needs require redesigned software and end-to-end delivery process, following common IT standards and best practices.

Before utilizing the Greenfield approach, organizations should conduct an in-depth evaluation of the resources available for the process. Pepper et al. (2016) shared that initial investment with this approach ranged from $50-300 million depending on the scope of work and the organization's scale. This IT investment size required legislative and executive support necessary to sustain financial commitments with vendors over multiple years (GAO, 2016). Leadership support and engagement depended on how the project was elaborated and presented. Yamashita (2017) argued that leadership buy-in and involvement during the project life cycle often depended on understanding the project objectives and impacts on the end user. Besides the financial aspect, human resources appeared to be another area requiring leadership attention during the preparation. GAO (2016) pointed out that federal and state organizations did not always have adequate resources and skills to run the modernization process from beginning to conclusion. The report further mentioned that these organizations needed to emphasize new training and coaching opportunities to speed up the process (GAO, 2016). Lastly, there was an urgent need for government organizations to hire IT professionals possessing skillsets that allowed them to fill any human resources gap in their relevant departments and proceed with IT modernization plans.

IT Modernization and Cloud Computing

The migration of legacy systems to the cloud was a means to innovate IT infrastructure well and support new functionalities. According to Khanye et al. (2018), cloud computing helped organizations address socio-technical changes, economic complications, as well as security and privacy issues. This concept gave the same

advantages as the classic IT modernization. Hence, it could be considered as such. Cloud computers offered the possibility to change users' demands and build a reliable and redundant system with an additional security layer (Manuel Maqueira et al., 2019). For several decades, the Michigan Department of Technology Management and Budget used mainframe computers to store critical applications and bulk data processing for different state agencies. Until a decade ago, these mainframe computers were not interconnected; they were physically located in different places across the country. This architecture did not facilitate information sharing and data synchronization from different sources (Yiyang et al., 2020). As a result, some users' status discrepancies were found depending on the server connected to the network. Cloud computing helped to consolidate all data centers into 1 source of truth, while turning data into knowledge for the citizens (Software AG, 2015). Other authors recognized that shifting to a cloud environment illuminated the challenges of running multiple physical data centers by moving the burden of this effort to a third party (Bardoliwalla & Rajan, 2019). Manuel Maqueira et al. (2019) admitted that despite addressing the storage aspect of cloud computing, manning software from operating systems through the lifecycle remained a challenge.

Cloud computers offered another possibility to assist public sectors with solution-sharing. GAO (2019) asserted that the number of IT solutions in federal and state governments was growing despite the complexity, high implementation cost, and production risks due to the large-scale IT systems in these sectors. In many cases, government organizations faced similar service needs. The cloud platform allowed

sharing numerous, if not all, solutions among federal and state governments, thereby saving time and limiting development costs (Mrozek, 2020).

The migration of legacy systems to the cloud, however, presented some significant challenges. Khanye et al. (2018) considered that data migration was a complex process that could be both time-consuming and expensive. In some cases, there was a significant difference between legacy and the new environment data configuration, making the data conversion an additional step in the process. According to Pavelka et al. (2019), data conversion was a critical step during the legacy data migration that configured old data (from several decades) to a format acceptable by the new IT environment. Building scripts to accomplish this goal required time and patience as they often need several adjustments before deployment.

Visualization and IT Modernization

The concept of virtualization could be defined as the process of abstracting and pooling resources. Virtualization essentially separated IT resources from the hardware that had originally provided them (Huvila, 2021). It enhances server consolidation strategies by enabling a framework, wherein resources could be allocated on an *as-needed* basis (Ali et al., 2019). According to Huvila (2021), decoupling the physical resources resulted in a dynamic modular architecture with more flexibility in multiple options to supply and demand IT resources. Using this concept, Fairfax County in Virginia reduced its physical servers from 512 to 8, resulting in a significant saving on electricity bills and reduction in operations and maintenance costs (Han et al., 2020). This

consolidation required a complex migration of data, applications, resources, and services throughout the project (Huvila, 2021).

IT Modernization Model of Development

For the last several decades, media used modernization as a means for the transmission of information and education to the general public. Melkote (2018) argued that information sharing impacted the lives of millions of people across the globe every single day. IT modernization in media positivity changed the way people communicate while speeding up information sharing. In telephony, for instance, the landline phone systems were progressively replaced by the Internet protocol-capable phone systems handling a high amount of data besides the voice. Portable phones were becoming smarter with more functionalities and high data capacity storage from pictures to documents. The creation of the web and the modernization of computer systems allowed for more research on the Internet, increased data sharing, and efficient email communication platforms.

The modernization of the communication infrastructure illustrated the integration of IT in communication software and hardware. (Kivikuru, 2017) demonstrated that the communication systems had improved significantly in performance, quality, and reliability from the receiver to the emitter. Aruna and Mohan (2020) argued that the migration from physical data storage to the cloud increased the amount of data shared among individuals and organizations while reducing the costs. The maintenance of communication infrastructures was considerably improved in the modernized environment. Przhedetskaya and Borzenko (2019) highlighted that the modernization of

communication infrastructures offered multiple options for diagnosis and repair in case of failure. Consequently, systems became more reliable with a minimum downtime period and an increase in their life cycle (Kivikuru, 2017).

Scholars and practitioners recognized IT modernization as an instrument to develop low-income minority groups in communities. Liu et al. (2016) maintained that a comprehensive IT modernization system, including educational and communication infrastructures innovation, exposed low-income minority groups in China to information susceptible to change their lifestyle. IT modernization offered reliable systems with easier access and lower costs. Xiao et al. (2013) mentioned that IT modernization was becoming a development trend in different communities. These authors encouraged local organizations to speed up the implementation of IT modernization while encouraging their citizens to use information in an efficient manner. Modern Science became a significant factor in integrating urban and rural communities with shared experience susceptible to creating new innovative ideas in both groups (Liu et al., 2016).

Chen et al. (2020) discussed IT modernization in intelligent transportation systems in the urban environment. The flexibility offered by IT modernization platforms reflected endless opportunities to innovate in the urban transportation industry (Li et al., 2021). Using high-definition cameras installed on highways and across cities, vehicles were identified with their plate numbers and sent to a database that provides information concerning the vehicle and its owner. This concept was currently used to replace tolls stations in multiple cities with high-cost savings. Vehicles no longer stopped to pay toll fees before proceeding towards their destinations.

Organization Governance Implication to IT Modernization

IT modernization efforts should be managed as an agency-wide initiative. There were several decisions before and during the lifecycle of the progress that inflicted significant impacts on both the business and the end-users. For this reason, one of the critical successes of IT modernization was the level of commitment and engagement demonstrated by business leaders and senior management towards the IT change process (Castel & Friedberg, 2010). Sharing the transformation plan with the leadership and setting expectations from each entity involved was critical for the project team. Discussions related to human and financial resources were needed for the project's success and the timeframe and any other potential disruption of operational functionalities during the migration (Li et al., 2017).

The business should review its long-term vision and plan to identify any potential changes in the production of services that could affect IT architecture (Jibai, 2018). Lastly, management was transparent while presenting its strategy to IT. Similarly, the IT team considered all aspects of this strategy while planning the new infrastructure (Li et al., 2017). This collaboration resulted in an architecture built in a new environment that met and exceeded the evolving business needs.

Putting a clear and acceptable timeline in place that was approved by all stakeholders (including the customers) was extremely important. For example, the leadership set the time to freeze legacy investments for the allocation of more resources to IT modernization projects (De Haes et al., 2017). Maintaining the same level of work on the legacy system significantly increased IT costs and eventually slowed down the

modernization process. According to Kude et al. (2018), maintaining good discipline throughout the modernization process helped the organization, as a whole, to focus on the IT transformation process while limiting unexpected changes and cost increases.

Organization leadership implied an understanding of limited support offered to legacy systems to dedicate the best IT resources to the modernization project. Li et al. (2017) claimed that some organizations failed into the trap of assigning available resources, yet with no required business and IT skills, to modernization projects. One of the consequences of this approach was to miss the collection of the critical requirements during the initiation phase that often extended the implementation timeline (Castel & Friedberg, 2010). Experienced IT professionals came late on board during the project lifecycle and then redid part of the work. In some cases, they reviewed the entire program. For time and cost savings, modernization projects should be staffed from the start with the best IT developers, architects, database administrators, and project managers available in the house. The same concept applied to the selection of vendors. Li et al. demonstrated that IT providers' understanding of the organization goals and mission could determine the IT modernization success. As IT governance selected vendors, it was essential to look at the proposed offer and consider the latter's experience and trustworthiness when making the decision.

Modernizing IT infrastructures from legacy systems resulted in an organizational change that needed leadership support. According to Hansen and Norup (2017), organizations needed to train their existing workforce to operate within the new environment. This training should be expanded to the end-users and all other stakeholders

that were directly or indirectly affected by the change. Modernized IT platforms often required the agile approach to develop and make any changes in the system, contrary to the legacy's waterfall approach. Some organizations hired agile coaches to bring their IT teams up to speed while using contractors with agile experience to execute the ongoing/current projects. Leadership should address the emotional change resulting from IT modernization. Changes, both negative and positive, within an organization could be challenging to tackle. Leadership communication at the top level affected the impact on the team positively (Hansen & Norup, 2017). Another approach was to lead by example. Some department heads were involved in IT modernization from the initial phase as they participate in the user-acceptance testing; for instance, creating a safe atmosphere for both IT teams (developing the products) and the users.

Assessment of IT Modernization Systems Failure

The United States government had undoubtedly spent billions of dollars to modernize IT systems in the recent years. However, this modernization came with multiple challenges, such as multiple delays of delivery dates, exceeding project costs, and missing the functionalities expected in the beginning (GAO, 2016). The State of Michigan alone failed to implement a few IT modernization projects initiated early in the 2000s. According to GAO (2016), the Department of Veterans Affairs (VA) had experienced three unsuccessful attempts to modernize three critical applications: *VistA*, *the Family Caregiver Program*, and the *VBMS*. While engaging the VistA modernization project, the department's goal was to illuminate approximately 130 different systems used by its staff (GAO, 2016). After almost 2 decades, the new system was deployed for

about $11 billion in estimated development and deployment costs, even though several areas needed additional functionalities (GAO, 2016).

The GAO (2016) highlighted some critical causes of IT modernization failure as well as several initiatives government organizations were taking to address these implementation failures. The GAO associated IT modernization project failures to three recurring themes; the lack of adequate IT modernization strategy, the absence of discipline to the process, and the lack of human resource management. The absence of leadership implications to address these three areas often resulted in modernization programs, whereby they missed their timeline, targeted cost, and performance objectives (Khalifa, 2017). Challenges related to discipline processes included the project scope, elaboration of a testing plan, data conversion strategy, the risk, and project management.

Human resource management challenges included the selection of an experienced workforce to execute the transformation process from start to end and change management throughout the organization (Hussain & Mozumder, 2018). Other areas impacting IT modernization success included the existence of a well-structured communication plan. According to Păcurar (2017), the lack of communication was one of the major causes of IT modernization failures. Communication was vertical to and from the organization's leadership and horizontal among the project team members. There were some activities identified as time-consuming that significantly impacted project completion when not handled well. Yamashita (2017) noted that developers went through several loops in some government organizations to clarify a few functionality requirements for a given application change. The author also highlighted the time needed

for an architect to set up a new server or the availability of business resources to complete user acceptance testing (an essential phase of the project life cycle).

IT Modernization Negative Impact on Healthcare

When implemented with no clear strategy, IT modernization negatively affected some organizations. Clark and Thompson (2015) demonstrated how an informal partial implementation of IT modernization created conflict among different groups in a hospital workforce. The National Health Service IT modernization initiative was introduced in an internal department of labor design for graduate nurses who used technological tools in their daily tasks frequently (Mason & Araujo, 2021). As a result of this new system, nurses were able to progressively move from the floor to perform administrative and supervisory roles on their computers. The direct consequence of this change was that the physical contact with patients became the sole responsibility of healthcare assistants (Clark & Thompson, 2015). Health care assistants became overloaded with the direct consequences of decreasing the quality of care offered to patients.

The absence of communication and inclusion of all stakeholders during the National Health Service IT modernization explained the discordance noticed after its implementation at the hospital. According to Collins (2004), one of the significant NHS IT modernization objectives was increasing communication among the hospital workforce groups limited by an obsolete IT legacy system. Instead, the program was contested after its implementation by the healthcare assistants and created a controversial working environment at the hospital (Clark & Thompson, 2015). This hostile work climate suggested that IT modernization was a process that needed multiple human and

technology considerations from start to the implementation process. Incomplete requirements or missing stakeholders could unfortunately result in an organization that was challenged by conflicting groups, less productivity, and loss of employees and customers (Mukunthan & Radha, 2017)

The modernization of IT systems in Taiwan's hospitals changed the nursing care services by creating an additional specialty. According to Lee (2017), integrating IT in almost all health care processes, from diagnosis to cure, required specialized personnel to assist users. The informatics nurse specialists' team was to fulfill this role. This group of users was heavily trained in nursing and IT to handle communication, data analysis, problem-solving, training, and system analysis (Lee, 2017). Their in-depth knowledge of IT and nursing was an advantage to rapidly understand nurses' needs and address them efficiently using technology tools. Hospitals in Taiwan benefiting from informatics nurse specialists' services testified to the value that they brought in their institution (Lee, 2017). Informatics nurse specialists assisted during the implementation of IT modernization by participating in all steps during this process and providing necessary training on the new infrastructure system (Junfeng et al., 2015)

Literature Review Related to the Research Question

This literature review highlighted the principal reasons behind the need for organizations to modernize their IT infrastructures, the analysis of several IT modernization approaches, and the factors contributing to IT transformation failure. The literature review organization in the section primarily highlighted government organization challenges and identified some strategic approaches. The review of multiple

prior studies revealed the legacy systems' limitations, including the high maintenance and operation costs and security risks, in today's advanced technological era. Meanwhile, many authors demonstrated the willingness of several government agencies to engage in the IT modernization process. However, this resulted in failure for a number of reasons. According to Wu and Yun (2018), one of the most common causes of IT modernization was the apparent problem of technical failure, including issues related to data migration and other application transfers, from the legacy system to the new environment. Coiera (2019) claimed that IT modernization failure was not only a technology problem, but a failure of human resources and organizational planning. Studies demonstrated the necessity to start this process with experienced IT professionals. The third reason for failure, in fact the most prominent one, was the absence of a holistic leadership strategy with a clear path to steer the IT transformation process. Ebad (2018) emphasized on the difference between managing regular IT projects and leading an IT modernization program in government agencies. The literature review revealed a repeated pattern of legacy system threats.

GAO (2016) identified some key systems built with technology older than three decades currently used in the government for critical functions. The body of literature was significant on three security threats of such systems: vulnerability to data breaches, maintenance and operation costs, and the lack of resources along with the knowledge of old technologies. As a whole, IT modernization programs became the priority of any government agency – federal, state, and local organizations. However, there was no strategy in place for holistic coordination of IT modernization between different

government agencies (GAO, 2016). As a result, IT modernization programs were often unsuccessful as ad hoc agencies engaged in the process without an accurate evaluation of the needed resources and timeline, hence, solely relying on their in-house capabilities to manage IT projects.

IT modernization programs provided multiple advantages to organizations when implemented properly. The literature review identifies several possibilities offered by modernized systems to help reduce IT costs while increasing security (Hu et al., 2020). The flexibility of modernized systems created an agile environment capable of adapting to multiple platforms to meet customer needs (Ennis-Cole et al., 2018). With the rapid technological advancement and the increased demand of users for more applications, IT modernization was becoming necessary for government organizations.

The literature review demonstrated that following the IT program management best practices associated with the actor-network theory were the first steps for success. According to Dawson and Jons (2018), actor-network theory associates human resources and technology in a network, thus resulting in a combination of efforts necessary for IT modernization program success. Following this concept, the review discussed some technical approaches used in the IT industry proven to be efficient (depending on the availability of resources and the level of risk that the team was willing to take).

Siu (2019) demonstrated that the lack of a strategic plan was associated with the absence of leadership implications on the IT modernization process. The literature review on strategic alignment between the project team, the leadership, and the business suggested each team’s implication at the highest level and a thorough examination of the

objectives' alignment to the organization's goals. The literature review exhibited how precise alignment between the new infrastructure environment's advantages and the business strategy helped in obtaining the leadership buy-in necessary for active participation during the project life cycle.

Gaps in the Current Literature

The literature review demonstrated that the modernization of legacy IT infrastructure in government organizations was an urgent need across all levels, from federal to state and local entities (GAO, 2016). An exciting body of research existed on potential risks related to the use of old systems in this era of advanced technology, along with other disadvantages (Khanye et al., 2018). Other studies identified numerous reasons behind the modernization failure in the federal agencies. However, a gap existed in literature to explore the lack of IT modernization strategy as a leadership problem.

Although a broad range of studies highlighted IT modernization best practices, there was a gap in the literature representing the absence of a well-elaborated IT modernization strategy as one of the main causes of failure. In most cases, agencies managed IT modernization projects like any other application development project. This approach explained the lack of holistic view necessary for the IT transformation process's leadership implication from the initiation phase throughout the process life cycle (Khanye et al., 2018). Understanding IT modernization challenges from all aspects was vital to avoid future failures that ultimately cause high financial stress in some state agencies (GAO, 2019). The Department of Health and Human Services (MDHHS) was such an agency that experienced IT modernization failure in the past. Nevertheless, it was

currently planning to reattempt the implementation of a modernized IT system. Choosing MDHHS for this study was important considering that it was the largest department in the State of Michigan. As such, the agency possesses the most prominent IT infrastructure systems. Besides, the department had a well-structured IT leadership team built around the IT governance executive. Also, well-elaborated project management and approval processes were in place. Identifying and planning a good IT modernization process helped IT leadership, the IT tech team, and a business area interact in a more agile environment. Each partner recognized its role and was committed to fulfilling it. Therefore, it was necessary to conduct research on IT modernization strategy in MDHHS to highlight the understanding of their IT team when it came to the IT modernization process and the alignment between all stakeholders and technical aspects.

Summary and Conclusion

The literature review revealed lessons learned from multiple IT modernization failures and how a critical understanding of the causes could help IT specialists evolve and mature the IT transformation process in the coming years. Despite several empirical research on the failure rates in US government organizations, the focus on the absence of a strategic approach was limited (GAO, 2016). The literature review emphasized on the need for research to identify IT modernization strategies suitable for successful infrastructure systems' upgrade from the legacy to the new IT environment. The IT systems in the government organizations appeared to be complex due to their sensitivities, security requirements, and government regulations. Therefore, a holistic approach was imperative to guide the leadership's implications at the highest level. The

literature review also revealed a lack of study focusing on the maturity of the team supervising IT modernization and the tacit knowledge of IT transformation approaches.

To conclude, further research could help in understanding how the elaboration of a clear IT modernization strategy helped government organizations successfully aligned all resources and technical tools available to increase IT modernization success rates in their agencies. The literature review indicated that IT leadership faces multiple challenges in modernizing IT infrastructures - quickly and cost-effectively. Actor-network theory served as the theoretical foundation for examining the success and failure of IT modernization process for the current research. Therefore, it provided new perspectives to the leadership to manage resources, processes, and people by using a complex environment network. Hence, Chapter 3 included the research methodology used in this study.

Chapter 3: Research Method

The purpose of this qualitative single case study was to explore effective IT modernization strategies to modernize IT legacy systems. This chapter describes the research design, rationale for qualitative single case study, the role of the researcher, the selection of the research methodology, the participant selection logic, instrumentation, the procedures for recruitment of participants and data collection, the data analysis plan, trustworthiness, the study's credibility, transferability, dependability, and confirmability, and a summary of the main points.

Research Design and Rationale

Developing a holistic strategy approach for implementing IT modernization programs in U.S. government organizations was challenging because of the disparities in size and goals (Gunawong & GAO, 2017). The increased IT cost lost due to IT modernization failure made leadership think about giving another chance to this process as it was becoming a burden in various ways. Previous studies have focused more on the technical reason for these failures; not addressing the lack of collaboration between IT teams and businesses during the lifecycle of the program around a network of commitment and participation (Gunawong & GAO, 2017).

Identifying a strategy and sharing it with all partners involved in the IT program could significantly improve the modernization of IT systems. This qualitative case study could lead to the identification of best practices and advantages of IT modernization. The research question asked, *"How do organizations create effective strategies to modernize IT legacy systems?"* The selection of a qualitative single case study as the research design

helped to answer the research question. According to Alam (2020), researchers use the qualitative method to expand the understanding of the case studied. May et al. (2021) recognized qualitative research's capacity to provide an in-depth description of the situation studied.

The qualitative method was appropriate for the purpose of this research to understand how organizations created effective strategies to modernize their IT legacy systems. A qualitative method gives the opportunity to collect data about a human group in its natural setting, analyze the data collected, identify and extract participants' perspectives, and interpret the results (Alam, 2020). A quantitative approach tests the relationships among variables with a focus on numeric data. Koulinas et al. (2019) explained that the quantitative method does not help to fully understand the participant's experience and knowledge about the research question. A mixed-methods research design combines qualitative and quantitative approaches, either sequentially or concurrently, in the same study (Yin, 2018). The quantitative approach did not align with this study's purpose. Therefore, a mixed-methods design was not suitable.

According to Yin (2018), the qualitative research design has five categories: *grounded theory, ethnography, case study, phenomenology,* and *narrative*. Each of these designs was used in a particular context. Grounded theory helps generate theories, ethnography describes people's cultural characteristics, phenomenological design is used to study human lived experiences, and narrative design helps examine individuals' life stories and experiences. Grounded theory was not appropriate for this study because this approach does not recognize the researcher's involvement and role during the data

collection and processing, leading to case understanding (Dwyer & Walsh, 2020). Ethnographic design was not an appropriate approach either because I did not intend to describe people's cultural characteristics (Chee et al., 2021).

Similarly, phenomenology did not align because the study was designed to reveal the participants' feelings and the knowledge of their lived experiences (Conway & Elphinstone, 2017). The narrative design, on the other hand, focuses on examining individual or small groups and their personalized stories (Lindsay & Schwind, 2016). Again, it was not the purpose of this study. Baran and Jones (2016) demonstrated that a case study helps to explore processes, activities, events, or programs, and individuals. Yin (2018) argued that a case study represents an in-depth investigation of a real-life context current event. The case study design included different tools that helped researchers identify and preserve critical material of real-life events.

The single case study helped conduct in-depth research of a single department with the largest and oldest IT infrastructure in the state of Michigan (Gallo et al., 2020). The selection of this research design enabled the understanding of real-life IT modernization strategies for IT legacy systems. Hence, the single case study design appeared to be an appropriate and practical approach to understanding the IT modernization challenges of the state department in the natural life context (Gaveikaite et al., 2020). A total of 13 participants, including IT leaders, IT project team members, and IT users, were purposefully selected to participate in this study. One of the selection criteria was the participants' previous experience(s) and current knowledge about IT modernization programs in government organizations.

Role of the Researcher

One of the particularities of qualitative research is the consideration of the researcher as a tool used to complete the study (Suominen et al., 2021). I clearly defined my role in the research to increase the credibility of the qualitative research (Haven & Van Grootel, 2019). This study used the single case study approach as espoused by Dwyer and Walsh (2020). It was essential to acknowledge that worldview influences researchers' perception through their views and experiences.

There were multiple essential functions that I needed to fulfill to complete this study, including participant, observer, interviewer, investigation, writer, and data analyst (Haven & Van Grootel, 2019). My responsibilities in this study were to develop the interview questions, document review maturity, select the population, and sample the research participants. All mentioned roles thus demand bias management to the greatest extent, especially during the data collection and interpretation phase. The first step in this process was a thorough review of the interview questions and document matrix to ensure their relevance to the study while ensuring none led the participants' answers (Gobo, 2015).

Another consideration for the study to be valid was the accuracy of data collected and interpreted by the research. Denzin and Lincoln (2011) argued that the researcher is the custodian of data collection and analysis in qualitative research methodology. Whittemore et al. (2001) emphasized the necessity to establish concise and clear data validity criteria for qualitative research. One of the duties of the researcher in such a case is to strive for data credibility, authenticity, criticality, and integrity throughout the study.

These authors argued about the necessity to disclose the researcher's relationship with the topic and the research environment (Whittemore et al., 2001).

My experience with the state of Michigan includes my engagement in IT project management. I worked for several years in state agencies, managing various projects from application to infrastructure. Later, I moved to the position of IT resource management, where the job responsibilities included supervising a team of project managers and overseeing their daily operations. MDHHS's current agency IT department size was significant and divided into groups. This study population came from a group of colleagues that do not directly work with me. This targeted selection was essential to avoid bias and conflict of interest. As an IT professional, it was crucial to take great care of how the interviews with peers were handled, letting them express their knowledge, ideas, and feelings without influence.

Following the research methodology while observing rules and requirements could benefit the researcher. According to Suominen et al. (2021), researchers should generally conduct a single case study in a mutualistic state. Although this approach came with risks and benefits, it also required honest reflection and engagement on the case studied. This approach contributed to increasing the study level of integrity and validity.

Methodology

The research question prompting this study implied and expressed the use of single case qualitative research methodology (Haven & Van Grootel, 2019). After selecting participants, the next step was to use the open-ended interview method to collect the qualitative data utilizing an interview questionnaire (see Appendix C). The

document review matrix helped examine documentation shared by the agency IT teams (relevant to the study). This combination of data collection aimed to explore any source that could help increase the participant level of understanding on the impact of a well-elaborated IT strategy on IT modernization (Yin, 2018). All data collected were then coded into different themes and analyzed outputs to respond to the research question.

Participant Selection Logic

The study participants came from different IT departments in the state of Michigan, including IT technicians, IT leadership, customers, procurement, and legislative. The common denominator of all these participants was their experience with past IT modernization programs implemented within the state of Michigan. Selecting the state of Michigan as the research location was because of its ambitious use of IT systems to ameliorate the quality of services to its citizens (GAO, 2016). According to Pozzar et al. (2020), the quality of research data is often based on the selection of both the location and the research participants. There were three sample groups of interest for this research. The first sample regrouped participants with at least 5 years' experience in IT modernization programs as core project team members. This group included project managers, developers, architects, testers, and database administrators constituting the technical team executing the work.

The second sample was represented by people often considered as leadership staff, including the project sponsors, the department head, the procurement team, and the finance. These individuals were the decision-makers. Although this group of individuals did not participate in the daily operation, they made decisions. As such, they approved

the program budget, validated the resource assignment, and made other significant decisions throughout the IT modernization program life cycle. The last sample was individuals representing customers, project owners, and users of the system being modernized. They were part of the program decision team, providing requirements and assisting with user acceptance testing. This group also communicated with the citizens impacted by IT modernization changes to collect feedback and share expectations. The ultimate selection criteria were the need that the research participants have experience using elaborated strategies during the initiation and planning phase to improve IT modernization program success rates while facilitating the process quality and performance. A purposeful sample approach helped to predefine a group of participants to respond to the research study (Demirok et al., 2019). Mthuli et al. (2021) argued that no rules regulate the sample size in qualitative inquiry. The author agreed that a sample of 13 is a suitable average number of participants needed for a qualitative study (Mthuli et al., 2021).

To date, most qualitative single case study literature had used in-depth individual interviews with 2 to 12 participants (Marshall & Rossman, 2010). However, best practices are required to continue to sample until the data become redundant or until the responses from interviewees yield no new information (Bryman, 2012; Morse, 2007). Following this approach, interviewing the research participants, collecting data, using the review matrix document, and continuing until reaching data saturation were considered (Falqueto et al., 2018).

After identifying the sample groups, the professional relationship of the state employees and I facilitated the introduction to potential participants and helped know if they were willing to assist with the study. Saunders et al. (2015) recognized that novice researchers often experience challenges in establishing their first contact with research participants who are reluctant to give an interview. Using my professional contacts helped to resolve this problem. Out of the initial list of 28 potential participants, approximatively 13 were selected, thereby ensuring that all groups defined in the study sample size were represented.

The first contact with participants was *individual* through an introductory phone call, followed by an invitation email (see Appendix A), including an outline of (a) the purpose of the research study; (b) a statement of the confidentiality of the participants' answers; (c) a statement on the voluntary study nature; and (d) contact information. The participants were given 2 weeks to respond with their interest as interviewees in the study via email, by replying with "*I consent*". Each interview was recorded with 2 electronic recording devices: one as a primary device (laptop), and second as a backup device (Cellphone). This recording allowed participants to listen to their thoughts after the interview and make necessary corrections. Having this option increased the research participants' level of confidence in the interview process. I also took notes on paper as an additional backup in case of an issue with the recording process. The Zoom conference platform also offered the backup option during virtual interviews.

All materials, electronic copies, transcripts, notes were stored in a secure password-protected database for 5 years (Zhang & Wang, 2021). Maintaining clear and

concise communication with the study participants about the interview process helped address any concerns before scheduling the interviews. According to Yin (2018), detailing the interview process in advance increases participants' confidence and encourages them to share their thoughts freely. This communication included information about the date and time for the virtual interview, the type of application for video calls, and the expected duration of the discussions. I communicated the need to have a quiet environment with little or no background noise to avoid distractions.

Instrumentation

Qualitative researchers have multiple data collection tools at their disposal to assist them in finding answers to their research questions. Yin (2018) identified several qualitative research collection methods, such as focus groups, observations, individual interviews, and action research for data gathering. An open-ended interview guided by a series of questions was the primary data collection instrument to gather data from the targeted participants. Given their overloaded schedule, most of the research participants did not have enough time to meet multiple times. In such a case, the open-ended interview was adequate, as it saved time and allowed me to conduct separate interviews with multiple candidates in a relatively short amount of time (Cristina, 2016; Saunders et al., 2015).

One of the first steps was to create the interview questions (Appendix A) and the document to organize and classify data collected. Despite the existence of few interview questionnaires found in the literature, developing a new set of questions specific to this study and aligning with the case explored in the research was necessary. The pilot

approach helped test and validate the efficacy of the interview questionnaire (see Appendix C) before using it with participants (Castillo-Montoya, 2016). This study did not include the pilot phase. Rather, the first interviewee's answers allowed for revisiting the formulation of some questions for alignment as well as their style for an easy understanding.

Any effort that concurred with ameliorating the quality of the qualitative research data increases the credibility (Yin, 2018). Verifying the alignment of the research question by using the interview framework to assist with the constitution of a survey-based conversation was necessary. Also, provision of feedback on the interview protocol and piloting the interview were important. This interview protocol helped me to understand participants' experiences and described those experiences and their meaning (Rubin & Rubin, 2005). For a permanent alignment check, this interview protocol helped me during the data collection process and increased the data collected.

The member-checking technique and the triangulation were other tools to strengthen the quality of data collected from the research participants (Saunders et al., 2015; Treharne & Riggs, 2014; Yin, 2018). Iivari (2018) shared some advantages offered by the member checking technique, including improvement of the data accuracy. Further, Saunders et al. (2015) recognized member checking as a practical approach to enhance data validity, credibility, accuracy, and transferability of the research. Under this technique, participants reviewed and edited their interview transcripts for validation before analysis.

The document review allowed organization and classification of data collected from multiple sources, thus easing the analysis process. IT transformation programs' documentation appeared in multiple forms. Keeling et al. (2021) shared some advantages of this document review matrix providing a concise analysis of multiple documents based on my selected criteria. The matrix was organized to collect information by title, abstract, keywords, author, date of publication, database, eligibility to research, and exclusion reason. Multiple matrixes were necessary to draw the article phase selection to ensure a thorough analysis of resources while excluding any records that did not meet the eligibility criteria (Keeling et al., 2021). The document review matrix assisted with the interview transcripts analysis and classification as well.

The qualitative research approach sought to conduct an in-depth analysis of a given case study by gathering multiple sources of related information. To achieve this goal, Cristina (2016) advised avoiding asking interview questions that might result in calculated or fixed answers; instead, it was recommended to engage participants in a conversation that allowed them to answer questions using their own words. Interview questions with obvious or fixed answers do not allow participants to express their actual views on the topic. Follow-up questions were necessary to get the best out of the interviewee and direct the conversation towards specific evidence (Cristina, 2016).

Over the years, the interview technique for qualitative research had been improved and redefined multiple times to transform it into a smooth process for both interviewers and interviewees. Lodico et al. (2010) defined an interview as a purposeful conversation between two or more people, where the participants have the opportunity to

express their thoughts on a particular topic in their own words. Wahyuni (2012) argued that open-ended interview techniques helped participants to share their views while answering open-ended questions. For this study, an interview was conducted with each participant from the department leadership, IT technical teams, and customers within the Health and Human Services (HHS) agency at the State of Michigan. This series of 13 separate interviews were conducted on a one-on-one basis to allow participants to share their views in a safe environment. The goal of this exercise was to reach the data saturation on the IT modernization strategies in government organizations (Falqueto et al., 2018). According to Falqueto et al. (2018), research interviews reached saturation when the interviewer starts receiving redundant answers with no new information or value-added on the previous responses.

The expectation from the series of 12 open-ended questions developed for this research was to acquire at least 7 to engage participants throughout the conversation. According to Hanson et al. (2011), only 4-6 open-ended questions often result in effective instruction and detail during the research interview. After selecting participants, the next step was to contact each one by phone to plan the interview date and time considering their availability. Another critical decision was to confirm the interview was held virtual (via Zoom) not in-person. Next, I sent a confirmation email, including a copy of the interview questionnaire (see Appendix C) to interviewees, to review before the interview date. This email included the remainder of the interview process, the timing, schedule of one-on-one conversation with no compensation, the appointment date, time, and virtual communication tool. I started the conversation on the interview day by

reading the informed consent form. After the introduction, the first questions were to know more about the participant background to open the interview, followed by the first research question, then the next, until the last open-ended question on the list.

Data triangulation was required for this study due to the use of the single case study approach. Internal and external artifacts from multiple libraries and online resources related to IT modernization programs corroborated to add more sources to the interview data. According to Singleton et al. (2010), five primary data sources were available for research: public documents, personal and private documents, mass media, non-verbal sources, and archival sources. For this study, using publicly available data from the state website ensured the credibility of their source to avoid going through multiple layers of authorization that was often required to access confidential documents. Singleton et al. (2010) recognized that publicly available data were the most credible sources of information in different fields of study. During the interview, some participants shared public documents on IT modernization to support their views.

Procedures for Recruitment, Participation, and Data Collection

These research participants were recruited from DTMB, and MDHHS IT teams and IT leadership based on their past and current experience with the IT systems modernization program of the department. The selection of IT specialist participants was based on their hands-on involvement in the modernization process and experiences from past IT transformation efforts in the agency. These participants helped to analyze the single case study from the applicability perspective. Next, using the organization chart available in the public domain, I identified and selected some participants from the IT

leadership department considering their decision-making role and a few users with a good understanding of organization's mission and objectives. Creating a roster using a purposive sampling strategy and including 13 participants was the last step of recruitment.

The first contact with the participants was by phone, even though email served as the primary communication method from the follow-up moving forward. Later, a follow-up with the first invitation email (see Appendix A) was conducted a couple of weeks after the mail to participants with no responses. Depending on the number of participants willing to participate in the study, I determined the need to expand the number of preselected research participants, while emphasizing the participation conditions. Informing potential participants of the absolute protection of their confidentiality and privacy during the study helped many candidates to make up their minds with positive answers. Any potential participant received a verbal and written notice clarifying that they could withdraw from the study at any time without penalty. Finally, all potential participants were informed of the ethical protection if they decided to exit the study before the publication.

The first step of the interview preparation was to schedule the date, time, and Zoom link for each participant (who accepts to be part of the training). The date and time were based on participants' availability. Some participants preferred to meet after regular business hours or on weekends to avoid distractions. As far as the location was concerned, all interviews were conducted via video call (using the Zoom application) from home or office spaces (due to the pandemic restrictions/lockdowns). Sharing the

informed consent form with each participant before the beginning of the interview was a non-negotiable step. Next, I clearly explained the purpose of the study and the importance of participation in the study. The interviewees were reminded of the use of recorder device to gather data from the conversations. The data were further transcribed to a document review and open-ended interview tools for analysis. At this stage, I reassured the participants about the opportunity to review the interview transcripts at the end of the interview to make any corrections (as needed). During this process, I sent a request to the Walden University Internal Review Bord (IRB) for approval to conduct the research before any data collection.

The data collection phase started with the first scheduled interviews. In the beginning, each participant received an assigned code to eliminate identifiable private information (Office for Human Research Protections, 2016). Each interviewee sent an email with the informed consent confirmation and receive a copy of the interview protocol. I then proceeded with the interview after ensuring that the participants were comfortable and ready to answer the interview questions. Participants received a copy of the interview transcript within a week to verify accuracy and completeness. Each interviewee had 2 weeks to review the transcript and make any adjustments before the data were considered ready for coding and analysis. Any non-response after this time frame was considered as the validation of the transcript. This assumption was shared with the participants as part of the interview process awareness.

According to Yin (2018), four data collection groups including interviews, observations, documents, and physical materials. I collected data for this study using the

open-ended interviews approach and a document review technique. Lodico et al. (2010) defined the interview process as a purposeful conversation between two or more individuals during which interviewees share their thoughts on a particular topic in their words. This research interview protocol began by thanking the participants for their time and inputs in the study. The interview structure, including topics and different questions, guided the interviewee while reminding them once again that their responses were voluntary. Part of my role was to reassure the participants of the confidentiality of their responses and remove any identifying information from the study results.

The first set of questions served as an ice breaker, asking interviewees' background, current responsibilities, roles, and experience in IT modernization. These questions allowed participants to share a brief synopsis of their knowledge and responsibilities in the current position. Next, I asked participants about the most significant issues concerning IT technicians, IT leadership, and business. The last question in this opening section was regarding the evaluation of the participant's level of understanding of IT modernization programs - from both strategic and technical perspectives. When time permitted, the interviewee had the opportunity to incorporate any additional comments into the discussions.

The following section included aspects specifically designed to cover this study's research question related to the US government organizations' IT modernization strategies. To ensure data saturation, I collected additional information from documentation, such as press releases, books, reports, and any publicly available

information related to the study. This data collection and analysis process was represented in the figure.

I asked questions in the order listed on the interview questionnaire (see Appendix B) that has been previously developed and tested. The guiding interview questions created to ask the 12 open-ended interview questions was used as a reference during this process. Each conversation was recorded using 2 digital recorders, with 1 as a backup. I expressed my gratitude to each participant at the end of the interview for participating in this academic research. At the end of the process, informing the interviewees of the data storage and destruction policies was essential. All recorded data were stored in an encrypted external device and saved in a secure location for 5 years before discarding it. I used the member checking approach to confirm the participants' responses and scheduled follow-up interviews (as necessary) to collect missing data from participants. NVivo application helped to analyze the data collected.

The purpose of conducting interviews during research was to answer the research question stated in Chapter 1. The open-ended interviews supported by a series of open-ended interview questions created flexibility to collect in-depth perspectives concerning the research question (Oltmann, 2016). The research question identified to explore this single case study is, *"How do organizations create effective strategies to modernize IT legacy systems at the State of Michigan?"*

The series of open-ended interview questions (see Appendix B) to support this data collection are as follows:

1. What strategies does your organization deploy to manage IT modernization programs?
2. As an IT professional, what is your role in IT modernization programs planning and execution in your organization?
3. What strategies has your organization used to manage IT modernization programs?
4. How has your organization addressed the challenges related to the modernization of legacy IT systems?
5. Who are the key stakeholders involved in your organization's IT modernization programs? How do they fit in the process?
6. What do you think about the communication among stakeholders during the IT modernization program's life cycle?
7. As an IT professional, how do you evaluate IT modernization strategy's effectiveness and success?
8. What do you think an organization like yours can benefit from elaborating concise and shared IT modernization strategies?
9. In your opinion, what are some specific actions that should be taken to encourage the identification and implications of IT modernization strategies?
10. What are some challenges related to your relationship with other stakeholders involved in the IT modernization program?

11. Elaborate about your IT workforce and some challenges of finding human resources with experience and skills needed for IT modernization program strategy?
12. What else do you think is critical to your organization's IT modernization process strategies?

These interview questions followed Qu and Dumay's (2011) framework that outlined the best open-ended questions for a successful interview process. The authors also defined open-ended interviews as systematically asking questions guided by the case studied (Qu & Dumay, 2011). Similarly, Kvale (1996) adopted a typology of questions providing an overview of the interview question, purpose, and sample questions. An example of the Kvale qualitative interview guide was demonstrated below (see Table 2).

Data Analysis Plan

Qualitative data analysis encompassed qualitative researchers' processes to make sense of the data collected (Gajbe et al., 2021). However, Saunders et al. (2015) asserted the importance for the researcher to use the appropriate data analysis technique and to apply it effectively. According to Liem (2018), it was necessary for me to segment data into smaller values corresponding to each research question. This procedure required an in-depth review of interview notes and transcripts to identify the categories and themes.

The qualitative single case study used required the data analysis to remain as close to data as possible. I maintained the data source triangulation methodology used during the data collection by utilizing the analytical data triangulation to enhance the research problem understanding (Denzin, 2017; Yin, 2018). Gajbe et al. (2021) defined

Table 2

Qualitative Interview Guide

Type of question	Purpose	Example
Introduction	To initiate the beginning of the interview	What is your definition of interoperability between disaster response agencies during a major emergency?
Direct questions	To collect data from participant	How would you describe interoperability failure between disaster response agencies during a major crisis?
Specifying questions	To develop more precise descriptions from general statements	Describe your professional experience with social media mobile analytics and cloud computing technologies?
Indirect questions	To pose projective questions	Briefly, describe your organization's standard operating procedures for sharing information with external disaster response agencies during a major emergency?
Follow-up questions	To direct questioning to what has just been said	What is your opinion of disaster response organizations using social media mobile analytics and cloud computing technologies to collaborate with disaster victims during a major disaster?
Probing questions	To draw out complete narratives	Could you provide an example of how social media mobile analytics and cloud computing technologies could positively impact the quality and effectiveness of emergency management during major disasters?

Silence	Allow the participants' time to reflect and contribute important information.	N/A

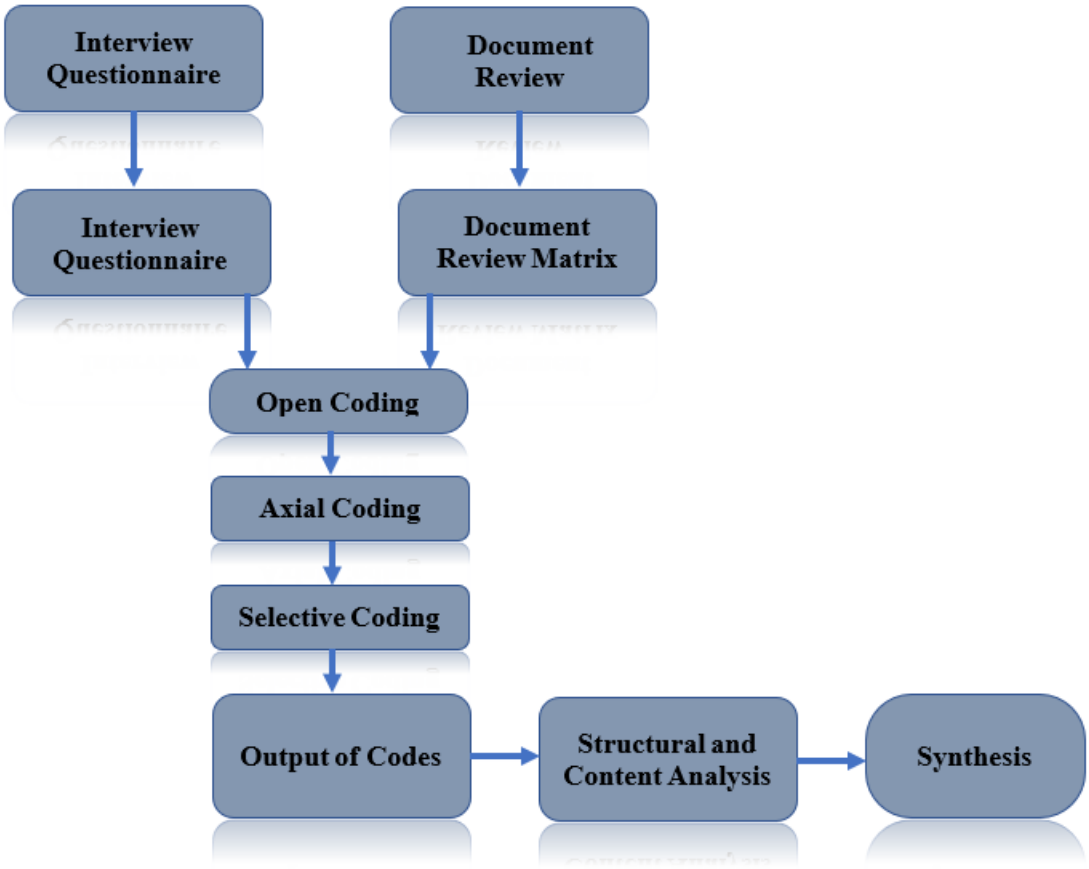
analytical data triangulation as a means to analyze multiple data sources through an approach that explored and integrated the participants' perspectives and experiences as well as the information collected from journals, books, and other media.

The qualitative data analysis process has multiple nonlinear and intersecting phases depending on the methodological approach (Gajbe et al., 2021). The current single case study included data organization and management, writing and representation, and immersive engagement. Through data organization and management, I developed a strategic plan by naming and labeling all data sources, developing a rationale for using transcripts, and engaging in data proceeding (Sottile et al., 2021). Also, immense engagement involved data readings and strategy analysis, including coding, connecting strategies, and dialogic engagement (Denzin, 2017). Lastly, the data were visually represented under the writing and presentation phase (Sottile et al., 2021). The following graph illustrated the interconnection of the three-pronged data analysis process. Qualitative Researchers used four steps to conduct their data analysis, including transcription, organization, coding, and validation (Denzin, 2017; Marshall & Rossman, 2010).

Following this process, I transcribed the data collected during the interview and sent it to each participant for review before engaging in each step. In addition to the analysis and coding of the data collected during the study, the data from the first 2

Figure 2

Qualitative Data Collection and Analysis Process



interviews were processed at first to identify any emerging patterns or information that needed to be recalibrated in the remaining set of interviews. This process required extra effort. However, it has immense worth as it allowed the interviewer to adjust the interview questioning to cover the research questions thoroughly. At the end of the data transcript phase, the digital recordings from the interview were converted into electronic transcripts. Temi.com served as a useful tool to transcribe this research data into Word format. Later, they were organized and analyzed using qualitative research software called NVivo.

Tugun et al. (2020) maintained that qualitative researchers have multiple deductive approaches for their research data analytic. I used the pattern-matching technique to analyze the research results. According to Yin (2018), pattern-matching was the most suitable deductive approach for single case studies. The author further highlighted that this technique did not involve statistical tests. Instead, it helps to compare the value gathered during the case study to the pre-established benchmark (Yin, 2018). The matching-pattern technique identified the patterns in the research data and compared them against the empirical-based pattern from the literature to predicted values set before the data collection (Almutairi et al., 2014). A similarity between the research data and the empirical or predicted patterns helped to enhance the study's internal validity (Gibbert et al., 2008).

Pattern-matching required the elaboration and identification of empirical theories intended to be tested during the research before the beginning of the data collection. Almutairi et al. (2014) noted that these theories could contain multiple variables. This preliminary phase helped to prepare the comparison of the patterns after the data collection and to guarantee the credibility of the research results. Yin (2018) highlighted the necessity to have at least two differentiated theories during the case study data collection and analysis with the pattern-matching approach. Murphy and Ensher (2008) used this approach to investigate and compare the leadership of some senior managers against the Charismatic Leadership Theory.

Saldana (2015) recommended the utilization of software for data patterns' analysis and identification in place of the manual process. For instance, *Atlas.ti* offers a

systematic coding process that linked the study topics and ideas while helping to visualize and understand the data collected better (Atlas.ti, n.d.). Computer software enhanced data accuracy and the findings of key themes and patterns necessary for the data comparison in the matching process.

Issues of Trustworthiness

Qualitative researchers should act according to the set standards, including credibility, transferability, dependability, and confirmability. According to O'Kane et al. (2021), trustworthiness accurately described how to evaluate and validate the object nature of qualitative designs within a single case studied. Jones and Donmoyer (2021) reasoned that, qualitative researchers should develop validity approaches aligning with the research goals and questions as well as the contexts of their studies. There were 2 aspects of validity in qualitative research: internal validity and external validity, respectively known as audibility and transferability (Yin, 2018). They constituted the first criteria of the study validity.

Credibility

Credibility represented the qualitative researcher's ability to manage all the complexities encountered during the study and to be able to deal with patterns not easy to explain (Guba, 1984). Also known as internal validity, credibility relied on the research design and a meaningful choice of research instruments that lead to the acquirement of high-quality data. This data validity criterion fulfillment passed by combining several data collection methods, primary being the interview followed by the documentation review. Both methods helped to achieve data saturation. In addition, implementing a

series of validity strategies established and reinforced credibility. First, triangulation helped to reach data saturation by using multiple means of data collection. Next, having the participants reviewing the transcript of their interview with the possibility to make corrections and additions ensured that each one provided as much information as possible concerning their views on IT modernization in their organizations. Lastly, peer review consultation and feedback analysis were an essential process to identify any bias and misalignment. O'Kane et al. (2021) believed that qualitative researchers should advocate for bias neutrality for a credible study and acknowledge any potential bias through the reflection.

Transferability

Transferability, also known as external validity, represented the second strategy to ensure the study's trustworthiness. Transferability represented how qualitative study results could be transferable or applicable to a broader context while maintaining their context richness (Jones & Donmoyer, 2021). In some cases, however, the reduced sample size required for qualitative research did not allow researchers using this research method to conclude with a large population. Myers (2013) recognized that failure to transfer qualitative research results to a large population was considered a detainment.

To ensure the transferability of this study, I recruited participants from different backgrounds and levels within the IT department as well as non-IT staff. The goal was to gather a broader view of the interviewees' perspectives on the single case study (Denzin & Lincoln, 2011). The technical team participants shared their thoughts as the people executing decisions on the ground and leading the IT modernization efforts on a daily

basis. In addition, participants from the leadership oriented their thoughts on a holistic view of the IT modernization programs from the decision-makers' perspective. Lastly, users focused on the impact of these programs on their daily operations and align with their mission and objectives. This multiplicity helped collect and analyze data leading to research results applicable to other agencies. However, more studies needed to be conducted for thorough validation.

Dependability

Dependability, the third validity criterion, referred to the stability of the research data. According to Heystek and Terhoven (2015), qualitative studies are considered dependable if their results are consistent and stable over time. Dependability entailed a reasoning argument for the data collection method and the alignment between the data collected and the argument. (Shufutinsky, 2020). The multiple approaches concept helped to address the validity of this study. The interview questionnaire (see Appendix B) format was built and tested to answer the research questions of this qualitative single case study. The triangulation approach helped ensure the collection of any information missed during the interviews or provide complementary data. Lastly, the audit trails strategy verified the data collection plan alignment to answer the research questions.

Confirmability

Confirmability was the validity criterion that focuses on the qualitative researcher bias impact on the research findings. Shufutinsky (2020) identified the goal of confirmability as the process of acknowledging and exploring the ways that qualitative researchers' biases impact their interpretation of data. In this context, O'Kane et al.

(2021) recognized that bias could follow the researchers during the interview process. To mitigate bias during this study, 1 approach was to review the interview questionnaire (see Appendix B) multiple times while leaving enough room for the participants to share their thoughts rather than being affected by my opinions. The computer software was ideal for this data organization and analysis. The implementation of triangulation strategies and external audits also helped achieve the confirmability of the study (Yin, 2018). Addressing bias during a qualitative study was critical because researchers using this approach were considered the primary instrument of the study (O'Kane et al., 2021). Hence, I allowed a few academic peers to challenge the study by providing feedback on bias notice during any research stages.

Ethical Procedures

This study was conducted under the IRB rules and regulations required for qualitative research using open-ended interviews and archival data collection methods. One of the critical steps of this research was sending a request to the IRB to ask permission to proceed with the research and not start any data collection until granted. Next, I followed all ethical procedures required by IRB and APA while gaining access to participants and collecting information from archival documents. The documents and other media sources were open to the public (with no authorization) to access them. As a courtesy, I informed the authors of each document and the IT leadership department of using them as a source in the study. Removing the department and any individuals' names from the documents was part of this ethical view.

The recruitment process of the interview participants followed the IRB procedure (as described on the application form). I identified the prospective participants and capture their names and contact information on a list. The next step was calling each participant to verify their willingness to participate in the research. An initial invitation email (see Appendix A) following the phone call included an outline of the study purpose to indicate that their participation was voluntary and not paid. After receiving the participants' responses, a confirmation email followed to each participant who decided to participate. This email also informed about the condition of withdrawal from the study at any time or skip any questions that seems inconvenient or uncomfortable to answer without penalty. My brief introduction along with his academic credentials increased participants' confidence levels. The subsequent correspondence included the Informed Consent Form and the interview arrangement (including location and date). I assigned a code to each participant for confidentiality. All participants' data were coded, saved in a secure format, and stored in a secure location. A few days before the interview, I sent the interview protocol for familiarization.

On the day of virtual interview via Zoom, I reminded each participant about their identities' protection and signing a confidentiality agreement. The names and contact information of the participants were treated with the same level of confidentiality as the data collected. As such, their personal information did not appear anywhere in the study results. The interview questionnaire (see Appendix B) started with collecting participant demographic information, including gender, education, job title, and responsibility in their organization and the number of years in the IT industry (Liem, 2018). During the

interview, the interaction ensured that the interviewees express their thoughts and answer questions freely. A ‘Thank You’ email was sent to each participant to express gratitude for their time and contributions and to inform about the time to receive a copy of the transcripts for review.

All recorded data and other documents collected were stored on a password-protected computer. A copy of the data was stored on an external password-protected hard drive and deposited in a safe for security purposes. The data were archived for 5 years after the study before the physical and numerical destruction of data management professionals.

Summary

Chapter 3 presented the research design and methodology that was used to conduct this single case study. Chapter 3 also provided the rationale behind the study, the role of the researcher, the issues of trustworthiness, and a brief summary. This chapter highlighted other key rubrics, including participants’ selection criteria, privacy protection, the research results validity criteria, and my bias management. I also explained the procedures to answer the mentioned research questions using the data collected and analyzed. Chapter 4 presents the data and its analysis.

Chapter 4: Results

This qualitative single case study aimed to scrutinize and investigate effective IT modernization strategies for bringing significant improvements in the IT legacy systems migration. I used an IT leadership perspective to conduct this study and concentrated on the involvement and contributions of the organizations' IT leaders in the respective IT modernization programs to ensure successful migration of IT legacy systems. Moreover, I used the actor-network theory in this qualitative study to explore and examine how IT leadership (as key stakeholders) implication in IT modernization programs could be helpful in improving the IT legacy migration process while reducing the failure rate in the state of Michigan. I interviewed a sample of 13 selected IT professionals (representing the total population of IT professionals with experience in IT modernization in the state of Michigan) was interviewed to achieve the research purpose. Also, a series of open-ended questions was used during the interviews conducted via Zoom. Each interviewee gave the consent to use the provided information in the study. To date, none of the participants have requested to discard their information.

The research question of the study stated, *"How do organizations create effective strategies to modernize IT legacy systems?"* The findings obtained from the data collected through participants' responses and documents helped in determining numerous strategic approaches for the creation and implementation of successful IT modernization programs.

In this chapter, I discuss the results and findings of this research. The first part encompasses several topics, including the participants' identification and the process to

contact them to participate in the interview, the interview process, the data transcript, analysis, and storage (under the Research Settings section). The next section explains the participants' demographics, data collection procedures, data analysis procedures, evidence of trustworthiness, and the study results. The chapter concludes with a summary (including a transition to Chapter 5).

Research Setting

The data collection procedures and the interview questions were submitted for approval to the Walden University Institutional Review Board. The Board approval was received on April 11, 2022 (Approval Number: 04-11-22-0458750). After the said authorization, I began the participants' recruitment process by first posting the need for volunteers on several media and then collecting the contact information. Fifty potential participants were contacted from my network to inquire about their willingness to participate in the study. Overall, 13 individuals from the mentioned showed interested to participate in the interviews. Later, I sent the consent form individually by email to all volunteers to ensure every participant understands the study description, potential benefits to the community, and participants' rights during the interview process. The consent form also included the first few questions to demonstrate what participants should expect.

Thirteen participants responded to my emails. The phrase, *"I consent"*, confirmed their participation in the study. Next, the participants were contacted to discuss and set up a convenient date and time for the online interview via Zoom. Hence, no meeting location was identified for the interview. However, I ensured to verify that the participants'

computer systems were capable of supporting the Zoom application. I also emphasized that the participants must choose a safe location with no background noise, a place wherein they could speak freely. On the day of the interview, I reiterated the participants' rights so that whoever wished to withdraw from the interview at any time could do so conveniently and without any hesitation (as outlined in the consent form). At the interviews' beginning, every participant was also informed that I was only using the audio recording part for the transcription (even though the recording includes both video and audio). All interviewees were asked the same questions to keep the data collection process consistent. The interview duration varied from 45 minutes to 1 hour using Zoom (Version 5.10). The last step involved the transcription of each interview (13 in total) from the recordings into a Microsoft Word document, whereby www.temi.com platform was used for the purpose

Demographics

This study included 13 interviews from participants related to the IT field (represented in Table 3). Among them, 2 participants held the position of IT project manager in various departments across the State of Michigan and local companies. Five were members of the IT executive committee. Two were part of the DTMB IT agency services recognized as IT technical team members. Table 3 also provides detailed descriptions, including the participants' gender, education, and years of experience.

The group of volunteer participants consisted of three women and 10 men. Among them, three participants had acquired a master's degree and nine participants had

Table 3

Categorization of the Public-Sector Datacenters Costs

Participants ID	Years of experience	Education	Sex
LK01	24	Bachelor	M
LK02	30	Masters	F
LK03	10	Masters	M
LK04	24	High school	F
LK05	20	Bachelor	M
LK06	6	Bachelor	M
LK07	11	Masters	M
LK08	9	Bachelor	M
LK09	37	Bachelor	M
LK10	10	Bachelor	M
LK11	32	Bachelor	M
LK12	10	Bachelor	M
LK13	32	Bachelor	F

acquired bachelor's degree, whereas 1 participant had an associate's degree and 1 had a high school diploma. Even though there was a difference in the participants' educational achievements, they all had at least 6 years' professional experience in the IT field. The participants were randomly assigned a pseudonym from LK01 to LK13 to protect their identity and confidentiality. I even ensured that the group did not include any vulnerable participants or had a direct association with the chain command.

Data Collection

After the IRB review and procedure approval, I started the data collection process. As mentioned already, the IRB approval number was 04-11-22-0458750. I used 2 data collection techniques – interviews and document reviews. The sample size allowed me to obtain adequate data to achieve data saturation and respond satisfactorily to the proposed research question. With the use of the Zoom application, I was able to conduct video

interviews of all participants. I made sure to first acknowledge and appreciate the voluntary participation of the IT-related professionals before the start of every interview. In addition, it was also verified that each participant had joined the Zoom interview meeting from a safe location. I ensured to not only share a brief study overview but also followed other essential requirements during each interview to mitigate personal bias and allow the participants to express their views independently and without hesitation. Although some participants offered to reach out during working hours, I planned to conduct all interviews after working hours (and during weekends) to avoid disrupting the regular work schedule of the participants. Most participants served as senior and project managers; such scheduling was important. Before each interview, I took permission to turn on the audio recorder to record the interview.

As seen in Appendix A, 12 open-ended questions were used during the interview to let the discussion flow and remain consistent. Even though direct one-on-one meetings were preferable, the Zoom application was used due to the COVID-19 pandemic restrictions as well as the location of several participants. However, the online interviews allowed me to communicate with the participants verbally and observe their body language through video recordings. All in all, I understood and comprehended the participants' experiences related to the impact of the IT modernization strategies on the IT legacy migration programs. Moreover, the ability to take field notes and conversation recordings allowed me to fully capture the actual perceptions of the participants concerning the topic, including the non-verbal gestures (body language). Each interview spanned between 45 minutes to an hour. Depending on the interviewee's response, I used

probes or follow-up questions to ensure better participant engagement for a successful interview session.

The Temi Transcription Software transcribed the audio recordings into a Word document. To check transcription accuracy, I listened to the audio while following the text and made appropriate adjustments to ensure the inclusion of the accurate thoughts and perceptions of the participants. Afterward, several Microsoft Word documents were also sent to the interviewees to obtain their confirmation verification. It is worth mentioning that this exercise allowed the participants to make amendments to the respective documents (as seemed necessary) to reflect their views better. Overall, numerous participants made few insignificant changes to their transcripts. Later, as a final step, I uploaded the interviews' transcriptions into a drive for data analysis and management.

I used a second source of data collection, including the review of multiple documents, financial reports, and publication(s) related to IT modernization in Michigan. These documents were open-source and available to the public. Hence, they did not require any authorization for accessibility. I found several hard copies of journals and press releases in the state library. However, almost 10% of the documents reviewed were online (located on the state public website).

Data Analysis

After the data transcription (as explained in the previous section), the data analysis process began. I selected the pattern-matching data analysis technique from Yin (2018) to accomplish this task. According to Yin, pattern-matching analysis involves

defining a pattern of related research before the data collection and comparing or matching it with the respective findings. This approach required comparing themes from the research data and predicted themes. Before using pattern-matching for theme comparison, I used the Thomas and Magilvy (2011) inducting coding procedure for theme identification from the research data. All themes written from the transcripts and document reviews responded to the research question on how organizations create effective strategies to modernize IT legacy systems. I used inductive coding for data analysis and highlighted the findings' frequent or significant themes (Thomas & Magilvy, 2011). Thomas and Magilvy developed five important steps for the process adopted in this data analysis.

For this particular research study, the first step comprised the collection of raw data through research interviews, document analyses, and my field notes. It also included the data transcription and review by both the participants and me. Next, I prepared the data for analysis by organizing it into files (based on predefined criteria). Later, I familiarized myself with the content by going through the files, thereby getting the idea to create themes. The next step involved data coding as I changed the codes depending on the need. I also used code overlapping during this process. Lastly, themes were created based on my understanding of the data.

I ensured continuously changing the initial coding themes based on his understanding. This general approach helped in the identification of the final themes as well as the establishment of the foundation for the case study analysis using a specific analytical technique. In the end, pattern-matching helped compare themes to ensure

effective qualitative case study data analysis (Yin, 2018). Using pattern-matching, I interpreted the meaning of the study findings and proposed recommendations accordingly. Based on the interview data, relevant documents, and field notes, I generated themes that offered insight into several strategies to modernize IT legacy systems. The data analysis yielded the following themes: (a) Modernization strategies, (b) Role and involvement, (c) Strategic communication, (d) Performance metrics, and (e) Benefits.

The study used NVivo 12 for Windows by QSR International (2022). I uploaded the interview transcripts into NVivo after saving them as Microsoft Word documents/files. NVivo 12 enabled me to ensure and maintain order in the data, create notes, and most importantly, identify themes and clarifications. The data uploading process included opening a new project on the NVivo 12 platform and importing all the interview transcripts from each participant file. To start the NVivo coding, I used standard text to assign headings for interview responses. I also used the interview responses' key terms to develop emerging themes generated through NVivo's word frequency queries. Hence, this process proved useful in data interpretation by creating notes, clustered code, similarity, and word frequency queries. The reports from NVivo recalled multiple themes that I used to answer the research questions while relating to the action-network theory's conceptual framework.

This data analysis generated five themes that I interpreted inductively to derive findings and propose recommendations from the research. The first three themes implied the necessities of the IT leadership implication during the planning and execution of IT modernization programs. The remaining themes related to how IT modernization

strategies in organizations could be elaborated and expanded. These five themes constituted the qualitative single case study results. It is essential to mention that I did not notice any discrepant cases in this research data.

Evidence of Trustworthiness

The research value and the clarity that I maintained during the study defined the findings' worthiness (Cope, 2014). I implemented the four strategies (as stated in Chapter 3) during the data collection to ensure evidence of the trustworthiness of this study (Levitt et al., 2017). Moreover, the study met all trustworthiness criteria, including credibility, transferability, dependability, and confirmability.

Credibility

Credibility denotes the qualitative researcher's capability to manage the complexities encountered during the study conduct process and deal with incomprehensible patterns efficiently (Guba, 1990). Also referred to as *internal validity*, credibility relies on the research design and a functional choice of research instruments that allows the convenient acquirement of high-quality data. The fulfillment of this specific data validity criterion is made possible with the combination of several data collection methods, the interview being the primary method, followed by the documentation review. Both methods help achieve data saturation.

Implementation of various validity strategies helped establish and reinforce credibility. In this qualitative study, triangulation helped reach data saturation by employing multiple data collection methods. The interviewees came from various levels in the IT organizations. Also, the participants were allowed to review the transcript of

their interviews to make amendments and ensured that each interviewee provided as much information as possible concerning their views on IT modernization in their respective organizations. Similarly, peer review consultation and feedback analysis proved effective in the identification of any bias and misalignment. Wright and Dagan (2020) believed that qualitative researchers should advocate for bias neutrality for a credible study and acknowledge any potential bias through reflection.

Transferability

Transferability, also called *'external validity,'* ensures the study's trustworthiness. This strategy represents how qualitative study results could be transferable or applicable to a broader context while maintaining context richness (Jones & Donmoyer, 2021). In some cases, however, the reduced sample size required for qualitative research does not allow researchers to employ this research method to base their conclusions with implications on a large population. Myers (2013) recognized this failure to transfer qualitative research results to a large population, thereby considering it a detainment.

To ensure the transferability of this qualitative study, I recruited participants from different backgrounds and levels within the IT workforce and non-IT staff. With the help of this approach, I could attain a broader view of the interviewees' perspectives on the single case study (Denzin & Lincoln, 2011). The participants belonging to the technical section of the field shared their thoughts as individuals involved in executing decisions on the ground and leading the IT modernization efforts on a daily basis. On the other hand, participants serving on executive positions oriented their thoughts on a holistic view of the IT modernization programs (from the decision-makers perspective). Overall,

the interviewees' answers focused on the impact of IT modernization programs on their daily operations. A few participants' answers presented these programs' outcomes alignment with their respective objectives and primary mission(s). This diversity allowed me to collect and analyze data efficiently, thereby leading to concrete research results applicable to other agencies. However, more studies still need to be conducted for thorough validation.

Dependability

Dependability, the third validity criterion, refers to the stability of the research data. According to Heystek and Terhoven (2015), qualitative studies are dependable if their consistent results demonstrate stability over time. Dependability revealed a reasoning approach for the data collection method and the alignment between the data collected and the argument (Shufutinsky, 2020). The multiple-approach concept used during this study helped me address its validity. The interview questionnaire (see Appendix B) format was created and tested to respond to the research questions of this specific qualitative single case study. The triangulation approach, in a similar manner, ensured the collection of any missing information (during the interviews) and provided complementary data. Lastly, the audit trails strategy was helpful for the verification of the data collection plan alignment to answer the research questions.

Confirmability

Confirmability is another validity criterion that focuses on the impact of the qualitative researcher's bias on the research findings. Shufutinsky (2020) identified the goal of confirmability as the process of acknowledgment and exploration of ways that

impact qualitative researchers' biases concerned with data interpretation. In this context, O'Kane et al. (2021) recognized that tendency could overwhelm researchers during the interview process. Hence, to mitigate bias during this study, I reviewed the interview questionnaire (see Appendix B) multiple times while leaving enough room for the participants to share their thoughts (rather than being affected by my opinions). In this regard, the computer software was ideal for effective data organization and analysis. The implementation of triangulation strategies and external audits proved imperatively practical in achieving study confirmability (Yin, 2018). Addressing bias during a qualitative study was critical as researchers who use this approach are considered the primary instrument of the study (O'Kane et al., 2021). Hence, I allowed a few academic peers to challenge this specific qualitative study by providing feedback on biases noticed during any research stage.

Study Results

The interview questions' design allowed participants to respond without any deviation from the main focus of the research. Hence, I ensured to constitute all interview questions in a way to successfully obtain answers for the research question while addressing multiple aspects. For this purpose, NVivo 12 software was used as the qualitative data analysis tool for code identification and subcodes' generation from the participants' answers. This software proved helpful in the organization of text in a legal and hierarchical structure, thereby determining specific phases or words essential for additional analysis.

Moreover, I employed thematic content analysis to identify the ‘6’ codes and ‘33’ sub-codes within the participants’ answers transcribed in Word format. After similar grouping codes, the iterative process facilitated the process of combining overlapping codes and deleting redundant categories. I attempted to evaluate and identify the themes that could answer the research questions. In this regard, the results below represent the content of the overarching research question of this study.

Table 4

Primary Level Code Categories along with the Sub-Codes

Code Category	Sub-Codes
IT Modernization Strategies	Develop a roadmap, partnership, system integration, objective and goals, business motivation, and cost savings
IT Modernization Challenges	Fundings, data migration, risks
Role and Involvement	IT executive, IT modernization lead, IT strategist and functional architect, project manager, project manager with multiple functions.
Strategic Communication	Challenges, good practices, importance
Performance Motive	Customer satisfaction, system performance, time-budget-scope
Benefits	Cost savings, security, system improvement

The results have been presented using the hierarchical tree structure to allow the observation of participants' responses to the interview questions. I used the number format to show every question and then used a series of keywords and themes to identify common themes from those answers. Table 4 below describes the themes for code and subcode as a result of this analysis.

IT Modernization Strategies

IT modernization strategies include organization plans and approaches to manage the systems' transition o from the legacy environment to modernized platforms. The data indicated that there could be multiple IT modernization strategies within the same organization depending on the type of systems, the stakeholders, and most importantly, the level of IT Executive involvement in the process. Participants favored the necessity of clear organizational strategies for creating and implementing a successful IT modernization program.

Roadmap

Some participants recognized the development of an 'organization roadmap,' including details of the existing legacy systems, as one of the significant steps towards the effective implementation of IT modernization strategies. LK04 mentioned that the organization's IT leadership planned the modernization program by identifying its legacy systems and establishing a roadmap with all necessary steps and activities. On the other hand, LK06 shared that "the overall strategy is, we are developing a roadmap that delivers the Department Director's business version, utilizing the best-in-class IT that we have available." Further, LK06 mentioned that the organization he works for is

organizing its portfolio to fulfill the need and help the Department Director to accomplish her business plan (LK06). LK08 described an incremental replacement of legacy system process modules or group of functionalities as the organization's roadmap for the IT modernization program, "And then, we slowly proceed piece by piece until we have the full legacy system replaced and deployed on the new platform." Likewise, LK09 stated that their IT modernization roadmap was based on their data conversion from the legacy system to the new platform as there was a roadblock encountered in this process from past experience. Also, LK06, LK08, and LK09 asserted that the roadmap must be developed following a predefined structure that can depend on the applications' size or the system's end-of-lifetime frame. LK13 recognized that the size and member of systems existing in the organization make it highly challenging to establish an accurate list of legacy systems in the State of Michigan. Their current roadmap focuses on the main system (mostly at the enterprise level).

Partnership

Organizations engaging in partnership with IT firms helps the former stay on top in the IT industry. This association is also recognized as one of the principal strategies adopted for modernization programs. Almost all participants in this study agreed that partnering with major IT companies, like Microsoft and other well-known vendors in the IT industry, helped their organizations to plan, execute, and implement IT modernization programs. The data indicated that this approach is critical considering the availability of contemporary IT-related knowledge and human resources for a successful IT modernization program.

As shared by LK04, “We had partnerships with partners and used the magic quadrant to identify where we should potentially be looking at modernizing certain solutions, looking at the portfolio across the state to identify those systems that are at risk of being end-of-life or being unsupported so that we can look at how we can strategically maybe run a modernization program.” Hiring a qualified and experienced consultant with recognized success in modernization programs is another partnership approach many organizations take. According to LK05, their department had been engaged with the IT vendor community to request assistance in elaborating a strategy to help modernize 25 different portals. LK12 believed that there must be uninterrupted contact with Technology companies to stay informed about the recent trends and challenges of the IT industry. This collaboration helped their department to improve the plan for their systems’ future instead of reacting inefficiently in case of misinformation or negligence.

The data indicated a consensus of the necessity to select a good and well-informed IT partner. According to LK03, organizations should take adequate time to select the right, trustworthy vendors as their strategic partners. They should only collaborate with vendors that “do not just understand the technology but are also very familiar with their business processes.” Participants unanimously recommended the need to select a vendor that has successfully deployed the solution elsewhere (in other state or federal organizations). LK09 shared his/her department’s recent success with a vendor; “we had the luxury of working with a very good vendor that bring knowledgeable people to the table.” The vendor’s team included experts from both legacy and modernized systems that had already proven their credibility and performance in multiple other states.

The team combined new system development with a series of Customs Off-the-Shelf (COTS) software to successfully modernize a three-decade-old main frame system.

System Integration

Data indicates that organizations usually use the system integration approach to elaborate their IT modernization strategy. As an example, LK02 presented the case of an international organization dealing with siloed legacy systems installed in different countries with all the operational challenges. Using the system integration strategy, the organization migrated all systems to a unique, robust application (move to the cloud). As stated by LK02, "We firmly believe that this change will ameliorate the quality of the company services considerably while limiting systems downtime and maintenance costs."

Another system integration revealed in the data considered including IT modernization strategies in the overall IT planning. LK04 mentioned that many IT executives have started including their IT strategies within the departmental IT plan for the approaching years. This integration helped budget modernization program funding and resource allocation during the preparation of future operations and maintenance.

Agile Versus Waterfall Approach

Participants' responses did not reach a consensus on the suitable IT modernization approach when they were asked to select either the Agile or the Waterfall approaches as their organizational strategy. The data indicated the pros and cons of each of the mentioned approaches., thereby opening their choice to a case-by-case basis. LK01 stated that the most recent IT modernization program developed and implemented under his management used the Waterfall Approach. According to LK01, this approach was

suitable to the context granting the sequential nature of tasks and the implication of multiple partners and vendors. LK06 identified the Waterfall as a more traditional project management approach offering the possibility of modular replacement of the legacy systems.

LK06 disagreed with the Waterfall Approach as a methodology considering the level of risk involved; “You run the risk of developing a system, and you don’t know how well it’s going to perform in production, nor if you met the user’s needs” until all is completed. To mitigate these risks, they opted to build the new system in phases and release it in modules in production. Simply put, they used the Hybrid Approach - a combination of Agile and Waterfall approaches.

Almost all participants of the study recognized the necessity to combine the Waterfall and Agile approaches. LK01, LK06, and LK08 acknowledged that the current environment is extremely dynamic, and customers’ demands have increased considerably. Also, they recognized the significance of the ability of making system adjustments at any stage of the development considering the customer needs. Keeping this requirement in mind, the participants acknowledged unanimously that the Agile approach could be used for software development whereas the Waterfall approach could be useful for application integration and deployment within an IT modernization program.

Business Motivation

According to the acquired data, it was acknowledged that a principal strategy that could be used to successfully manage and deploy IT modernization programs in any

government organization is to ensure that the Executive and the entire department is on board when it comes to a proposed project. In this study, the participants demonstrated their belief that the business area buy-in is inevitable for successful modernization of legacy system due to its implication at multiple levels during the program development and implementation process. Data also showed that senior leaders are required to clearly communicate the correlation between the modernization objectives/goals and the IT modernization.

Objectives and Goals

LK10 shared that the first step in their strategic approach was to ensure that the Business area understands the objectives and goals behind engagement in the modernization program. As far as the second step was concerned, it was to consider and address any concerns and provide additional clarification(s) where required. When it comes to the third step, LK10 emphasized that “you need to make them understand upfront that you will be very open about what you need to avoid suspicions.” Similarly, LK11 stated, "IT modernization means a lot of different things to different people.” The participants further mentioned that IT modernization does not merely deal with an organization’s financial and security aspects. Hence, it is imperative not to make false assumptions and clarify the definition of IT modernization in the business context to avoid misunderstandings in the future. LK12 mentioned that remaining updated about the commotions within the IT industry could help convince the business to engage in IT modernization processes. As mentioned, the IT industry today is extremely dynamic. For

the same reason, staying behind the competitors could negatively affect the organization's business operations.

LK05 shared that the IT modernization strategies in his/her organization included using Lean Processes Improvement as a baseline for discussion between IT and the Business teams. This approach allowed them to engage in healthy discussions regarding the future of the IT infrastructure and application (with the users at the center of the design interest). The IT team must gather information by asking questions, such as "How do we talk to the end users, engage them in this process, which in the past hasn't typically been done?" Addressing IT modernization from the end user perspective could prove excessively helpful in understanding the intricacies and operations of the program. As stated by LK01, "one of the key strategies to obtain the business buy-in to engage one of the major mainframe platforms to a modernization program was to align the program's outcome with the organization objectives and goals." This approach was appropriate as it helped not only find funding to support the program but also supported freeing out essential resources that were deemed necessary to make the program successful.

Cost-Saving

Data also revealed that the participants used cost-saving as a primary way to motivate the business(es) to engage in IT modernization programs. IT modernization helped save maintenance and operation costs by consolidating multiple systems on a single platform. The data consolidation and updated application(s) presented knowledge of the newer environment. For success in this endeavor, LK06 stated how important it is to "work with the business to understand if the new system will provide value to their

daily operations." LK13 explained how IT modernization could support in helping the automation of several business processes and reduce staff labor.

Challenges

I also found that the data indicated numerous challenges in the processes concerned with elaborating and implementing IT modernization strategies. These challenges exhibited multiple layers, including funding, human resources, communication, and data management. Additionally, the data reveals the lack of funding and communication as the root causes of IT modernization failure in government organizations.

Funding

According to LK08, "IT modernization of legacy system doesn't usually start until they have funding available to do it, and many times it is not available, so very hard to modernize systems." The participants considered funding as a main hurdle in IT modernization. LK08 also shared that securing funding in the state for an expensive project is rather long and requires excessive endeavors and time compared with the private sector. According to LK13, "the funding for us at DTMB is done through the funding request, just like it normally would be done by any agency, but that only addresses the funding needed for the DTMB portion of those costs. we need to coordinate with all 20 departments to provide the information with impact assessment of a request for funding." This process requires exceptional coordination and communication and sometimes starts a year or two or earlier. Data showed that the state budget is elaborated 2 years in advance, i.e., any IT modernization program must have funding secured in the

Fiscal Year budget to start in the later year(s). In LK13's words, "You can't get money for project planned for FY24 if you have not submitted your funding request year." However, a specific process - "off cycle request" - is required to fund a project the same year. Nevertheless, it depends on the agency, the cost, and the risk.

In the same context, the data findings suggest that the modernization of legacy systems not only appears costly and time-consuming; they shall always continue to demonstrate the same. According to LK12's statement, "legacy system is something that always becomes a pain because we will end up spending a lot more money if we don't modernize those systems on time." It is essential to mention that the operating systems and other applications have become obsolete and will be added to the list of existing legacy systems, thereby increasing the cost needed for the organization's IT modernization portfolio. Additionally, it is worth mentioning that the unsupported systems are costly to maintain due to their outdated nature. Also, they represent a security concern for the entire network.

Human Resource Challenges

As data findings indicate, acquiring and keeping resources with required skills to modernize IT legacy systems is equally challenging. As reflected by the LK06 statement, "the giant challenge in emerging technology is that they don't have people with a ton of experience behind them." LK06 and LK07 believed there is a lack of IT professionals in the market with expertise and experience in the transition of old legacy systems to modernized platforms, like Cloud. As established by LK07, "it is difficult finding resources with a good mix between understanding technology, understanding business

processes, and being able to do both of those." Similarly, LK10 recognized that "their challenge was finding good people to take over the old stuff so that we could move the new people to the project without them having to contribute to handling their old stuff."

LK13 highlighted state civil service as a big impediment to IT staffing for multiple reasons. LK13 stated, "Government employees' salary schedule does not follow salary increase in the IT industry." Participants agreed that the antiquated process of reviewing salaries imposed by the state constitution has no usefulness either, as this regulation did not consider an individual's position for a thorough evaluation. Instead, it imposes the cost of living on the employees. Another challenge in the civil service is the lengthy duration of the hiring process. There is a high demand for IT professionals in the market, and the few qualified for modernization programs do not have adequate time to wait for a longer time before their job confirmation at the state. LK10 recalled missing 2-3 highly qualified IT professionals due to the acknowledged delay in the state hiring process.

Stakeholders Management Challenge

Considering the data revelations, IT modernization programs require the involvement of multiple partners, vendors, business areas, and public and private organizations. Maintaining an open line of communication to ensure all parties are up to date is a challenge. The same challenges were faced in this case. LK01 stated that communication among stakeholders was truly challenging due to the nature of the stakeholders involved. LK01 also shared that while DTMB led the project from the state side, local jurisdiction officials were the key stakeholders who elected officials that were

not supposed to report to the state directly. In this context, it was indeed a challenge to make the respective group of stakeholders follow the instructions or accomplish any task on time. The Bureau of Election staff at the state did not even provide enough assistance to cover the communication gap. Instead, it encouraged the officials to continue with this behavior, thereby making the situation even more challenging. LK01 also discussed the challenges related to the communication regarding the new authentication login process with users. The staff was exposed to the multifactor authentication for the first time. Hence, instead of following the institutions, they considered this process to be a system malfunction.

Strategic Challenges

Going through the data also revealed multiple challenges during the elaboration of IT modernization program owing to the high number of entities involved in the process, each one defending its interest. LK03 shared the experience and mentioned that "the bigger challenge we had with the stakeholders was because everybody had different expectations." People view things differently. Hence, LK03 mentioned how each group wanted to impose its views on others. Some entities did not consider any willingness to put in the resources requested due to their budget constraint. Ironically, they still wanted full control of the program.

Similarly, LK06 mentioned that every individual has a different vision; hence, modernization has a different meaning for everyone. LK08 recognized that "getting everybody to agree on what they are supposed to be doing and what they are responsible for would be one big challenge for all the different stakeholders." Likewise, LK05

emphasized that “each of us has an individual job; collectively, we need to come together to make decisions to move forward.” The participant further commented, “I can’t ask somebody to understand something on my end and vice versa in the space we are because we don’t do those jobs and so I think the answer is, there’s going to be some educational knowledge transfer between all the different groups to make those changes.”

Implementation Challenges

According to the data, some challenges had a direct impact on the implementation of IT modernization programs that involved issues in infrastructures, application resources, and the process. LK06 stated that “the biggest challenge during the IT modernization implementation was keeping both legacy and modernization systems in sync and making them interact with each other, until the legacy system is completely replaced.” This challenge mostly affected the modular implementation approach that uses multiple releases during the IT modernization implementation. According to a statement by LK06, “When replacing a system that has six modules, after you release module one, you have to keep it in sync with the other five that left behind” to maintain business operations. IT modernization programs involved multiple partners that were required to collaborate to determine the figure needed to deploy the organization’s application in process. This is because the lack of collaboration, at any level, could be chaotic and may result in program’s failure. LK10 shared the experience in the following statement: “When we were rolling out one of our old systems on a new platform, using the water fall model, the lack of business and IT teams’ coordination resulted to a failure after a couple of years of efforts.”

Lack of clarity concerning the roles and responsibilities of each individual or stakeholder group could be another cause of IT modernization failure. According to LK01, some people in their IT modernization program were unaware of their responsibilities. LK07 shared that "they were often thinking somebody else was going to be the one doing some things and no body end up doing it." Such assumptions within the corporate environment, precisely wherein IT project is planned and discussed, affect the results with time slips extending the program end date while increasing costs. As LK01 shared, the project team started to lose interest in the project, whereby essential resources were pooled for other high priority efforts, and the IT modernization program failed. Another challenge, as mentioned by LK01, another challenge is ensuring all stakeholders understand the organization's objectives and how they align with their tasks. Similarly, LK06 shared that "there is often a lack of vision or lack of communication of the vision that makes it hard for stakeholders to understand why they are asked to complete certain tasks at a particular time."

LK04, in the same context, shared the not-so-good experience of a collaboration between IT leadership in the department. He stated that "they are very narrow focused when it comes to what they want to do, their ideas and goals are based on either a partnership with a different state, a conference they recently participated in." After their return from the conference, their objectives were to implement the same approach learned without considering any technical and procurement requirements. LK04 also added that "a lot of challenges came from the fact that without an existing IT section in the department of military affairs, people did not know how to procure things the right way."

Another problem was interacting with vendors who had no or limited knowledge of the state IT functions. Such vendors usually plan and propose projects according to the IT industry standard; however, they ignore many requirements preferable by government entities, like the procurement process or the need to have an authority to operate before deploying a system on the state platform. This lack of knowledge substantially impacted the IT modernization timeline and cost.

Stakeholders' Roles and Involvement

The data also revealed that IT professionals serving on multiple levels, including IT executives, IT Technicians, and Database Administrators, are also involved in the IT modernization program. The participants reflected this diversity that helped in the data collection process from a diversified IT group perspective.

IT Executive

According to the data, senior IT leaders must understand the significance of an IT modernization program to identify their organizational strategy better. Data also indicated the importance for IT executives to understand business processes and gain awareness of ways to overcome IT funding for supporting IT modernization. LK11 explained, "my role as the PMO Manager is to start working with the directors, start brainstorming with them on which vendors company to select as partners, and see what dates are coming, what is on the roadmap for each and every system." Similarly, LK12 shared that if a system appeared to collapse or reach its end-of-life phase, the team started with data collection to initiate the modernization plan. Using the relationship established with the Executives of other departments, LK13 worked in partnership with the team and started the

conversation on IT modernization at the leadership level. This conversation at the highest level of the organization allowed the senior leadership to grasp the notion of IT modernization strategies and understand the ways of integrating this concept into their future strategic plans and objectives. Meanwhile, the Tech team continued with the groundwork, including collecting information and analyzing vendors and other resources (resulting in the program cost determination). LK12 also added, “My team really played a critical role putting it all together before we can send over to the top leadership for prioritizing.”

According to the findings obtained from the data, it was revealed that some departments are acknowledging the inevitability of utilizing dedicated human resources to implement IT modernization program(s) strategies effectively. As stated by LK04, “I am their lead for the IT modernization efforts and developing any plan around that.” LK04 mentioned how this position was newly created and that he was the first in this respective role. LK06 defined his role as two-fold, including IT Strategist and Functional Architect. As an IT Strategist, LK06 described the organization’s “IT strategies are going to be going forward, including the most efficient vendors solution, and the overall organization strategies.”

On the other hand, rendering services as a Functional Architect allowed LK06 to assist the directors in achieving the organization’s vision. LK07 mentioned, “my major focus is ensuring that any projects that I participated in are implementing the best practices and are meeting the standard set by the department.” Similarly, working as a controller allowed LK01 to facilitate the department to achieve its goals. LK01 also

described how “helping people focus on the objective, making sure that all tasks included in the scope are valuable, are some of the things I constantly bring the conversation back to.” LK01 used the controlling power to ground IT modernization program teams focused and refrained from being the scope creep.

LK08 also explained how most of the time was spent planning and executing the department’s IT modernization program. During the planning, LK08 helped the IT team by involving in the multiple analysis process to determine whether the new software needed to be built or COTS products were required. Consideration was also given to using a combination of both or a software as a service with vendor support. Furthermore, LK08 asked questions, such as “Do we have a capable internal staff to build the new product? Are we supposed to contract with a vendor to build the new product, or is it something that we could reuse along the way?” Data revelations also suggested the significance of researching similar modernized application(s) or architecture(s) already existing in the organization or to check whether they could be reused or adjusted to fit the new system requirements. Receiving satisfactory responses for the questions and using this approach could be useful in time-saving, cost reductions, and retaining and recruiting proficient human resources.

In this context, LK09 was recognized as a multidimensional team player capable of fulfilling multiple roles, including Project Manager, Data Transfer Administrator, Quality Assurance Representative. According to LK09, “If you are looking to staff an IT modernization program, that is the exact type of player you need in the team.” The professional role of LK11 ranged from identifying systems to modernize to prioritizing

efforts, arranging and retaining resources, saving budgets, and removing any obstacle(s) susceptible to negatively impact the IT modernization program.

IT Project Manager

The collected data also highlighted the roles and responsibilities of a Project Manager and how he/she should possess IT modernization experience (either serving as a Senior Project Manager or IT Modernization Program Leader). Also, a Project Manager with IT certification is preferable to manage the stakeholders involved in the modernization process. As a Senior Manager, LK01 collaborated with the Technical Team to develop the detailed project plan and transformed the technical language so that it could be comprehensible for the leadership. According to LK01, the key was to contribute as a liaison between the leadership, the Technical Team, and the users. Another major task was to coordinate the whole plan and to execute the program.

Further data analysis specified that the IT professional role can change during the execution of an IT modernization program. LK10 shared his experience by stating, “I was basically in charge of the procurement at the beginning of the project, working on the whole procurement process; that role changed to contracting officers, setting up proposal, and selecting vendors.” Also, LK09 shared how his professional role juggled from being a Conversion Lead, Database Administrator, Database Designer, Test Manager, Business Analyst, to Project Manager (depending on the resources’ needs). Similarly, Project Managers were limited on the Human Resources management for IT modernization program, thereby creating a risk. This is because the Project Manager(s) were supposed to work only with the resources allocated to them (no matter the resource possessed any

experience or not). The inability of Project Managers to recruit team members with IT modernization experience increases the risk of program failure(s).

Stakeholders

Data shows that numerous stakeholders are also often involved in the IT modernization program. According to LK09, stakeholder is any entity that interacts with the legacy system being replaced. These entities could be a person or a group of people and were involved throughout the project lifecycle. For LK03, "stakeholder is anybody on the executive from the top State Legislature and State Electors Official and could go all the way up to the Governor." The data from the Secretary of State was used by several other departments across the state. All those users were stakeholders during the mainframe modernization process. LK03 talked about their participation at multiple levels, including individual systems' testing, and how it assisted with the compatibility between platforms (before the deployment in production). The data also suggested that the key stakeholders for the IT modernization program were identified on the basis of the participants' role(s) in the organization. LK04 explained how their key stakeholders at the Executive-level rendered services as the Deputy Directors (for each business area) and the Chief Financial Officers. LK06 cited the Chief of Information Officer, DTMB staff, the end users, and the vendor community as the project stakeholders. In addition, LK06 discussed about the external partners, such as the federal agencies (CMS, ACF, and ADA) that often support modernization programs at the state by providing financial support.

LK01 emphasized on the Business Owner's role who must possess a hands-on experience with the software or system modernization. According to data findings, this group of stakeholders demonstrate exceptional sensitivity considering that they would be the first to use the new system after its completion. These stakeholders included state employees at the branch offices and the citizens. As confirmed by LK13, their key stakeholders included "the four IT deputies and the CIO who makes all final decisions." Also, LK13 explained that the Director Deputies are in charge of defining IT modernization strategies that align with the organization goals followed by the director review and approval.

Relationship Between Stakeholders

Data findings also highlighted several challenges that are faced while managing stakeholders considering their conflicting schedules, interests, and requirements. LK10 revealed how the Project Manager was supposed to ensure that all stakeholders were kept up to date with any change(s) on the plan and confirm the program status on a regular basis. While sharing the experience, LK01 informed how one of the main challenging tasks was to verify that each entity request was answered while creating a conducive work environment wherein all stakeholders are entertained equally. Similarly, LK07 shared his opinion on the topic and informed how it was constantly ensured that the program objectives do not directly contradict with any objective of the stakeholders. According to LK01, there was a permanent conflict between some stakeholders as they wanted to defend their respective interests and needed assurance concerning the appropriate usage of their fundings. Another challenge that the Project Manager face in

such scenarios is keep the stakeholders' focus within an extremely dynamic environment wherein change is constant. As described by LK01, "leadership focused more on the defects and errors generated by the system during the texting phase than encouraging the 90% of success accomplished by the team."

IT Resources

The interviews also helped in finding out that there is a dire need of building and maintaining a strong IT team for a successful IT modernization program. According to LK05, a good team should include people possessing knowledge of both the old and new systems; people who have the capability to understand and develop the business requirements effectively. LK03 explained, "I felt like we were lucky that we get a good team of people, and we treat them well enough to have their participation till the end of the project." Due to the lack of qualified resources, however, some departments hired contractors to reinforce their IT team capabilities. In LK04's opinion, DTMB was a great partner because of the help provided to their team with temporary staff during their project; "I am a firm believer in our business partners and our contractors because they provided the balance needed to process ups and flows of resources on specific projects." A contractor with integration experience on the new system brought value to the IT modernization program.

Hiring IT Resources

Going through the data assisted in realizing that technical competency and experience in the IT field are critical factors that directly influence the success of IT modernization program(s) in any organization. Data also highlighted numerous avenues

and criteria of the resource-hiring approach. LK10 shared how their department key criteria for hiring IT resources included professional certification that could be substituted by predetermined number of years of experience. Participants also emphasized on the candidates' ability to interact in a team setting as a critical requirement. As per LK05, "I will most likely hire a person with a positive can-do attitude than anything else because all technical stuff is teachable." This approach has been suitable with the current shortage of qualified IT professionals. According to data, the state is willing to hire less qualified technicians to later train them to the required standard(s) through various programs, such as the State Unified Information Technology Environment (SUITE). As reported by LK08, even though this process is time-consuming, it guarantees service continuity in the organization.

LK11 stated that "there are some key skills out there that are primarily driven by pay." LK05 asserted that such candidates are difficult to recruit as a majority of individuals are discouraged by the low salaries offered to the IT professionals by the state. However, LK11 suggested that this challenge could be addressed by filling in a few numbers of contractors who can execute special tasks within a short time period. According to LK11 observation, such contractors worked alongside state employees and shared the same work environment. It is imperative to mention here that the obtained data also discussed the circumstances during the COVID-19 era. It was discussed that remote working has also become a new norm in the IT industry. According to LK04, the state has been endeavoring constantly to run a physical office (twice a week at least). On the other hand, LK12 shared an apprehension saying that "if the state does not allow remote

work, we might not be able to get the right talent pool." As described by LK11, the state is a government entity that operates with the implementation of various laws and regulations that need timely review and adjustments to enable efficient and productive remote working.

Strategic Communication

Reviewing the obtained data also helped in understanding the imperativeness of the elaboration of a strategic communication plan during the initiation phase of any IT modernization program. Participants unanimously agreed that the employment of multiple ways of communication, emails, phone conversations, meetings, and town hall gatherings (in some instances) are extremely important for keeping all stakeholders up to date and discuss any requirements/concerns. Also, the indications from data suggested the senior leaders were involved in the elaboration of strategic communication. On the other hand, the Project or Program Manager leading the IT modernization program was engaged in the program implementation. This approach reflected the importance of the involvement of the IT leadership on the overall communication process.

As stated by LK09, the communication process at all levels during the modernization of the largest Secretary of State Mainframe System was exceptional, whereby "we had dedicated a group of people to do just communication during the program." LK10 discussed the advantage of moving his office closer to the project team and acknowledged how this move helped in ameliorating the communication between his team and other partners involved in the program. In addition, multiple daily and weekly meetings allowed all stakeholders to remain aware of any change(s) during the CARS

Modernization Program. LK11 was of the opinion that communication during IT modernization should be concise and confident due to the cost involved and the high level of risk. Such strategies could be helpful in avoiding any statement that could create doubt or misunderstanding. According to LK12, "communication must go top down and not bottom up to help the senior IT leaders identify a modernization strategy that fit with their organization and shared with everyone." However, other participants in the study advocated for the Horizontal Communication Strategy Model that allows stakeholder(s) to participate in the elaboration and implementation of organization's IT strategy.

LK05 asserted that "communication has to be timely; it has to be clear; it has to be concise; it has to tell the people that are involved in the IT modernization communication of what to expect." The participant continued to share his experience and informed that setting realistic expectations with all stakeholders increased confidence and motivation. According to a statement by LK04, "we have enforced some standards so that project manager gets their projects updated and communicated out every week." The participant also shared how critical it is to communicate with the senior leaders on a regular basis and how this goal was achieved by implementing a governance structure that ensured holding up a once-a-month meeting with the IT executive. LK04 explained, "we go over the status of all major projects, including IT modernization programs as well as some services required that are still in planning or that we had initially prioritized as what we want to do next." As defined by LK02, Project Managers are the liaison between IT teams, Business teams, and all other stakeholders involved in the program; as such, they tracked all tasks to ensure timely completion. As described by LK07, it is important

to implement a solid communication plan that may help capture tasks' status and coordinate the overall project.

Importance of Communication

The interviews demonstrated participants'' unanimous agreement on the importance of communication during IT modernization program(s). LK03 stated that "communication is very important because you need to keep everybody updated, to keep everybody informed and you need people to support the program." Similarly, LK04 mentioned that "communication helped with the lessons learned as well to streamline on where the most steps are." The communication approach helped LK04's team to identify an efficient relation to replace the database. LK05 believed that "you could possibly call it a catch rate, but communication across everything we do is vitally important." LK12 described the communication flow that involved leadership of all agencies in the 19 states to the IT management groups working with these agencies, the Business Relationship Managers, General Managers (for analysis and estimation), and agencies' Executives (for funding requests).

Participants also agreed that the most likely reason of IT modernization program failure is the lack of communication. As described by LK08, communication is probably the number one reason things fail as untimely communication or no communication at all resulted in dissatisfactory results. Also, the data indicated that the lack of two-way communication between program stakeholders, Project Managers, and IT leadership caused uncertainty and distrust, thereby significantly impacting the team's problem-solving capacity.

Performance Metrics

As suggested by data, multiple approaches, including customer satisfaction, system performance and time-budget scope, can be useful to measure the performance of IT modernization programs' implementation. In this regard, LK8 was of the opinion that customer satisfaction on the new system was a better approach to measure the new platform performance as this feedback from the users and the businesses is based on the expectations from the system and actual deliverance. The system must also be user-friendly while having the ability to resolve any issues noted in the legacy system. According to LK01, "the people had the ease to use initiative model at the end of IT modernization program" considering the new system's accessibility and security features. LK07 mentioned that customers shared their opinion on the system performance after experiencing it. LK01 affirmed that the system performance met and exceeded the business expectations (initially stated in the requirement section). Beside the security feature, the system availability increased to 99.98% and the performance increased 100% as the response time went from 5 minutes to less than a second.

LK03 stated how the business area was provided with more options resulting from the modernization program. Also, it ensured the availability of added features depending on the users' needs and ability to make rapid changes according to the requirements. The participant further described another key factor, thereby stating that the business used to evaluate the new system by compiling the number of transactions (processed in both systems during the same timeframe). This was further validated by LK09. As an outcome

of this factor, the processing of a net increase of the number of transactions was made possible on the new system (despite the presence of new fields).

The project had triple constraints, including budget, schedule, and scope. Participants agreed that the triple constraints were the major elements that allowed project elevation during its life cycle. LK02, LK05, LK08, and LK09 unanimously acknowledged that the senior Business and IT leadership used the triple constraints to evaluate IT modernization program performance. Each department focused more on a particular constraint depending on their objective and goals. According to LK05, “We are very sensitive to our department budget, and we assured our money is spent wisely.” LK02, on the other hand, conversed about how customers and leadership were focused on the IT modernization program scope and time, ensuring all requirements were included and implemented in the new system in a timely manner. LK11 used the return on investment to evaluate the efficiency of the program cost and found a saving of $15.25/call after the call center modernization.

Data Conversion

Due to the complexity and challenges associated with the conversion of legacy data, several participants shared their experience of using the data conversion process to measure IT modernization program performance. LK08 recognized that the poor quality and duplicate data from the legacy was a key challenge during the data conversion. LK09 advised that hiring an expert that understands legacy data and the new system configuration is extremely critical for an effortless and unproblematic data conversion. In

addition, it must be mentioned here that multiple IT modernization programs have failed due to the lack of focus on the data conversion from the legacy database.

Benefits of IT Modernization

The study findings suggested that organizations benefited from IT modernization in a multitude of ways, including the cost-saving related to operation and maintenance, system reliability, system security and compliance, and system improvement. LK08 stated that modernizing their IT platform improved the overall system efficiency while causing considerable reductions in the operation and maintenance costs. LK01 described how the modernization of legacy systems in their department resulted in the 50% reduction of the number of support staff. In addition, LK09 discussed how IT modernization helped the respective system to comply with some federal requirements, such as ADA and AMVA. Sharing his perspective, LK01 mentioned that “we constantly look for opportunities to improve IT systems in terms of saving money, securing system, scanning in the information, and providing the best customer service to the state resident and the people of the State of Michigan.”

According to LK12, modernization systems offered more security to the network when compared with what the legacy systems offered. The ‘upgrade’ process from 1 version to another is uncomplicated and swift. According to what LK01 observed, “the most important thing I would think about in the current future systems is the security of the information and the system security as well.” LK13 revealed that the ultimate goal of maintaining a rigid security around the system and data was to avoid cyber incident at all costs.

Summary

Chapter 4 presented described the data. A total of 13 participants from multiple IT departments in the State of Michigan and surrounding states were interviewed online (using open-ended questions). I did a comprehensive review of the processes that were previously outlined and approved by IRB (while doing the sampling, data collection, and data analysis). Moreover, NVivo 12 was used for data analysis, employing a series of open and axial coding methods. The findings from the single case study indicated that organizations used multiple IT strategies to implement IT modernization systems. Participants agreed on the significance of maintaining an effective communication process among stakeholders as a key element of IT modernization success. The participants' acknowledged funding was a challenge for IT modernization programs. Similarly, the respondents identified several advantages such as cybersecurity, system reliability, and the reduction of maintenance and operation cost savings when IT is modernized in organizations. Chapter 5 presents discussions, interpretations, and recommendations.

Chapter 5: Discussion, Conclusions, and Recommendations

The purpose of this qualitative single case study was to explore effective IT modernization strategies to revolutionize IT legacy systems. The nature of this study was a qualitative single case study. The single case study method was suitable for exploring the necessity of planned strategies to modernize legacy systems. A series of interviews involving 13 IT professionals facilitated the researcher in identifying several strategical approaches, challenges, and benefits of IT modernization from multiple departments at the state of Michigan. Participants shared their different thoughts and perspectives freely, solely based on their respective roles in the IT structure. This research revealed the need for the legislature to review IT modernization funding processes, the human resources hiring procedures, and the pay scale for IT personnel in the state. The study also emphasizes the role of IT executives who need to be at the forefront of IT modernization programs to not only lead the efforts but also communicate the need at the leadership level. The data analysis resulted in ‘5 codes’ and ‘33 sub-codes’ identified to answer the research question. Chapter 5 contains the interpretation of the findings. Chapter 5 also discusses the limitations and implications of this study and offers recommendations.

Interpretation of Findings

From the data analysis, I was successful in finding several reasons that cause IT modernization failures within government organizations. IT modernization program required effective strategies aligning with the organization’s goals and objectives and a direct communication process/channel to connect multiple agencies and stakeholders during the program lifecycle. The responses from the research participants demonstrated

that IT modernization failure or lower success rates were either caused due to technical reasons or non-technical reasons, or a combination of both. IT professionals in the research identified data migration from the legacy system to the new system as the principal technical reason impeding the process. At the same time, the lack of funding or human resources was considered to be the non-technical reasons for disrupting the execution of IT programs' modernization.

The participants' responses confirmed that elaborating an organization roadmap with details of the existing legacy systems, including software and infrastructure, was one of the major critical steps of IT modernization strategies. Other participants had a similar take on the roadmap, claiming that an organization roadmap helped prioritize legacy systems based on their age, size, and cybersecurity vulnerability. This information helped the respective leadership determine what applications should be applied for IT modernization and budget forecast. The participants' comments are congruent with the literature review in Chapter 2 that specifically highlighted the need to classify applications into architectures, thereby indicating different configurations, maintenance requirements, and infrastructure designs (Mingsiritham & Koraneekij, 2020). Similarly, the literature review revealed that the categorization of the legacy system(s) helped the leadership to decide what application(s) needed to transition to a new environment.

The research findings also shed light on the necessity to create a strategic communication plan to encompass the IT modernization program's initiation and implementation phases. Approximately 90% of research participants confirmed using different communication approaches and tools to share the program status with the

respective stakeholders. For instance, participants admitted meeting almost five to six times weekly to discuss the program status and any change(s) with their customers.

Chapter 2 also emphasized the significance of elaborating a concise communication plan while managing IT modernization programs (GAO, 2016). The literature review also indicated that around 60% of IT modernization programs in government organizations experienced failure due to a lack of communication (GAO, 2016). Establishing a clear communication structure or model and ensuring all stakeholders understand the expectations was a critical part of the initiation and planning phases. Hershock (2017) shared the bottom-up and the top-bottom communication approaches regularly used in the IT industry between multiple actors and partners.

The interviewees' responses also indicated that all participants recognized stakeholders' management during IT modernization program as a major challenge, considering the involvement of a large number of partners, vendors, business areas, and public and private organizations in the effective implementation of an IT modernization program. The participants recognized receiving multiple expected outcomes from the business areas participating in the program. Maintaining open communication and addressing all requirements while considering each stakeholder's expectation(s) was a constant battle for project managers.

Overall, the opinions of the research participants on this specific topic were in alignment with the literature review findings presented in Chapter 2. GAO (2016) recognized that IT modernization program in government organizations was indeed challenging due to the number of stakeholders involved in the process. Yamashita (2017)

argued that creating a set of requirements that covered the expectation of all key stakeholders was necessary for 2 reasons: to have their buy-in and to alleviate conflicts between stakeholders. Therefore, it is certainly important to maintain some agility during the process, thereby offering a chance to key business areas to make some adjustments to their requirements (Yamashita, 2017).

The responses from the participants on performance metrics confirmed the necessity of identifying an authentic process to measure IT modernization success. Most participants considered customer satisfaction the most remarkable way to measure the modernization systems' performance. Other participants viewed the new system's usability, availability, and security as the performance-measurement factors. One participant focused on the number of features offered by the new system and how user-friendly they were for the customers. Lastly, 2 participants highlighted the triple constraints, including budget, schedule, and scope as performance metrics of their IT modernization programs.

Chapter 2 also explains that service operation performance must be evaluated based on the value it delivers to the business (and not simply the achievement of technology; Bayadilova et al., 2020). GAO (2016) confirmed that IT modernization offered multiple performance metrics approaches, including the evaluation of the impacts of the new system on the overall organization goals and objectives. Hanyf and Silkan (2020) based their performance metrics on tools and mechanisms to collect and compare service operation performance to business needs.

Participants acknowledged the necessity to select the best project management methodology for IT modernization programs. Seven participants exhibited positive views towards using the Waterfall Approach to conduct IT modernization programs. The participants acknowledged the appropriateness of this methodology for their organization given the sequential nature of their program tasks. However, several participants agreed using the Agile Approach in some areas, including new applications' development. One participant stated that the Waterfall Approach offered the option of modular replacement of the legacy systems until complete migration. Six participants disagreed with the Waterfall methodology and opted to conduct all their modernization framework based on the Agile methodology. Participants stated that the Agile approach offered more flexibility to make amendments on the product as the program is continued. Nevertheless, all participants agreed on the necessity to mix both Waterfall and Agile approaches in modernization programs (based on the requirements).

The responses from participants also represented the essence of the literature review in Chapter 2. The majority of participants were positive about using the Agile approach as a project management methodology for IT modernization program. The literature review highlighted the said approach as being more flexible, offering the possibility to make multiple adjustments during the program lifecycle. The participants added a discussion on the Hybrid Approach to the body of knowledge that referred to the combination of Agile and Waterfall methodologies within a same program.

The responses from the research participants on the IT modernization benefits mirrored the literature review presented in Chapter 2. All participants explained the

benefits of IT modernization in terms of maintenance and operation cost-saving, improvement in cybersecurity, and employee productivity. One participant mentioned "staff reduction" in their department to be the result of IT modernization of end-users' platform, thereby saving 50% of operation costs. Other participants appreciated the high security level offered by new platforms that demonstrate more adaptation towards system upgrades and patches necessary to protect IT systems against cyber-attacks. The participants' responses also revealed an increase of productivity offered by modernized system(s) with unlimited new features (customizable to adapt to the business operations).

The literature review in Chapter 2 also presented the body of knowledge expanded on the benefits of IT modernization in private and public organizations. Otolo (2016) recognized that well-designed and well-executed IT modernization programs offered substantial business benefits. According to Ebrahimi and Walsh (2018), IT modernization expanded organizations' capacities, made changes to fulfill future demands, and improved service quality while saving costs. The data consolidation resulted from IT modernization was an example of cost saving (Tarnawska & Rosiek, 2015). The business process automatization implemented with IT modernization improve organization productivity by up to 80% in some companies (Das et al., 2018). The body of knowledge highlighted the fact that organizations were taking multiple steps to protect their IT systems. Lavric (2019) considered infrastructure modernization a key step for explicit actions to protect organizations against general data breaches and cybersecurity attacks. According to Christopher (2020), IT modernization programs transformed IT

platform into an agile and flexible environment with the capability to easily adjust to address any security issues and business needs.

The participants in this study were unanimous on some of the IT modernization challenges in their respective areas. Hence, the discussion regarding those challenges added value to the body of knowledge of IT modernization literature considering that researchers have ignored this topic previously. All study participants recognized the IT funding process at the state of Michigan as more challenging and time-consuming than in the private sector. One participant mentioned that obtaining funding for IT modernization was a major hurdle. Another participant revealed the challenge related to the collection of funds from the state's 20 departments for enterprise modernization programs, like Windows upgrade. This funding challenge often delayed IT modernization commencement, thus resulting in high costs of non-supported systems' maintenance.

Another challenge revealed by the findings of this study was related to human resources. The participants identified multiple reasons to explain the lack of experienced IT professionals capable of conducting an IT modernization program. One participant highlighted the state hiring process and salary of IT professionals at the state not matching the IT industry standard. Another participant pointed out how the job market competitiveness has made candidates preferring work remotely. The literature review in Chapter 2 revealed how difficult it was for the state and federal governments to attract and maintain IT professionals from the start to the end of the IT modernization program. Both research findings and body of knowledge mentioned hiring contractors or partners as an alternative for the resource shortage.

Managing the long list of stakeholders coming from multiple areas with each entity defending its missions and objectives was a challenging task for 95% of participants. Some participants highlighted how difficult it was for them to effectively communicating with all stakeholders to share the program status and discuss changes. One participant mentioned that the relationship between stakeholders was at times confrontational due to their different ways to perceive some requirements. Another participant established a linkage between the stakeholders' management challenges and the incapacity of some executives to elaborate an efficient IT modernization strategy.

The study findings detailed the technical challenges as well. Participants noted the difficulty of maintaining both legacy and modernized systems in sync during the modular implementation process. Other participants emphasized on the challenge related to the synchronization of the user acceptance testing and the sequential deployment of the new IT system in production, especially when more than five entities were involved in the process. The majority of participants mentioned the data migration from the old to new system as a serious challenge. One participant mentioned that testing the database compatibility was highly recommended before deciding on the new platform on which to migrate the legacy system and to avoid surprises.

Limitations of the Study

Sturesson and Groth (2018) defined limitations as a factor that is usually recognized as a weakness in conducting a study. Three limitations were noted during this academic research. The small sample size of 13 participants was the first limitation. I used a purposive sampling of IT professionals from different areas within the state of

Michigan. This participant size may limit the team's feasibility of this study finding to other departments or states. A future study with larger participant size and broad selection across departments, states, or federal government could help to overcome this limitation.

A second limitation of this study was structuring the interview questions to collect the maximum data related to IT modernization strategies in government organizations. The semi-structured interview questions were built to answer the research question and not necessarily to elaborate on all aspects of the IT modernization. I did not conduct any pilot study to test the participants' understanding of IT modernization strategies in their respective organizations. Any lack of participants' elaborative responses might appear as limiting in their thought process and making it challenging to share their responses' context.

The third and last limitation is related to the research bias (Yin, 2018). This limitation might have impacted the study's trustworthiness. During this research, I developed the interview questionnaires and used them to conduct interviews with all participants. Along this process, my professional and personal bias might have influenced the data collection and analysis. However, my endeavored to limit this bias and increased the data trustworthiness by taking specific steps, including allowing participants to check and verify the accuracy of data gathered from them during the interviews and also by following the interview protocol.

Recommendations

The purpose of this qualitative single case study was to explore effective IT modernization strategies to improve IT legacy systems migration at the state of Michigan.

The study revealed multiple challenges and best practices, contributing to the knowledge based on organizations' perception on how to implement IT modernization programs. Elaborating concise and effective IT modernization strategies may increase the success rate of IT legacy migration to newer platforms and also improve IT maintenance and operation costs, systems' performance, and cybersecurity. The assessment of study results also highlighted the need for a better process to provide fundings for more IT efforts, a more straightforward IT professional hiring process adapted to IT industry, and training on stakeholders' roles and responsibilities. The findings of this study also revealed the importance of dedicating resources to manage communication during IT modernization programs as well as an in-depth involvement of IT executives' implication before, during, and after the program.

Hence, one of the main recommendations in this regard is to continue conducting research on some IT modernization strategies identified during this study to better understand how to apply them in government organizations. Research should be conducted on developing IT modernization roadmap that must include all specifications necessary to prioritize the migration of organization legacy systems. This process should be led by IT executives and the Heads of all State Departments to ensure a more inclusive list of systems at the enterprise level as well as at the internal departments' systems. This roadmap should be followed by a cost evaluation for each system modernization that will lead to the identification of the funding availability and timeline.

Another suggestion for future research is related to the development of an efficient process to hire experienced and qualified IT professionals in the state

government. This study may help to understand some of the roadblocks of the current process characterized as slow with a long candidate confirmation wait time. This same study might also help to identify some particularities of IT professionals hiring process from the IT industry that the state could benefit from to improve IT talent hunt process. IT professionals' paygrade is another area of concern that needs research and improvement. Having a low salary rate in government organizations comparing to IT industry did not help to hire and retain senior IT staff. Researching how organizations could adjust this gap could be beneficial to address the lack of experienced IT professionals for IT modernization programs.

The process of elaborating an effective communication for IT modernization programs is the next suggestion for future research. IT modernization can mean different things to different people; therefore, establishing a strategic communication is critical. This research could help to understand how to build a communication team set the expectations and identify the communication channels. Communication could be presented in three phases in that research. The first phase is to explain the benefits and importance of IT modernization to customers and ensure everyone understands the definition of IT modernization. The second phase of communication could cover the initiation, planning, and implementation phases (involving the information sharing throughout the project lifecycle). Lastly, the communication phase focusing on the end users and any processes and organizational changes resulting from the IT modernization must also be covered.

From the data migration perspective, a further study could be conducted on how to effectively and efficiently migrate data from the old legacy system to the new IT platform. Perhaps, this study could extend on the choice of the new platform based on the database compatibility. Besides the funding challenge, the data migration process was identified in the research funding as a principal cause of IT modernization failure. This study could help address this concern by identifying best options to move from a data silo approach to a data governance master concept with an efficient data management process in place for multiple systems on the cloud.

Implications

This qualitative single case study findings revealed multiple implications for positive social change and theory. The study also contributes to the body of knowledge for IT modernization programs in government organizations. An evaluation of the results helped to better understand the positive impact this study might have on the literature on old IT legacy systems and State citizens' daily life.

Implications for Positive Social Change

The purpose of this qualitative single case study was to explore effective IT modernization strategies for improving the process of IT legacy systems' migration. The findings from this study revealed triple implementation in the society that could impact the state residents, including the state employees. These findings could increase the success rate of IT modernization programs that are directly related to the improvement of cybersecurity, maintenance and operation costs, and the IT systems' performance and reliability. Through their responses, the participants in this study demonstrated that they

understand the challenges of the existing IT legacy systems' data sharing, limited capacity to add new features, insecurity of the infrastructures and data, and high costs. More importantly, the participants shared some challenges of the current IT modernization programs in their respective areas, including funding, communication, Executive support, data migration, and stakeholders' management.

The results of this qualitative single case study could contribute to positive social change by creating a work environment that engages all stakeholders involved in IT modernization. The participants identified the top-down communication approach as being the most appropriate. The difference is that IT Executives should be leading any IT modernization program starting from the organization roadmap and securing the funding. In addition, IT Executives should empower their Program Managers and provide full support to them during the program lifecycle. IT Executives' support might mitigate the lack of trust of some stakeholders (Hsieh, 2021). An empowered program management team can easily implement a strategic communication plan, thereby resulting with less conflicts among stakeholders and good information sharing with all project partners. This approach could lead to more IT modernization program successes and encourage the leadership to engage with the migration of more legacy systems in the organization.

The findings from this study might have implications to other state departments. For instance, changing the hiring process for IT professionals identified as a hurdle by 1 participant could allow to hire and retain more experienced and talented employees across the state in multiple fields/areas. Moreover, the same assumptions could be made about funding of IT projects and programs across the State of Michigan. The implications

are similar for the state and even the federal government that maybe facing the same challenges. The ultimate goal of taking steps to improve IT modernization process is to provide better services to the customers and users. Similarly, the results of this study could contribute to positive social change by improving the quality of IT services offered to the state citizens (Claro & Jara, 2020). The study results confirmed the benefits of IT modernization that directly tied to each citizen in their daily lives, including data security and access to multiple state services (benefits, unemployment, vehicle titles). IT modernization allows the state IT team to easily implement any changes on the system based on the policy and legislature changes. An example is the changes applied by MDHHS on their website to offer benefits to citizens during the COVID-19 in 2020 and 2021. Such rapid changes are not possible on legacy systems. Being able to offer these benefits in short notice to thousands of citizens in need saved many lives.

Implication for Theory

I explored IT Executives from multiple areas to establish the correlation between well-elaborated IT modernization strategies and the legacy migration success rate. Existing studies on the impact of IT strategies on the IT modernization elaborated on the increase of IT modernization program success rate as well as in the systems' performance amelioration (Li et al., 2021; Zhang et al., 2022). The researchers agreed that some organizations are still struggling to establish IT modernization strategies that aligned with their overall IT goals and objectives. Hence, the inability of IT Executives to build IT modernization strategies and to communicate across their organizations could lead to IT modernization program failure (Zhang et al., 2022).

The findings resulting from this study provided some information that could assist future researchers who might want to add to the existing body of knowledge on the correlation between IT strategies and IT modernization program success in private organizations. With this era characterized by an ever-changing nature of IT, leadership will benefit from adopting a clear strategy to migrate their legacy systems. The agility offered by IT modernization programs to stakeholders could be another topic that future researchers could lean on. The limitations and recommendations of this study may open the door to future researchers to explore this topic from different perspectives, adding a significant insight to IT modernization.

Implications for Practice

The finding from this study could prove significant for IT Executives and other related professionals. The study results revealed that organization's leadership and IT professionals shared the same thoughts on the correlation between well-elaborated IT modernization strategies and the IT modernization program success rate increase. The study results also highlighted some critical factors that could reduce risks during IT modernization programs. In the existing body of knowledge, scholars and practitioners blamed IT modernization failure on the lack of communication (Cao, 2022), the lack of leadership support (Kucherenko et al., 2021), and the limited availability of funding and experienced human resources (Kovaliv et al., 2021).

The responses from the participants of this study revealed similar understanding of IT modernization and the causes of its failure. While insisting to the absence of the organization IT modernization strategy integrated to the overall goals and objectives, the

participants shared their perspectives related to each cause of failure. They did so by extending their thoughts and proposing some awareness to alleviate these challenges based on their individual experiences within the IT industry.

The study results revealed the mitigation of data from old to new systems as the most challenging technical task, thus causing IT modernization failure. In the existing studies, few scholars have identified this recurring issue. Ghasemaghaei and Turel (2022) demonstrated that poor data migration between systems could significantly impact the new systems' performance. The literature identified the data cleansing steps as critical tasks that helped clean the old legacy systems data before engaging with the data migration to the new environment (Haddad et al., 2021; Rteil et al., 2022). Some participants advised to select the new platform based on the data base compatibility with the old systems to avoid facing major hold ups during the modernization program.

Conclusions

This research study contributed to identify some IT strategies that could increase IT modernization programs success rate in government organizations, including the elaboration of the organization roadmap aligning with the overall IT goals and objectives. Based on the data analysis, 100% of participants recognized the necessity to identify, structure, and communicate a well-elaborated set of IT strategies to the organization. The participants also shared several best practices used in their respective areas to overcome some IT modernization challenges, including the selection of good professional partners, the creation of dedicated team for communication, and the involvement of IT Executives. The participants generally agreed on the top-down communication approach to govern

the execution of IT modernization programs due to the multiplicity of entities involved in the process. The development of an effective IT modernization strategy integrating the state overall goals and objectives could improve the migration of legacy systems to new platforms, thereby offering more security, less maintenance and operation costs, and improved performance with a promotion of the positive social change to the state residents.

Senior leaders at the state agencies may use the research results to develop and promote the elaboration of effective IT modernization strategy integrating all entities involved in the IT operation and maintenance. IT executive should develop a trusted partnership will all state departments, implement an inclusive conversation around IT modernization, including the pros and cons, and identified any opportunity susceptible to increase IT modernization success rate. The findings from this study lead to the development of a training program for senior leaders and other stakeholders participating in IT modernization programs on the steps necessary for IT modernization strategies elaboration and strategic communication.

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Appendix A: Invitation Email for Study Participants

Subject: A Doctoral Study of Potential Interest

Dear [Name],

My name is Luc Kamdem, and I am currently a doctoral candidate at Walden University pursuing my Ph.D. in information system management. I am conducting research on the IT modernization. My study is entitled: "Exploring Critical Success Factors for Implementing IT Modernization Systems in Michigan State Agencies." I am interested in exploring how organizations create effective strategies to modernize IT legacy systems.

I seek to interview leaders who have experience in IT modernization projects and are currently working full-time with the State of Michigan in IT management roles. Participants who accept to participate in the study would be asked to do so in a Zoom interview. The results and findings would be shared with participants and other scholars. All responses would be categorized, and no participants' names would be attached in any form to the results. Confidentiality is assured through protocol established by the Walden University Internal Review Board (IRB). Individuals who meet the above criteria and are interested in participating in the study are asked to contact me at XXX-XXX-XXXX or via e-mail at XXX@WaldenU.edu.

Participation in this study is voluntary.

Note: No compensation would be provided for your participation in this study.

Thank you for your time and consideration.

Best regards,

Luc Kamdem

Appendix B: Interview Protocol

This questionnaire will be used to collect information from semistructured interviews with information and communications technology managers to support answering the research questions. The individual interviews provide data to answer the 2 research questions.

Interview Methodology

The interviews will contain a predetermined set of 12 open-ended questions. The predetermined questions will be the same for all participants. The interviews will be conducted via Zoom.

Introductory Questions

- What IT State of Michigan agency organization are you from?
- Briefly, describe your primary position?
- How many years have you been in your position?
- Briefly describe your participation in an IT modernization project while in your current or previous position?

Open-ended Interview Questions:

1. What strategies does your organization deploy to manage IT modernization programs?
2. As an IT professional, what are your role in IT modernization programs planning and execution in your organization?
3. What strategies has your organization used to manage IT modernization programs?

4. How has your organization addressed the challenges related to the modernization of legacy IT systems?
5. Who are the key stakeholders involved in your organization's IT modernization programs, and how do they fit in the process?
6. What do you think about the communication among stakeholders during the IT modernization program's life cycle?
7. As an IT professional, how do you evaluate IT modernization strategy's effectiveness and success?
8. What do you think an organization like yours can benefit from elaborating concise and shared IT modernization strategies?
9. In your opinion, what are some specific actions that should be taken to encourage the identification and implications of IT modernization strategies?
10. What are some challenges related to your relationship with other stakeholders involved in the IT modernization program?
11. Tell me about your IT workforce and some challenges of finding human resources with experience and skills needed for IT modernization program strategy?
12. What else do you think is critical to your organization's IT modernization process strategies?