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Examination of Strategies to Implementing Chip-and-Personal Identification Number Credit Card Authentication Infrastructures

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This is to certify that the doctoral study by

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

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MS, University of Phoenix, 2014

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Doctoral Study Submitted in Partial Fulfillment

of the Requirements for the Degree of

Doctor of Information Technology

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Abstract

Chip-and-Personal Identification Number (PIN) technology is seen as a game changer in many e-commerce industries and a transformational technology in the 21st century. However, security concerns have made chip-and-PIN adoption relatively slow. Massive unauthorized card payment transactions in the United States (U.S.) cost victims an estimate totaling billions of dollars. Information Technology (IT) managers are concerned with credit card fraud's financial loss and liability cost. Grounded in Rogers's diffusion of innovation theory, the purpose of this qualitative pragmatic study was to explore strategies used by IT managers to transition their e-commerce organizations to chip-and-PIN credit card authentication infrastructures. The participants were six IT managers from companies in the U.S. with experience implementing chip-and-PIN infrastructure securely. Data were collected using semistructured interviews, statistics provided by their organizations, and publicly available data. A thematic analysis revealed 3 major emerging themes: (a) elements influencing the selection of strategy, (b) payment card industry data security standards regulatory compliance, and (c) value to the business and customer experience. A key recommendation is for business leaders to mitigate the risk of credit card fraud by implementing payment card industry data security standards. The implications for positive social change include the potential to inform consumers and business owners, secure electronic funds transactions, instill trust in e-commerce payment systems, and reduce instances of credit card fraud and crimes.

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Dedication

I dedicate this doctoral study to my wife, partner, and best friend, Brigitta "Louise," who has been supporting me on this journey since day one. Thank you for being there with me to cheer me on, motivate me, and keep me grounded during all these times. Although it was not always convenient for you, thank you for your unconditional sacrifices, allowing me the time and space to complete this study. I could never have made it this far in this endeavor without you. I would also like to dedicate this to my mother and father who, early in my life, instilled in me the need to value, seek, and complete education. I would also like to acknowledge the deep respect and admiration for all of my immediate family members; Carolyn, Timothy, George, David, Molly, Joseph, and their spouses that provided me guidance, love, and leadership throughout my entire lifetime. Finally, I want to acknowledge my sons, Daniel and Neville Jr., for being who they are, great young men. I cannot forget acknowledging my nieces and nephews, hoping to be an inspiration to them as they have been for me. Thank you all.

Acknowledgments

It is with joy and a thankful heart that I express my deep gratitude and appreciation to my Committee Chairperson, Dr. Robert Duhainy. I thank you for your exceptional guidance, mentorship, leadership, and personal investment into my cause. I would like to thank Dr. Richmond Adebiaye, Dr. Gary Griffith, and Dr. Osama Morad, who served as my second committee members. I would like to thank Dr. Gail Miles and Dr. Steven Case who both served as my URR and DIT Program Director and supported my efforts along the way. Dr. Miles is a true steward in delivering higher level education in the DIT program and championed my efforts to continue and finish the program. I would like to express a very special thank you to Dr. Timothy Gallimore for his mentorship and strategic guidance throughout this whole doctoral study mission. He was very instrumental in me selecting the DIT program, and continually followed up on my progress and motivated me to endure.

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Section 1: Foundation of the Study

The purpose of this qualitative study was to explore strategies used by information technology (IT) managers to transition their e-commerce organizations to chip-and-personal identification number (PIN) credit card authentication infrastructures.

Background of the Problem

IT managers are challenged to provide the most secure computing environments for their users, both internal and external. Protecting their organization's customers from credit card fraud and stolen personal identifiable information (PII) are mandated compliancy requirements. With limited implementation of chip-and-PIN credit card authentication systems within the United States, the findings from this study can be used to inform all stakeholders on the benefits and capabilities of implementing chip-and-PIN credit card authentication infrastructures.

Problem Statement

According to the 2013 Federal Reserved Payments Study, the estimated number of unauthorized card payment transactions in 2012 was 29.5 million, with a total loss estimated at $3.9 billion (Gerdes et al., 2013). The U.S. Department of Justice, Bureau of Justice Statistics, National Criminal Justice found approximately 66% of credit card fraud victims experienced a financial loss (Harrell, 2015). The general IT problem was the lack of chip-and-PIN credit cards and point-of-sales (POS) enabled terminals in the United States. The specific IT problem was that some IT managers lack strategies to transition their e-commerce organizations to chip-and-PIN credit card authentication infrastructures.

Purpose Statement

The purpose of this qualitative pragmatic study was to explore strategies used by IT managers to transition their e-commerce organizations to chip-and-PIN credit card authentication infrastructures. The targeted population was IT managers in e-commerce organizations, located in the United States, who had strategies to transition their organizations to a chip-and-PIN credit card authentication infrastructure. In the findings of the study, I identified strategies that other IT managers can apply to efficiently transition their e-commerce organizations to a chip-and-PIN credit card authentication platform. The implications for positive social change include increased security of credit card transactions and protection of consumer's PII, reducing fraud in the global e-commerce market and financial crimes committed within society.

Nature of the Study

I selected a qualitative approach as the most appropriate means to explore strategies used by IT managers to transition their organizations to chip-and-PIN credit card authentication infrastructures. A qualitative methodology allows the researcher to gain information on the participant's experience and interpretations of the phenomenon, using techniques like field notes, participant observation, and open-ended questions (Leppaaho et al., 2016). A quantitative methodology can reveal statistical information and test hypotheses of the past and current phenomenon (Frels & Onwuegbuzie, 2013). The goal of this study was not to measure variables, prove a hypothesis, or compare the statistical outcomes of each organization's strategy. A mixed-methods approach is a

methodology with which a researcher uses the data sets and statistical results from a quantitative method combined with aspects of the qualitative method to further interpret the reason of a phenomenon (Mauceri, 2014). I did not have a hypothesis in this study; therefore, neither the quantitative method nor the mixed-methods approach was appropriate for this study.

I used a pragmatic inquiry design to explore the strategies used by organizations' IT managers to transition their organizations to chip-and-PIN credit card authentication infrastructures. Conducting a pragmatic study is an effective design to investigate a contemporary phenomenon using participants in real-world environments (Patton, 2015; Salkind, 2010). Using a pragmatic inquiry design allowed me to develop in-depth insight into each organization's experience, transition strategy, and strategic perspective from their IT managers.

When selecting the most suitable study design for this study, I considered ethnographic and phenomenological designs as possible alternatives to a pragmatic study. An ethnographic design is used to capture and compare organizational cultural influences, behaviors, and experiences of participants within a group during their lived experience of the phenomenon (Jarzabkowski et al., 2014). In a phenomenological study, the researcher collects data from multiple, in-depth interviews with participants who have already experienced the phenomenon (Gill, 2014). Based on the need to research multiple organizations and their strategies during their transition, I determined that the phenomenological and ethnographic designs would not be as effective in exploring in-depth the strategies and transition events as shared by the IT managers who experienced

their organizations' transition to chip-and-PIN credit card authentication infrastructures. Therefore, the ethnographic and phenomenological designs were not selected.

Research Question

This study was guided by the following research question: What strategies are used by IT managers to transition their organizations to chip-and-PIN credit card authentication infrastructures? Appendix B contains a list of interview questions, which I asked to explore more detailed elements of the main research question.

Theoretical or Conceptual Framework

In 1962, Rogers first framed the innovation diffusion theory (IDT), which is a model used to define how new ideas are disseminated among people in society (Shaw et al., 2022). Innovation defines the new ideas, and diffusion is a method of communicating new ideas to people in a social system (Scott & McGuire, 2017).

Decades later, Rogers (2003) refined, popularized, and documented the diffusion of innovation (DOI) theory, explaining how innovation is communicated in a social system. I used the DOI theory as the theoretical framework for this qualitative pragmatic study. Innovation diffusion is an effective research concept used in the decision-making process for emerging information technology (EIT; Cegielski et al., 2013). The innovation-decision process consists of five main levels: knowledge, persuasion, decision, implementation, and confirmation. Cegielski et al. (2013) stated that EITs represent an avenue for enhancing the effective and efficient flow and utilization of information within the organization to support business objectives and, ultimately, firm performance. Drnevich and Croson (2013) found that without an alignment of business

and IT strategies, a business will not be effective. Green (2014) found that performing and evaluating qualitative information systems (ISs) research is best conducted using a methodological framework.

In this research study, I applied the constructs of the innovation-decision process to gather real-world input and open feedback from IT managers. The persuasion and implementation phases of the innovation-decision process were the main themes within the study. Given the vast list of organizations required to do a full phenomenological study on authentication technologies affecting the global market, census sampling was the best alternative to conducting the inquiry of stakeholders necessary to answer the research question in this study. Based on the limited international knowledge of the organizations taking part in the research study, Ahmad (2014) gathered and triangulated information from both interviewing sessions and experiential knowledge. Census sampling enables researchers to gather adequate experiential knowledge and information to complete their study without conducting an exhaustive and prolong inquiry process of all organizations. Focusing the questions on the main phases of the DOI theoretical framework ensured sampling data saturation on the main themes of the research study (see Baldwin & Fellingham, 2013).

Definition of Terms

Chief information security officer (CISO): The corporate-level person responsible for the security of their organization's computing environment (Souppaya & Scarfone, 2013).

Chip-and-PIN: Smart card technology with an embedded chip on the credit card read by a card reader and requires the input of a PIN to complete a transaction (Figliola, 2015).

EIT: Emergent IT that organizations may or may not adopt (Cegielski et al., 2013).

EuroPay, Mastercard, and Visa (EMV): The original instance and standard of chip-and-PIN technology for electronic transaction payments. Chip cards are formally known as EMV cards, named for the coalition of three companies: Europay, MasterCard, and Visa (Figliola, 2015).

IDT: A model used to define how new ideas are disseminated among people in society (Cadarette et al., 2016).

Interview protocol refinement (IPR) process: The process used to efficiently collect, record, and document information from participant interviews (Castillo-Montoya, 2016).

POS terminal: The equipment used to execute the exchange of funds during a sale of goods and services (Abubakar & Ahmad, 2013).

Technology acceptance model (TAM): A method to measure user's acceptance of technology. TAM is often used to analyze data and information collected for quantitative and mixed method studies (Tan et al., 2014).

Thematic analysis (TA) process: A method for identifying and analyzing patterns in qualitative data (Clarke & Braun, 2013).

Unified theory of acceptance and use of technology (UTAUT): A widely used theory to evaluate end-user ’s adaption to innovation and information system changes (Chang et al., 2016).

Assumptions, Limitations, and Delimitations

Assumptions

To establish the baseline and communicate essential ideas of the study, past and current factors pertinent to the topic are defined as assumptions within the study (Kirkwood & Price, 2013). My first assumption was that a current review of available literature indicated a need for further exploration in the body of knowledge and strategies for implementing chip-and-PIN authentication technology within the United States. Another assumption was that the organization’s IT manager plays a key role in bringing resources, stakeholders, and technologies together to deliver the appropriate security measures and authentication infrastructure. My last assumption was that successful implementation of chip-and-PIN POS terminal authentication technology within the United States will reduce the security risks associated with conducting e-commerce payment transactions with credit cards.

Limitations

Limitations are the expect shortcomings of capabilities within a study to provide a total solution to the entirety of the problem or phenomenon (Brutus et al., 2013). The first limitation was based on the variety of organizational structures and e-commerce hardware infrastructure utilized in the United States. Therefore, the study could not fully inform, cover, and provide a strategic solution for every type of credit card POS terminal

infrastructure. The next limitation was the fact that online e-commerce purchases do not require the credit card to be present, limiting the effectiveness of studying the use of chip-and-PIN authentication technologies as it relates to an online website and online e-commerce purchases. The final limitation was that the findings of the study may not include strategies that are suitable and applicable to all organizations.

Delimitations

Delimitations define the parameters and scope of a study (Podsakoff et al., 2016). To present an effective, comprehensive, and informative qualitative pragmatic study, I applied three main delimitations. The first delimitation was the established size of the population of the participants in the study. To focus on specific planning and implementation strategies, the interview participants were IT managers in the retail industry. The second delimitation was that the interviews were conducted using participants located in the United States. The final delimitation was the fact that large, internet-only, web stores were not evaluated in this study.

Significance of the Study

Contribution to IT Practice

IT managers are challenged to provide the most secure computing environments for their users, both internal and external. Protecting their business' customers from credit card fraud and stolen PII are mandated compliancy requirements. With limited implementation of chip-and-PIN credit card authentication systems within the United States, the findings from this study may inform all stakeholders on the benefits and capabilities of chip-and-PIN credit card transactions. The results of this study may also

provide an informative set of findings to fill the IT knowledge gap for consumers, managers, and security professionals required to implement and maintain chip-and-PIN credit card authentication infrastructures in the banking and consumer-facing economic industries. The findings of this study may provide strategies used to improve the efficiency of the processes currently in place to implement credit card chip-and-PIN authentication technology. In addition, the study results can be used as an IT strategic template to efficiently transition other nations to the same credit card authentication platform, securing both consumers utilizing credit cards and vendors providing services within the global e-commerce market.

Implications for Social Change

The results of this study may contribute to positive social change through potentially being used to help protect businesses and consumers from credit card fraud. Consumers using chipped credit cards may reduce the risks of credit card fraud and financial liability to merchants, resulting in lower administrative costs and fees levied against all stakeholders in the e-commerce process (Robertson, 2014). The findings of this study might help to inform individuals about the current status of the IT innovation processes of chip-and-PIN credit card authentication. These individuals might use their increased IT knowledge to communicate, demand, and insist that businesses and their business partners increase credit card security with chip-and-PIN authentication infrastructures. Paying for services with the more secured chip-and-PIN credit cards may be safer when conducting business with local and international service providers. Once the chip-and-PIN credit cards authentication infrastructures are implemented throughout

all financial and business institution globally, individuals traveling worldwide would have easier and safer access to their buying power, reducing their risks of potential credit card fraud. Informed credit card users, their vendors, and banking institutions may be on a more secured e-commerce security platform, reducing the number of identity theft crimes committed. Additionally, the study results can be used as a strategic template to help efficiently transition other nations to the same credit card authentication platform, securing both consumers utilizing credit cards and vendors providing services within the global e-commerce market. Securing the electronic exchange of funds by using chip-and-PIN authentication technology can reduce the amount of credit card fraud and number of crimes committed.

A Review of the Professional and Academic Literature

In this literature review subsection, I present and review historical information and empirical data related to the topic of the study. Additional research and the collection of literature was conducted to support the methodology and conceptual framework used to guide this study. I conclude this section with a final summary of literature research and findings.

The literature review is organized in three main categories: scholarly, peer-reviewed; non-peer-reviewed; and scholarly seminal literature. I present the literature in the following order: a review of the current IT status, IT problem, methods to design and develop the study, and methods to collect and validate the data from participants of the study. The majority of literature was selected from academic and professional organization databases, including ProQuest, Sage, Thoreau, and Science Direct. The first

phase of the review was to collect the appropriate data to confirm the need of the study topic and the specific IT problem. A thorough search in online library databases and government-sponsored statistical sites provided exemplary supporting information to support the study. I conducted further review of the literature to establish the conceptual frameworks and models that were used to support the foundation of the study. Extensive research was conducted on how innovation diffusion is an effective research concept used in the decision-making process for EIT. It was important to ensure 85% of the total supporting literature sources address current IT technology issues and have a publication date of less than 5 years ago. The selected peer-reviewed studies, papers, and journal articles support established facts, proven theories, and known limitations to the topic under study. The percentages and statuses related to the literature reviewed are listed in Table 1.

Table 1

Summary of Literature Review

Reference type	Total	Published less than 5 years ago	Published more than 5 years ago
Peer reviewed	78	70	8
Non-peer reviewed	13	10	3
Seminal source	3	0	3

Application to the Applied IT Problem

The purpose of this qualitative pragmatic study was to explore strategies used by IT managers to transition their e-commerce organizations to chip-and-PIN credit card authentication infrastructures. In the literature review, I addressed the specific IT problem

and strategies applied to implement chip-and-PIN credit card and POS authentication infrastructures. The first portion of the literature review includes a description of the impact of the IT problem and importance of having a concerted strategy to address the problem. In the second area of the subsection, I discuss the IDT conceptual framework and the application of IDT constructs to the IT problem. In addition, literature outlining previous IDT research and findings are presented. In the closing subsection, I summarize the literature review, emphasizing the application to the IT problem and need for further research study.

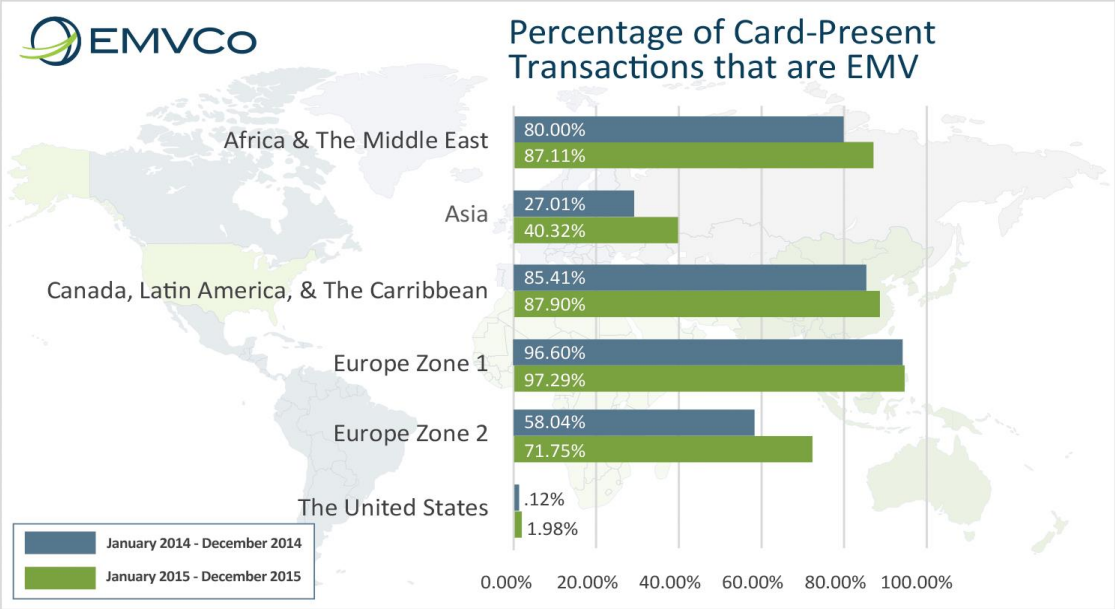
According to the 2013 Federal Reserved Payments Study, the estimated number of unauthorized card payment transactions in 2012 was 29.5 million, with a total loss estimated at $3.9 billion (Gerdes et al., 2013). The U.S. Department of Justice, Bureau of Justice Statistics, National Criminal Justice found approximately 66% of credit card fraud victims experienced a financial loss (Harrell, 2015). The main theme and phenomena under study was the lack of chip-and-PIN credit cards and POS-enabled terminals in the United States. A federal and financial institution compliance mandate required organizations to implement the more secure chip-and-PIN capability by fall of 2015; however, some retailers have not fully converted to the full implementation, forcing customers to use the older magnetic strip methods to authenticate their purchases (Bush, 2016). The two-factor authentication process, using chip-enabled terminals with a secret PIN, provides a more secure electronic payment transaction.

Despite the increase in issuing of chip-and-PIN credit cards by the banking institution, some merchants are still not capable of providing chip-enabled authentication

infrastructures (Bush, 2016). Some merchants have upgraded POS terminals; however, their networks are not enabled or certified to accept chipped cards. Recent banking statistics indicate an increase in U.S, EMV payment transactions, but minimal in comparison to other continents and nations, such as Europe, Africa, Asia, Canada, Latin America, and Caribbean (EMVCO.com, 2016; Milker, 2007; Shepard, 2016; Wakamori & Welte, 2017). Figures 1 and 2 show the comparison with other continents.

Figure 1

Statistics of EMV Transactions



Note. Adapted from "MasterCard Reports Strong US EMV Uptake. 2016. EMV CHIP Deployment statistics," by R. Boden, 2016 (http://www.NFCworld.com). Copyright 2016 by Taylor & Francis LLC. Reprint with permission.

Figure 2

Statistics of EMV Chip Card Deployment and Adoption

Worldwide EMV Chip Card Deployment and Adoption*

	2013		2014		2015	
Region	EMV Cards	Adoption Rate	EMV Cards	Adoption Rate	EMV Cards	Adoption Rate
Canada, Latin America, and the Carribbean	471M	54.2%	544M	59.5%	680M	71.7%
Asia Pacific	942M	17.4%	1,676M	25.4%	2,459M	32.7%
Africa & the Middle East	77M	38.9%	116M	50.5%	160M	61.2%
Europe Zone 1	794M	81.6%	833M	83.5%	881M	84.3%
Europe Zone 2	84M	24.4%	153M	40.4%	200M	52.3%
United States	-	-	101M	7.3%	394M	26.4%

*Figures reported in Q4 of 2013, 2014, and 2015, respectively, and represent the latest statistics from American Express, Discover, JCB, MasterCard, UnionPay, and Visa, as reported by their member institutions globally.

Note. Adapted from "MasterCard Reports Strong US EMV Uptake. 2016. EMV CHIP Deployment Statistics," by R. Boden, 2016 (http://www.NFCworld.com). Copyright 2016 by Taylor & Francis LLC. Reprint with permission.

Data collected by MasterCard indicated a 105% increase in chip-and-PIN card usage since the October 1, 2015 transition of liability to merchant's deadline (Shepard, 2016). Even with the risks of liability for fraud and abuse of noncompliance credit cards, the 2 million merchants using chip-and-PIN enabled networks account for only 33% of U.S. merchants using chip-and-PIN card technology (Boden, 2016). According to Peter Larkin, President and CEO of the National Grocers Association,

> None of these delays are the fault of merchants, yet it's the merchant who is facing an onslaught in new chargebacks as well as confusion among consumers who don't understand why they can't use their chip cards at their local supermarket. (Karolefsk, 2016, p. 1).

Implementation of chip-and-PIN card technology in U.S. e-commerce markets is lagging behind the expectations of the payment card industry standards.

The comparisons between the U.S. credit card industry and other nations shows a great deficit and limited progress in improvements in U.S. credit card authentication technology infrastructure and protection of customer privacy (Boden, 2016; Wakamori & Welte, 2017). Credit card transactions using chip-and-PIN reduces security risks because EMV transactions at chip POS terminals provide more security of consumers' personal data than magnetic strip POS transactions (Foxworth, 2015). Rockwell (2013) argued that payment cards are often targets of fraud schemes that victimize the issuing financial institution and individual cardholders. The physical characteristics of payment credit cards can determine the ease at which they can be compromised, and typical counterfeiting methods were linked to counterfeit payment cards (Rockwell, 2013). Credit card fraud is mostly associated with credit cards equipped with only magnetic strip authentication features that are not capable of the chip-and PIN process at POS terminals (Cepeda et al., 2015). The findings from these studies show and support the need to implement the transition from magnetic strip authentication to the chip-and-PIN process.

With the growth in debit and credit cards as the main method of paying for services and products, there is a need for improved security of the card-based authentication system. Organizations must implement their IT solutions and innovation in an ethical manner (Kernaghan, 2014). Vendors are obligated to protect the customer's privacy rights under the Fair and Accurate Credit Transactions Act (Cepeda et al., 2015). User's acceptance of the new technology is critical for the successful implementation of

the chip-and-PIN authentication systems. The usage of credit cards is aligned with consumer confidences in the protection of their data and privacy (Arief & Adzmi, 2015). Customers will discontinue the use of credit cards at POS terminals if they believe the systems are unsecure. Implementing and educating customers on the increased security of the chip-and-PIN authentication systems will provide them with the confidence needed to continue using the convenience of credit cards.

Current trends for protecting access to computing environments include multifactor authentication. Two-factor authentication is a proven method used to ensure the right individuals and only that user can access data, providing confidentially (Choi & Park, 2015). Secure authentication is accomplished when a user must use two different identity factors to complete the authentication process (Kaur & Pathak, 2015). Combining biometrics technology as one element in the two-factor authentication process increases the security capability and complexity; biometric authentication includes the use of fingerprints, iris scans, face, and voice recognition (Martinovic et al., 2017). Multiple researchers have validated the advancement in the use of biometrics as a means for user authentication, with the possibility to use data representation modules within multimodal biometric systems to take advantage of facial recognition (Choi & Park, 2015; Martinovic et al., 2017; Moon et al., 2015). Payment card industry (PCI) systems can benefit from the dual usage of biometric systems for both data collection and user authentication (Choi & Park, 2015). The implementation of two-factor authentication methods demonstrates the potential effectiveness of using biometrics as a method of increasing security beyond smart card authentication.

Chip-and-PIN Smart Card Technology

Chip-and-PIN enabled credit card technology is an effective method of implementing two-factor authentication (Smith et al., 2018). The leading system for smart card-based payments worldwide, EMV, is widely deployed in Europe and is starting to be introduced in the United States as well (Bond et al., 2015). Chip-and-PIN enabled credit card technology is the foundational method used in e-commerce, two-factor authentication. The chip-and-PIN authentication process requires certified hardware and software systems to take full advantage of the more secure electronic fund transfer authentication method (Fourar-Laidi, 2013; PCI DSS, 2018).

Organizations are implementing various infrastructures that allow them to have secure e-business transactions. Bond et al. (2015) found that despite this wide deployment, a series of significant vulnerabilities make EMV vulnerable to the replay attack. Implementing changes to security specific protocols within the security authentication process and introducing a new authentication scheme will increase the strength of smart card authentication (Jiang et al., 2015). A framework-based solution can use smart cards to store keys and perform cryptographic algorithms, allowing e-commerce partners to realize secure transactions (Fourar-Laidi, 2013). Shin et al. (2013) expanded on the ideas of emerging capabilities in the dual-chip contactless card. There is the ability to overcome the insecure credit card transaction by using biometrics to activate the smart card technology. Elements and principles used in the listed technology can provide benefits for all stakeholders and support strategies in gaining IT investment funding support from C-level officers (Shin et al., 2013). Fully communicating the risk of

conducting insecure electronic fund transfers to both customers and vendors will support the organization's business needs statement and potential benefits to their profits.

The use of business intelligence is improving the effectiveness of companies in understanding their customers' requirements and increases the return on investment of their business initiatives (Ogiela & Ogiela, 2014). Converting the raw data collected from customers into business intelligence requires organizations to collect sensitive and confidential information from their customers (Soilen, 2016). Banks use their customer databases and analytics tools to craft highly sophisticated pictures of their customers' and prospects' values, profitability, and credit risks and then bombard them with 2 billion credit card solicitations every year (Peppers & Rogers, 2013). Credit card information and consumer usage habits are maintained in databases, presenting increased risks to customer privacy (West & Bhattacharya, 2016). Organizations must have a comprehensive strategy for implementing secure credit card transaction authentication and protection solutions.

IT managers are responsible for providing the most secure computing environments for their organization's users, both internal and external. With limited implementation of chip-and-PIN credit card authentication systems within the United States, protecting customers from credit card fraud, privacy, and stolen PII requires a viable IT strategy that compliments the organization's business strategy. Drnevich and Croson (2013) found that without an alignment between business and IT strategies, a business will not be effective. The relationships and confidence between the CEO, CIO, and IT managers are essential elements to ensure IT solutions contribute to the overall

strategy of the organization. Supporting the CEO's strategies with IS contributions is a key factor in successful organizations (Johnson & Lederer, 2013). Well-developed IT strategies and investments increase the performance of an organization (Mithas & Rust, 2016). The IT manager plays a key role in developing and executing the IT investments to secure their IT infrastructures and gain stakeholder buy-in for new systems.

Data and financial data security are a significant concern in business and in IS education from both a technological and a strategic standpoint. The establishment and requirements of the Payment Card Industry Data Security Standard (PCI DSS), and the associated consequences for noncompliance, represents a business-like approach to the organizational protection of data (Willey & White, 2013). PII, electronic health records, and financial data are prime targets for hackers seeking means to compromise the privacy of individuals. Performing and evaluating qualitative IS research is best conducted using a proven methodological framework (Antonenko, 2015; Green, 2014). Advancing an organization's business model to e-commerce requires a well-developed strategic plan and framework (Kaptein & Parvinen, 2015). The environmental concern must be considered to develop the appropriate framework and explore the factors needed to successfully evaluate the phenomenon. In some instances, a combination of multiple frameworks may be required to accurately measure the acceptance of innovation and the concerns of the environmental culture (Ho et al., 2015). Organizations must identify and use a comprehensive framework to accomplish their chip and PIN credit card authentication implementation strategy.

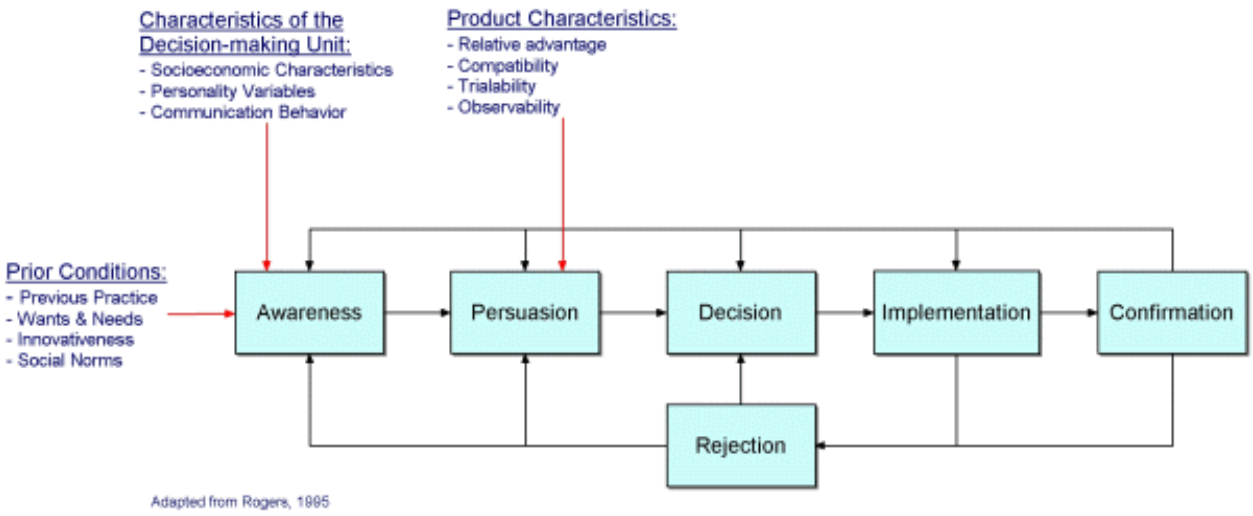
Diffusion of Innovation Theory, Core Elements

In 1962, Rogers framed the IDT. The IDT is a model used to define how innovative ideas are disseminated among people in society. The core elements of the IDT are awareness, persuasion, decision, implementation, and confirmation. The innovation diffusion theory model is depicted in Figure 3. Innovation defines the introduction of a new idea. Diffusion is an effective method to introduce new ideas to people in a social network (Dutta & Omolayole, 2016). The IDT provides tools to determine the factors, uncertainty, resistance, and rate of diffusion of a technology (Zsifkovits & Gunther, 2015). For a better understanding of the phenomena and ability to confer the themes to the reader, creating visual models and mapping is very effective means to demonstrate the point (Antonenko, 2015). The innovation diffusion framework will be an excellent means to evaluate, study, report findings, and make recommendations for future research.

In 2003, Rogers refined, popularized, and documented the DOI, explaining how innovation is communicated in a social system. The diffusion of innovation theoretical framework will be used to conduct this qualitative pragmatic study. The IDT model is depicted in Figure 3.

Figure 3

Graphic Illustration of Innovation Diffusion Theory Model



Note. Adapted from *Diffusion of Innovations* (5th ed.) by E. Rogers, 2003, Free Press. Copyright 2003 by Free Press.

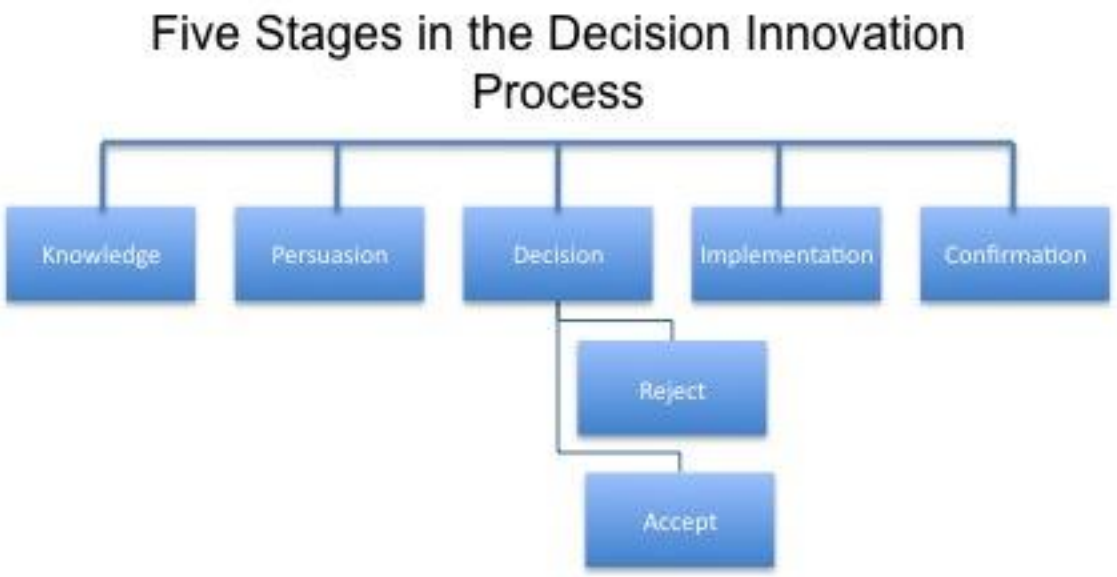
Innovation diffusion is an effective research concept, used in the decision-making process for EIT (Cegielski et al., 2013). The innovation-decision process consists of five main levels: knowledge, persuasion, decision, implementation, and confirmation.

1. Knowledge: The process of learning about the innovation or the phenomenon.
2. Persuasion: The time in the process where personal feelings and value judgements are made to form a final perception on the innovation.
3. Decision: The actual process of communicating a final stand on which to act on the innovation.
4. Implementation: The process of using the innovation.
5. Confirmation: The process is used to evaluate the decision and results of the implementation, for the validity of the innovation.

The innovation-decision process model is depicted in Figure 4.

Figure 4

Graphic Illustration of Innovation-Decision Process Model



Note. Adapted from "Evaluating Adoption of Emerging IT for Corporate IT Strategy: Developing a Model Using a Qualitative Method," by C. G. Cegielski, D. M. Bourrie, & B. T. Hazen, 2013, *Information Systems Management*, 235-249. Copyright 2013 by Taylor & Francis LLC. Reprint with permission.

Without an established framework, it is difficult to adequately define the concepts and themes of the study (Antonenko, 2015). Cegielski et al. (2013) EITs represent an avenue for enhancing the effective and efficient flow and utilization of information within the organization to support business objectives and, ultimately, firm performance. This research study applied the constructs of the innovation-decision process, to gather and analyze input and open feedback from IT managers. Innovation stems from knowledge recombination of prior discoveries and applications, the individual capacity to

search for knowledge over both familiar and unfamiliar technological domains is also likely shaping fundamental processes in creativity, problem-solving, and innovation within organizations (Van Knippenberg et al., 2015). Caiazza and Volpe (2017) used the innovation diffusion process to study the adaptation of precision farming technologies. Zhang et al., (2017) emphasize the importance each stakeholder and their efforts to bring about IT innovation acceptance within their organization. Successful IT solutions depend on the effective implementation of a strategic framework such as the innovation diffusion processes, between stakeholders and their customers. The phases of the innovation diffusion process assist in identifying roles; innovator, adopters and, intermediaries essential to applying the technology (Caiazza & Volpe, 2017). Using the innovation diffusion process, I was able to identify the key implementation players and stakeholders in a successful implementation of chip and PIN technology.

The decision, implementation, and confirmation phases of the innovation-decision process were the three main themes within my doctoral study. These three phases were selected based on their alignment with the strategic critically of getting stakeholders buy-in and witnessing the success of end-user usage of the strategy. The decision phase addresses the need to convince the organization leadership to adapt the technology and communicate the security advantages to consumers. Leaders, within an organization, are critical to creating the culture for change and be enablers for innovation (Camps & Molina, 2014). The implementation and confirmation phases covered the banking industry issuing of chipped credit cards, POS hardware installation, software certification, and customers successfully completing PIN and chip transactions. Denning

and Dew (2015) found that 90% of innovation is in fostering adoption. Organizations are often slow to adapt new innovations, based on perceived risks and cultural attitude towards change (Martins et al., 2014). Adopting change requires the ability to listen for concerns, histories, movements of social power, barriers, moods, reactions to offers, and followers in networks (Denning & Dew, 2015). In the decision phase, the IT manager must have a strategy which can convince stakeholders within his organization to adapt the new IT innovation.

Cost savings is one of the most popular factor in the means of persuading organizations to adapting new information technology. Franceschinis et al. (2017) evaluated the coherence of the underlying preference structure using as criteria psychological constructs from the theory of diffusion of innovation. Using the theory of diffusion of innovation was a means to validate the theory by providing evidence of segmentation of the population consistent with the individuals' propensity to adopt innovations (Franceschinis et al., 2017). Franceschinis et al. findings indicated that preferences for heating systems and respondents' willingness to pay for their key features vary across segments. "These results enabled us to generate maps that show how willingness to pay estimates vary across the region and can guide local policy design aimed at stimulating adoption of sustainable solutions" (Franceschinis et al., 2017, p. 314). Potential cost savings are very effective incentives to gain support and funding for new technology.

The medical industry benefits from the uses diffusion of innovation conceptual theory in research and implementation of new medical procedures and equipment. "Our

aim was to examine the speed (number of publications over time) and spread (across institutions) of each innovation and interpret uptake relative to innovation attributes, the social system, and communication channels" (Cadarette et al., 2016, p. 151). The Islamic community, often seen as a group which is slower to fully adopt technological innovations, provided a great opportunity to validate the effectiveness of the diffusion of innovation conceptual theory. Jamshidi and Hussin (2016) applied the innovation diffusion theory in their review of the adoption and understanding of credit card usage in the Islamic community. In the medical service industry and Islamic community, Jamshidi and Hussin's finding showed the alignment of customer satisfaction with services has a noticeable final impact on social influence.

Valente et al. (2015) incorporated the diffusion of innovation theory in their study to understand the level of efforts for diffusion of future information. Stages in the diffusion of innovation theory were effective in measuring the status of organizations and adopters within the innovation network. Valente et al. findings showed that online communication networks accelerated the ratification process. By using the data and analysis produced from the stages in the theory, the World Health Assembly can develop specific communication plans to spread the Framework Convention on Tobacco Control (FCTC) information about tobacco use and health safety.

The diffusion of innovation theory can be used to compliment other theories and framework within a study. In a study conducted by Nehme et al. (2016) the research measurement properties were designed to align the transtheoretical model (TTM) stages of changes with the diffusion of innovation theory stages. In comparison, the DOI staging

approach was more effective than the TTM at classifying the readiness for adopting change (Nehme et al., 2016). One of the main findings was the advantage of using a theory-based construct from outside the normal methods to evaluate health behavior research (Nehme et al., 2016). The combined research analysis theories were successful in identifying the value which transportation bicycling provided towards preventing the risk of chronic diseases.

Given the popularity of the internet, networks, and infrastructures used to connect the global exchange of information on the internet is affected by the innovations of diffusion in technology as well. Chen and Li (2014) conducted a study to analyze the complex dynamics of technical upgrades in the innovation of diffusion process. Chen and Li introduced the concept of Diffusing Mode of Innovation in the study. The mode included several types of innovation: institutional innovation, innovation of management, and technical innovation. Technical innovation occurs quickly and is usually forced on to other industrial networks to keep up with the standard. According to Chen and Li industrial network is a scale-free network, it makes the diffusion of innovation on industrial network very easily, and each enterprise has different affection on the whole industry. Technical innovation diffusion is an enabler for other forms of innovation, as supporting innovation infrastructure and knowledge management innovation multiplier.

Another perspective of adoption of innovative technology is the difference between men and women, in regard to accepting new technology. Dutta and Omolayole (2016) conducted a study of the influence of gender on the accepting technology and innovation diffusion. Internet usage was technology measured in the study. The study's

initial indications were that women prefer using information technology largely to satisfy their bonding and sharing nature whereas men prefer using information technology essentially as an enabling tool that enhances their abilities (Dutta & Omolayole, 2016). Despite minor differences between genders, the results indicate that acceptability to new information technologies are gender neutral (Dutta & Omolayole, 2016). The diffusion of innovation conceptual theory proved once again to provide valuable insight in quality research studies.

The diffusion of innovation conceptual theory has historically been applied to many different industries to understand their best strategies to implement new technology. Harvey (2016) used the innovation diffusion concepts in his research on the adaptation of the new 45 RPM single and 33 RPM album technology in the recording industry. The standardization of the 45 RPM single and 33 RPM albums in 1951 forced the recording industry to rethink their marketing strategies (Harvey, 2016). Findings from the study conclude that the industry tended toward sub optimal, risk-averse strategies, and that the LP likely succeeded despite record companies' efforts to control their products and messaging (Harvey, 2016). The diffusion of innovation conceptual theory was successfully used to gauge a major change in not just the recording industry, but to how it affected society as a whole.

Similar to the changes in the music recording industry, the travel industry transitioned from store front services agencies to more services being provide online. The travel communities and travel service agencies experienced a major change in the way consumers acquire travel process and arrangement. With more consumers making their

own travel arrangements with online booking sites, Agag and El-Masry (2016) conducted a study using the IDT and TAM models to explore the behavior and intentions of customers to conduct their travel process online. Customers were more positive towards using online travel services than visiting a travel agency office. The findings indicated that users of the online travel community services were more likely to recommend the services to others (Agag & El-Masry, 2016).

Eastwood et al. (2017) used the diffusion of innovation conceptual theory process to study the adaptation of precision farming technologies. The primary purpose of the study was to examine the interaction and distribution of research and extension roles of public, private, and agricultural industry organizations in precision farming innovation systems. A timeline analysis method, underpinned by a function of innovation systems framework, was used to examine activities of actors and organizations in the case studies (Eastwood et al., 2017). One of the major findings from Eastwood et al. study was that complex agricultural innovations require a collaborative approach for successful innovation and diffusion. As earlier mentioned, the innovation diffusion process was used to identify key roles and the impact they had on the adoption of new innovations.

In Nieuwenhuijsen et al. (2018) quantitative study, a diffusion of innovation theory was used to determine the acceptability of automated vehicle technology. Despite the multitude of advantages offered by automated and self-driving vehicles, there was no major increase in the purchase of those vehicles. One of the main themes identified from using the DOI theory was that the maturity of technology in automated vehicles were in direct relations with market size. DOI analysis provided valuable and iterative feedback

about the rate of acceptance of vehicles and sales of automated vehicles. Nieuwenhuijsen et al. findings were able to show the gradual acceptability of new automation features in vehicles over a longer period of time.

Research using a DOI theory methodology is prevalent in many technology disciplines. Hosseini et al. (2015) study involved the aspects of diffusion of innovation in the architecture, engineering, and construction industry. To ensure safety to populations, architecture, engineering, and construction methods are being standardize globally. It was important to study the global understanding and usage of the innovation of diffusion methodology within these industry communities of practice. Global virtual engineering team's efficiency and effectiveness are affected by the level of acceptance of the innovative technology. According to Ozorhon et al. (2014) findings, innovation barriers are responsible for the limitations experienced in construction organizations. Implementation of innovation diffusion within construction is highly depending on government enforcement (Na Lim, 2014).

Simpson and Clifton (2017) used diffusion of innovation in their study of early adopters of solar energy in Australia. The goal was to demonstrate that Rogers' theory would benefit the adoption of emerging solar technology, based on incentives. Government policies promoting the new technology through diffusion of innovation was evaluated, especially providing financial incentives. Simpson and Clifton findings attest to the effective use of incentive to drive the adoption of innovation. No matter what industry diffusion of innovation is a critical element to move technology forward.

Zhou and Li (2014) employed the diffusion of innovation theory in their analysis of the carbon emission reductions in China. The intent was to analysis how improvements, acceptability, and use of new technology could decrease the carbon emission affecting the population. According to Zhou and Li findings indicate economic growth is driving up carbon emission. However, industrial enterprises implementing technology innovation diffusion techniques could increase technology measures to reduce carbon emission. Zhou and Li study is another example of the wide-reaching effect and values the diffusion of innovation conceptual theory has in the analysis of accepting technology innovation.

When considering the possible conceptual frameworks and theories, the public-sector innovation (PSI) theory was reviewed as a possible framework. Gow (2014) presents a variety of samples in innovation theories to examine possible changes within the PSI theory. The outcome seems to be two themes in innovation theory changes. Innovation is seen either through a structured process or a continuous series of events in trial and errors. It seems that there is still important disagreement about what constitutes a true innovation, with the debate centering on the merits of a multitude of lesser improvements versus a smaller number of major, disruptive, changes (Gow, 2014). Glor ‘s (2015) grounded theory approach to examining the innovation of change within organizations argues that researcher cannot apply preset categories immediately, but must develop substantive theory first, then see if others’ categories are linked to the emergent substantive theory. The PSI theory would limit the potential applicability of this research study, excluding the value to private sector organizations.

In addition to the innovation diffusion theory conceptual framework, literature exploring the UTAUT and TAM theories for IT services were widely reviewed, as possible conceptual frameworks to conduct this study. The constructs: performance expectancy, effort expectancy, social influence and facilitating conditions, of the UTAUT theory is widely used to evaluate end-user ’s adaption to innovation and information system changes (Chang et al., 2016). UTAUT is a mature conceptual framework, developed on the improvement from other proven theories of technology adoption (Rahi et al., 2018). UTAUT was used to provide a comprehensive model of user’s motivation to use mobile payment card systems (Morosan & DeFranco, 2016). Maillet et al. (2015) study findings were very comprehensive; however, demonstrated some limitation in the use of UTAUT to gain a totally non-refutable study result. Khalilzadeh et al. (2017) used the hybrid of the UTAU and TAM theories to incorporate the user’s attitude in an effort to increase the efficacy of their study. The TAM theory is often used to analyze data and information collected for quantitative and mixed method studies. Tan et al. (2014) findings confirm that convenience is a key factor in mobile payment adoption. If consumers find the innovation useful, they are more likely to adopt the services offered (Rahi et al., 2017). Seetharaman et al. (2017) study using the TAM model validated an 85% supportability of acceptance of mobile wallet in Singapore. This is particularly in view of the advantages brought about by mobile credit card over cash or credit card payment in terms of quicker and more convenient transactions. In the Tan et al. study, the model only takes into consideration two constructs, resulting in the overall prediction as not considered to be complete. Under that circumstance, the PSI, UTAUT, and TAM

conceptual theories were not sufficient to be the independent conceptual framework, requiring additional constructs to defend the findings of the study.

IT is constantly changing. The methods and conceptual models used to measure changes and innovation must be adaptable to changes in technology. Overemphasis on construct measurement can lead to operationalism: a naive empiricism that reduces a concept to its measures. Substituting operationalization for conceptualization means that the original assumptions and meanings underlying the concept are left unexamined (Welch et al., 2015). One model can totally represent all factors affecting the adoption of innovation by customers (Park & Lee, 2014). Caiazza (2016) study provided insight into the importance policy maker exert on the overall success of innovation diffusion. Legal, economic, technical, and cultural barriers degrade the process of diffusion (Caiazza, 2016). Without the support of policy-maker to adapt appropriate policy and governance, consumers and providers of technology innovations suffer from innovation barriers. Focusing the questions in the study on those three main phases of the innovation theoretical framework ensured sampling data saturation on the main themes of the research study. Given the main objective of the study, the diffusion of innovation theory was used to evaluate, study, report findings, and make recommendations for future research.

Previous Research and Findings

Previous research conducted on smart card technology, like chip-and-PIN technology, show the favored potential for security. However, research indicates that organizations are not taking full advantage of the value. Conroy's (2014) article is a

summary of the state of chip-and-PIN credit card usage in the United States. “Despite the liability deadline, by the end of 2015 only 70% of credit cards in the U.S.A. are expected to be EMV-ready, and only 41% of debit cards. This is according to a report released by the Aite Group in October 2014” (Conroy, 2014, p. 1). Banks and vendors will be held responsible for protecting the integrity and privacy of the credit card. “According to the Aite report, credit card fraud has doubled from 2007 to 2014, reaching 10 cents out of every $100 in transactions. Most financial institutions are preparing to use Chip-and-Signature to secure credit cards, and Chip-and-PIN to secure debit cards” (Conroy, 2014, p. 1). After the banking industry issues all credit cards with chip technology, the security risks and financial liability transfers to vendors and their point of sales systems. In addition, Conroy (2014) illustrated the financial costs to credit cards holder and banking industry. The data supports the negative impacts of vendor’s credit card authentication systems not moving to the new chip technology.

Users must trust in the security of the emerging technology before they will use it. Jones and Leonard, (2014) study tested a model of buyer's trust in customer to customer e-commerce. By examining previous trust models, perceived web site quality, third-party recognition, fear of seller opportunism, information asymmetry, and Internet safety training were found to influence buyer's trust in conducting e-commerce transactions (Jones & Leonard, 2014). Tsohou et al. (2015) argued that security awareness processes are associated with interrelated changes that occur at the organizational, the technological and the individual level. Organizations which can provide consumer confidence in their

products and security of their organization business systems are more likely to keep their customers and strive financially.

Vuori and Huy (2016) conducted a qualitative study of Nokia to understand its rapid downfall over the 2005–2010 periods from its position as a world-dominant and innovative technology organization. The authors found that top and middle managers' shared emotions during the smartphone innovation process caused cycles of behaviors that harmed both the process and its outcome. Vuori and Huy study showed managers were afraid of external competitors and shareholders, while middle managers were mainly afraid of internal groups, including superiors and peers. The authors findings indicate that shared emotions can hinder the subsequent integration of attention, influencing innovation processes and outcomes and resulting in temporal myopia—a focus on short-term product innovation at the expense of long-term innovation development.

There were previous research and study findings from multiple functional areas supporting the effectiveness of using biometrics as a method of increasing security beyond smart card authentication. Moon et al. (2015) study improve on the theories and scheme findings presented by Lu et al. study on advanced scheme authentications. The recommendation is to use the findings and collection of empirical data to support the need for further study in the application of credit card smart card technology. Jiang et al. (2015) study supports the premises that smartcard authentication is more secure than simple login ID and password authentication. Jiang et al. findings support the capability for enhanced technical controls of the authentication process, leaving opportunities to

further inquire about the human behavior aspect and reasons for the slow implementation of smartcard usage in the United States.

There are statistics demonstrating the abuse and misuse of card credits in electronic payment transactions. According to the 2013 Federal Reserved Payments Study, the estimated number of unauthorized card payment transactions in 2012 was 29.5 million, with a total loss estimated at $3.9 billion (Gerdes et al., 2013). Gerdes et al. (2013) covered a variety of payment statistics including the charts and graphs, giving an unexpected visual effect and interpretation of the data. The data presented in the study provides enough data saturation to confidently substantiate the premises of abuse in unauthorized credit card transactions. However, it is limited to data, that was collected 7 years ago, leaving opportunity for further research efforts.

The U.S. Department of Justice Bureau of Justice Statistics National Criminal Justice finds approximately 66% of credit card fraud victims experienced a financial loss (Harrell, 2015). Collins (2015) presented up to date information on the use and circulation of EMV cards.. The fact that the credit card company expects 60% of all large U.S. retailers to have implemented EMV by the end of the year. EMV transactions specific algorithms are not publicly known, criminals cannot (easily) replicate the algorithm to produce counterfeit credit cards (Collins, 2015; Martinovic, et al., 2017). The findings indicate the value of using a chip and PIN technology to conduct e-commerce transactions.

Those Federal Bureau of Investigation (FBI) statistics were used in my research study to emphasize the additional network security benefits of using two-factor

authentication. In addition, EMV card transactions transmit data between the merchant and the issuing bank with a special code that is unique to each individual transaction. The unique transaction code provides the cardholder greater security and makes the EMV card less vulnerable to criminal activity while the data is transmitted from the chip-enabled PoS to the issuing bank (Foxworth, 2015; Shu et al., 2016). Kamel and Lanet (2013) described and defined the most common and dangerous attack named cross site scripting and propose solutions to prevent and check if the Web application is well developed, by applying secured development methodology. Kamel and Lanet study demonstrates the lack of knowledge of technical solution providers in the methodologies available for securing e-commerce smart card transactions. Hendi (2011) study demonstrates the effective uses of chip-and-PIN authentication to deter credit card fraud. Reduction in credit card fraud was successfully tracked over a period of years to substantiate the technology as the leading cause for the reduction. There was quantifiable evidence that the majority of credit card crimes against the United Kingdom credit card owners were committed from overseas, by using stolen credit card information in countries without upgraded chip-and-PIN authentication technology (Hendi, 2011). Lewis et al. (2014) findings indicate that a lack of security in e-commerce infrastructures are technology-related obstacles and barriers to international e-commerce. Research shows credit card transactions without chip and PIN technology introduces vulnerabilities to the global payment card industry.

There has been progress made in the uses of empirical studies, to further the transfer of knowledge to the information security industry. Hemphill and Longstreet

(2016) acknowledged the constant changes to security evaluation measures, challenges to restore confidence in technology security standard. It is important to understanding the cybercrime impact to stakeholders and providing them adequate information with methods for practical applications to protect credit card users (Arief & Adzmi, 2015). Choi and Park (2015) found the need for further research on multimodal biometric systems and supports my premise for a further doctoral level research study. Shin and Lee (2014) expanded on the ideas of emerging capabilities in the dual-chip contactless card, using a user's fingerprint to active electronic payment transactions without the requirement to interact physically with a POS terminal. There are future challenges to improve credit card fraud detection frameworks and continue the studies required to attracting more industrial contributions to body of knowledge (Fiore et al., 2017). The security of electronic fund transfers using credit cards requires continuous review, application of emerging technologies, and innovative methods for improvement.

Implementing chip and PIN technology is essential; however, validation and continuous improvement to the system is required. In a study by Ouerdi et al. (2013), the authors address the need to conduct vulnerability testing as a prerequisite to building security into trusted credit card security systems. The scope of the study was to develop robust test cases and run exploiting attacks against the vulnerability within the payment systems. Ouerdi et al. generated vulnerability test cases based on models of EMV specifications. The findings from this study provided supporting data for establishing relevant content to my research study and need for additional rigorous testing of authentication processes.

After a major comprise and data breach is conducted successfully, organizations must be able to react to the effects. Organizations must acknowledge, repair, and provide protection from future threaten events. Bahnsen et al. (2015) using a real credit card fraud dataset provided by a large European card processing company, compared state-of-the-art credit card fraud detection models, and evaluated how the different sets of features have an impact on the results. The authors present statics, conceptual theories, and frameworks about security breaches and trust repair strategies in their study. Wan and Zhang (2014) argued managerial step can lessen concerns about "cheap talk" and the limitations of mere words to repair trust after a violation. Wan and Zhang study proposes possible research suggestions about repair after privacy breach incidents. An important part of the implementation of a new authentication system is to gain back the confidence of the customers affected by the previous security breach. This information supported the quality of the data collected for the doctoral study.

In their efforts to reduce security risks and limit financial liability caused by security breaches, organizations are seeking other secure methods process credit card transactions. Lundberg et al. (2014) shed light on how retailers view alternative payment forms and to what extent they are willing to risk offending their customers by imposing payment restrictions. The focused was solely on the retailers' point of view on the payment stage, implying a need for additional research on customers' and bank representatives' views on the same matter. Citizens and stakeholders buy in is critical in successfully implementing smart technology (Yeh, 2017). A study by Lundberg et al. focuses on how the banking industry has and can lead in providing a more secure e-

commerce. Lundberg et al. provides a comparison between European and United States banking industries. The United States has the largest number of financial loss due to credit card fraud. “In the United States, although fraud constituted less than 1% of total expenditures, credit card losses totaled $5.33 billion, an increase of 14.5% from 2011” (Figliola, 2015, p. 2). Growth in e-commerce, international trade, reduction of trade restrictions, market capitalization of new nations, and globalization increases the uses of credit card transactions. Increase access to automated teller machine and vendors accepting credit cards has increased the use of credits cards for travelers. Figliola findings show globally, card fraud totaled $11.3 billion in 2012, an increase of 15% from 2011. With statistical data validating the increase in credit card fraud, the implementation of chip-and PIN technology is an essential authentication technology, to reduce the growing problem.

The internet of things (IOT) has increased the capability of using near-field communication (NFC); virtual credit cards, credit cards payment services loaded on phones, iPad, token devices, and other Bluetooth credit card payment options. Shin and Lee (2014) described how mobile payment is the integration of near-field communication (NFC) enabled smartphones and credit/debit/prepaid cards. Using the TAM and Technology Readiness and Acceptance Model, Shin and Lee (2014) demonstrate how those conceptual frameworks can be effectively implemented in a doctoral study. The banking industry in South Korea provides a digital certificate for the online banking users at no cost. The personal digital certificate must be saved on a personal smartphone. Without buying hardware authentication token, online banking users in South Korea can

use their own smartphone for their authentication in South Korea. Shin and Lee study suggest that to be a successful payment service, the NFC mobile payment service must be much more focused on the usefulness against other alternative payment methods. This was a reliable source for presenting an alternate perspective other than chip-and-PIN.

One of the growing security problems with credit card transactions is the Card-not-present (CNP) vulnerability. Without the actual credit card being present during the transaction, other non-tangible factors must be validated, requiring the vendor to depend on the verbal confirmation of the person making the CNP transaction. Pouwelse and Bruggink's (2016) address the growing complications of securing credit card transactions by CNP transaction fraud, within a study. Pouwelse and Bruggink study indicate that card fraud is a key cybercrime activity, with a full-scale underground economy. Conducting the study in Europe allowed the authors to draw from the ample amount of data collected on their credit card systems. Pouwelse and Bruggink present an effective depiction of the contrast of card fraud in the USA compared to the rest of the world. Biza-Khupe's (2014) study examined consumer information acquisition activities for banking services by proposing a model postulating search as influenced by perceived benefits, perceived risk, perceived search cost and prior knowledge. The tests measured a comprehensive model of consumer credit search behavior using structural equation modeling. The implications of these findings to theory and policy, particularly as concerning rethinking financial information regulation in consumer financial markets (Biza-Khupe, 2014). CNP is the weakest area and highest risk facing the credit card payment transaction process. The findings from all recent studies indicate the importance of using the more secure chip-

and-PIN method of authentication. The value of chip-and-PIN is lost in a CNP transaction.

Security breaches, computer viruses, malicious codes, and new hacking methods are being developed every day. These security threats are having a macroeconomic impact on the global payment card industry (Banka, 2017). Preventing or reducing the damage of these security threats require continuous innovation of technology and how humans use technology. There is a crucial need to continue analyzing human aspects in information security, because technology alone cannot deliver complete security solutions (Ashish et al., 2017). A common theme expressed throughout the literature reviewed was the need to continue further research on the improvement of user authentication technology, human side of information security, and integrating it into all phases of the information systems development life cycle. Until a higher percentage of merchants implement chip and PIN capable infrastructure, there is ample reasons and justification to conduct studies to explore the IT problem. In addition, there are limited peer-reviewed documents and resources published addressing chip and PIN technology implementations in the United States. Most documentation references the implementations and statistics in Europe, Asia, and Africa.

Transition and Summary

The purpose of this qualitative pragmatic study was to explore strategies used by IT managers to transition their e-commerce organizations to point-of-sales smart card authentication infrastructures. In this section, I conducted an extensive literature review, revealing some example of the success of chip-and-PIN technology in other countries.

The review provided insight into the gaps in the body of knowledge addressing the insecurities of credit card purchase in the United States, without using chip and PIN technology.

The following two sections of this study presents a comprehensive synthesis of the selected theories and concepts, as they applied to the problem statement and purpose of the study. In section 2, I provided detail explanations of the researcher's role, data collection process, and methodology used to validate the quality of the data. For the third and final section, I included a summary of the data, findings, and application to IT discipline. Also, I summarized additional recommendations made for further study and benefits to social change.

Section 2: The Project

In Section 2, I present a comprehensive synthesis of the selected theories and concepts as they apply to the problem statement and purpose of the study. Detailed explanations of the researcher's role, data collection process, and validation of the quality of the data are also provided in this section.

Purpose Statement

The purpose of this qualitative pragmatic study was to explore strategies used by IT managers to transition their e-commerce organizations to chip-and-PIN credit card authentication infrastructures. The targeted population was IT managers in e-commerce organizations located in the United States who had strategies to transition their organizations to a chip-and- PIN credit card authentication infrastructures. In the findings of the study, I identified strategies that other IT managers can apply to efficiently transition their e-commerce organizations to a chip-and- PIN credit card authentication platform. The implications for positive social change include the increased security of credit card transactions and protection of consumer's PII as well as the reduction of fraud in the global e-commerce market and number of financial crimes committed.

Role of the Researcher

To examine each organization's chip-and-PIN implementation strategies, I was the primary interviewer and data collection manager. In a qualitative study, the researcher is heavily involved in the interview, data collection, and assessment processes of the phenomena (McClusker & Gunaydin, 2015). In their study, McClusker and Gunaydin compared the research method and design choices and indicated the role the researcher

plays in each design. From this comparison, they reported that the qualitative researcher was more immersed in the data collection activities of the phenomena than a quantitative researcher. I initiated all correspondence with the participants, conducted all interviewing sessions, and collected and maintained all the data (in the form of participant interview audio recordings, field notes, other empirical data, and data files) in the current study.

Although I have knowledge on the use of chip-and-PIN technology, no personal or professional relationships existed between me and selected participants. I used chip-and-PIN smart card technology on a daily basis to access my desktop computer at my workplace. Without a successful chip-and-PIN smart card authentication login process, I cannot access my computer or network resources in my organization, so I am very familiar with the topic. Until the participants were selected, I only knew them as members of organizations with a POS technology presence. Several of the potential participating organizations have their headquarters in the United States. I did not have any relationship to the geographic locations of the participating organizations. The organizations and geographic locations selected for this study were chosen based on their ability to broaden the reach of retail organizations with substantial amounts of POS technology presence.

To ensure I conducted the research study in an ethical manner, I followed all elements within the Walden University institution's ethical guidelines. I requested approval from the Walden University Institutional Review Board (IRB) to conduct my study. IRBs provide oversight on studies involving human subjects, protecting participants from unethical research practices (Cross et al., 2014). In my request for

approval, I provided my National Institutes of Health (NIH) Protecting Human Research Participants Certification Number 1794335 (see Appendix B) to the IRB. I protected the privacy and information of all participants by following the guidelines laid out in *The Belmont Report* (see U.S. Department of Health & Human Services, 1979). Under the rules established in *The Belmont Report*, interviewers are required to ensure all participants and protected sensitive groups are not harmed by the research and interviewing processes (Barker, 2013). I had a complete understanding of and then adhered to the guidelines of the Walden University IRB and *The Belmont Report* to ensure all participants were protected and the study was fully aligned with expected ethical requirements.

As a certified system engineer and IS security professional, I have vast experience and technical skills acquired throughout my 35 years in the IT security field. A researcher's experiences have influence on their interviewing methods and interpretation of the collected data (Anyan, 2013). Despite having experience in the field of study, it was important that I adhered to the interviewing strategies and protocol for best accuracy. In West and Kreuter's (2013) study on the behavior of interviewers, experienced interviewers were just as likely to make mistakes as non-experienced interviewers, whenever they did not stick to the observation strategies. Having vast experience and familiarity with the topic can present potential issues to the study concerning the researcher's influence and personal bias. Conversely, as an experienced professional and subject matter expert in the field under study, my experience may provide valuable insight on the best means to interpret the data collected. I mitigated bias by accurately

documenting the statements and contents provided by each participant. Immediately annotating and recording the answers of the interviewees reduced the risks of bias (see Chenail, 2011). I used a proven interview protocol and data collection technique, coding the data collected and removing the names and specifics of the participants. Aligning the coded data to the established themes removes potential risks to researcher bias (Pierre & Jackson, 2014). Instituting an effective interview protocol and data collection and coding processes and then following those standards rigorously reduced the possibility of bias in the study.

Conducting an effective research study relies on the ability to bring credibility to the data collected in the study. In a qualitative study, the interview process is a fundamental method used to collect most of the data to be analyzed. A qualitative study can be conducted using public available records, organization data, and interviews consisting of semi structured and open-ended questions (Zohrabi, 2013). Based on my pragmatic inquiry design, this study required me to be consistent in the way I conducted the interviews across all organizations. I used a general interviewing protocol method to gather multiple perspectives of an organization's experiences with implementing chip-and-PIN authentication technology (see Appendix C). An interview protocol is used by researchers to ensure the structure, elements, and questions are conducted the same across all interview sessions (Patton, 2015). Interview protocols keep both the interviewer and interviewee focused on the main research question and topics. Interviewing IT managers in different organizations provided the appropriate data sets to validate the research findings. I designed and presented the interview questions in a manner to ascertain

specific information from IT managers based on a comparison between the old methods of magnetic strip authentication and the new chip-and-PIN system. Maintaining consistency and integrity of the data collected is most efficient when an interview protocol is established, implemented, and followed (Castillo-Montoya, 2016). Using a general interviewing protocol method ensured the interview sessions were organized and credible in this study.

Participants

To gain the most accurate data about chip-and-PIN implementation strategies, e-commerce organizations were the targeted population in this pragmatic inquiry. The participants were IT managers within the organizations selected. IT managers within the organizations were interviewed because interviewing a group of subject matter experts is the best way to gather information to support a research topic (see Sutton & Arnold, 2013). Managers at the executive level make the decisions on how organizations will implement their security posture (Flowerday & Tuyikeze, 2016). IT managers are expected to guide the implementation of IT security measures within their organizations (Ashenden, & Sasse, 2013). Organizations experience high turnovers of their IT security managers due to the increased cybersecurity complexity and stress of the position (Clay, 2015). The inclusion criteria for the participants were 2 years of experience as an IT manager and 1 year of experience with their current organization. Senior managers and their understanding of the value of IT security in their organization is a critical factor in understanding and reducing security risks (Barton et al., 2016). The organizations' IT managers were subject matter experts who implemented security solutions within their

organizations and was able to authoritatively speak to the strategies used in their implementation of solutions.

My strategy to gain access to participants for this study included written correspondence, telecommunications systems, mail messaging systems, and online collaboration applications. I searched for participants in organizations that have an e-commerce presence. I received permission to interview IT managers, who were the selected participants within organizations. I initiated contact with interview candidates by web interface, email, or phone, if email was not possible. Phone communication with perspective participants is an effective means to ensure maximum participation in the study (Flood-Grady et al., 2017). I sent a formal invitation to participants through online collaboration software or written email along with a consent form included as an attachment. Two weeks was sufficient time to gain a response from the potential participants. Participants agreed to the interview session either by making a website acknowledgement, email confirmation, or official mail correspondence. The researcher's views and methods used in communicating with participants can affect the quality of the study (Berger, 2015). Phone calls, emails, and online collaboration events were used to schedule the culminating interviewing session for each IT manager. Online and other technological methods are available to conduct interviewing sessions; however, face-to-face interviews provide the strongest validity in gaining the most convincing study findings from participants (Bowden & Galindo-Gonzalez, 2015). Using the web collaboration tools, internet, "contact us" mailboxes, phone calls, and follow-up

scheduling calls gave me full access to participating organizations and their representatives.

To establish a working relationship with the participants, I scheduled a preliminary interview kick-off meeting. To build trust and gain the participant's confidence, I discussed the purpose of the study, explained the interview protocol, established the interview session framework, and confirmed the time schedule. Interviewers should have an interviewing concept and be familiar with the questions they will pose to participants (Mittereder et al., 2017). I explained the data collection methods, IS measures, and record storage procedures to the participants. Protection of participant information is required by law and enforced by the IRB process. Participants will be more willing to share information knowing that their information will be protected against unauthorized disclosure (Beskow et al., 2014). I used final follow-up and open-ended questions to get the interviewees to share their implementation strategies, experiences, and recommendations on how to best implement chip-and-PIN systems. Open-ended questions provide participants with the opportunity to explain their reasoning behind their initial answer to a question. (Yii et al., 2014). Member checking can be used iteratively to validate information provided to the researcher for clarity and alignment with the research question (Harvey, 2015). I used member checking to validate the accuracy of the data collected.

The researcher can establish a positive working relationship with each participant by providing an effective open channel of two-way communication, communicating expectations, synchronizing schedules, and following the interviewing protocol. To

ensure the main research question is answered by the appropriate participants, IT managers within organizations were the key person to interview. I abstracted study data from IT managers using an interview protocol, consisting of eight sub questions supporting the main research question. The IT manager had the opportunity to bring all available resources with them to the interview and were provided with enough time to answer each question in detail.

Research Method and Design

In this study, I employed a qualitative methodology with a pragmatic inquiry design as the most appropriate means to explore the themes of the phenomenon. In this subsection, I identify, discuss, and review other potential methodologies and designs that were considered. In addition, I explain and justify my research methodology and design decisions.

Method

I selected a qualitative methodology as the most suitable means to explore strategies used by IT managers to transition their organizations to chip-and-PIN credit card authentication infrastructures. I selected the qualitative method to engage in a more in-depth, exploratory dialog with participants interviewed in the study. A qualitative methodology allows the researcher to gain information on the participants' experiences and interpretations of the phenomenon (Sutton & Austin, 2015). Incorporating open-ended questions and taking detailed field notes allowed me to better understand the participants' responses to the interview questions and the themes they expressed. I used the open-ended questioning technique because it was effective in extracting a clearer

understanding from the subject matter experts' perspectives. My field notes helped me explain some of the nonverbal expressions made by participants.

The qualitative research method empowers participants to be more open and express themselves, resulting in a more comprehensive research study (Edwards & Brannelly, 2017). A more comprehensive study provides data saturation and more evidence towards establishing dependability in the findings of the research study. The qualitative research method gave participants the freedom to expound on their ideas, experiences, and application of their strategies. By empowering the participants to speak openly and unfettered, an interview question could initiate a richer discussion about a specific theme the participant may feel is more important to explain their experience of the phenomenon. A qualitative interview session also provides flexibility that allows the researcher to ask about and understand the whole experience of the respondent (Makrakis & Kostoulas-Makrakis, 2016). As a means to gain the full picture, I asked each participant to explain any other critical relationships and partnerships affecting the success of their strategies. Using a qualitative research method provided me with more agile and spontaneous interactions with my participants, allowing me to adjust the questions and model the study according to the emerging themes.

In the initial search for the best research method, quantitative and mixed-method approaches were two other methodologies considered. A quantitative methodology can reveal statistical information and test hypotheses of the past and current phenomenon (Frels & Onwuegbuzie, 2013). My assessment, of understanding the problem within the study, did not reveal a need to test a hypothesis or compare statistical analysis of the

organizations participating in the study. I did not think numerically grading each organization against each other organization would provide the insight and interpretation of feelings of individuals who experienced the phenomenon. Quantitative research findings are commonly used to conduct numerical analysis of a hypothesis, rather than non-numerical data assessments (Landrum & Garza, 2016). The approach of this study was not to measure variables, prove a hypothesis, or compare the statistical outcomes of each organization's strategy. The most important aspect of the study was to explore and understand the strategies that were used by each organization. Using a quantitative method would have limited the interpretation of the participant's experience in the phenomenon. A quantitative method provides more detailed information base on measuring specific variables but limits the interpretation of the phenomena experienced by participants (McCusker & Gunaydin, 2015). Given those factors, a quantitative study approach did not align with exploring the IT problem within the study.

Another methodology considered was a mixed-methods approach. A mixed methods approach is a methodology which uses the data sets and statistical results from a quantitative method combined with qualitative methods to further interpret the reason of a phenomenon (Mauceri, 2014). With the main intent of the study was to determine the strategies to answer the "how" and "why" questions, conducting an initial quantitative study would not align with the IT problem and research questions, within this study. Without a need to test a hypothesis or compare numerical statistical analysis of each organization, I believe there was no reasonable cause to conduct a mixed method approach. Tsushima (2015) findings indicated mixed-method research needs to be

constructed based on measurable variables and present information which cannot be accomplished by conducting either a single quantitative or single qualitative method. Based on Tsushima definition of a mixed methods approach, I did not believe the research questions in my study required conducting both a single quantitative and a single qualitative method to explore strategies used in a chip-and-PIN smart card authentication process. Conducting a mixed-methods approach can a create conflict of the established norms of both qualitative and quantitative approaches (Archibald et al., 2015). I think a mixed methods approach would confuse the themes, audience, and focus of the main research question. My decision was further supported by the fact that this study did not have a hypothesis. Therefore, a quantitative method or a mixed methods approach was not appropriate for this study. The qualitative method was used to explore the strategies used by some IT managers to transition their e-commerce organizations to chip-and-PIN credit card authentication infrastructures.

Research Design

A pragmatic inquiry design was used in this study. A pragmatic study is an exploratory research design of a phenomenon, to gain in depth insight from multiple groups of individuals experiencing the phenomenon (Lohre, 2020; Nipp et al., 2016). A pragmatic inquiry design was used to explore strategies by organization's IT managers. A pragmatic study is an effective design to investigate a contemporary phenomenon, utilizing participants and analysis of publicly available data in real-world environment (Agrawal, 2021). IT managers participating in the study were the perfect candidates to explain their experiences and strategies. Using a pragmatic inquiry design provided in-

depth insight into each organization's experience, transition strategy, and strategic perspective from their IT managers. Interviewing and collecting their verbal and written statements gave the opportunity to document the phenomena. Pragmatic studies provide the means to use multiple methods to gather and document the participant's experience of the phenomena (Pagnini et al., 2021). Documenting the information from the participants provided the factors to define, establish, and refine the themes needed to report the results of the study. The results of the pragmatic study can be used to inform the other ecommerce organizations facing the same IT problem and determine future requirements for further studies. Pragmatic study research allows for an exploratory and conceptual understanding of the emotional and cultural behaviors of the studies participants (Mao et al., 2021; Stewart, 2016). Conducting a pragmatic study allows the research study to be shown as transferable, based on validating the study across multiple organizations. To ensure the appropriate level of scrutiny of the IT problem across the ecommerce industry, a pragmatic inquiry was the best suited design approach.

When selecting the best study designs, ethnographic and phenomenological designs were considered as possible alternatives to a pragmatic inquiry. An ethnographic design is used to capture and compare organizational cultural influences, behaviors, and experiences of participants within a group, during their live experience of the phenomenon (Jarzabkowski et al., 2014). In the ethnographic research study design, the researcher participates heavily in the group experiencing the phenomenon (Berthod et al., 2017). Ethnographic studies require the researcher to involve themselves in the physical events and actions of the group within the study of the phenomenon (Mears, 2013). The

intent of the study was to learn from successful strategies which have already been executed, by the participants, not to go through the transition with them. The recruited organization's information security measures, confidentiality requirements, and need-to-know policies would limit the researcher's ability to successfully conduct an ethnographic study design.

A phenomenological design study collects data from in-depth and multiple interviews with each participant, who have already experienced the phenomenon (Gill, 2014). A phenomenological approach can lead to different interpretations and acceptance of the facts, due to the individual perspective of everyone (Whittemore, 2014). Everyone within each organization was interviewed, only the appropriate IT managers. Phenomenological studies place more focus on individual experiences (Tomkins & Eatough, 2013). The primary goal is to gain a comprehensive and consolidated strategic insight from each organization, not multiple strategies from every employee. Based on the need to research multiple organizations and their strategies used during their transition, a phenomenological and ethnographic design approach would not be as effective in exploring in-depth the strategies and transition events from IT managers, who experienced their organization's transition to chip-and-PIN credit card authentication infrastructures. Therefore, ethnographic and phenomenological designs were not selected.

O'Reilly and Parker (2013) agreed with the concept of saturation, that qualitative research is concerned with the richness of information and the number of participants required. I ensured all formats of data, information, and opportunities to gather information were exhausted. Appropriate saturation depends on the nature of the topic

and the resources available. It is acceptable, therefore, that any limitations of sampling adequacy are transparently reported. Researchers thus need to be clear in dissemination if they reached saturation, how they reached it and what issues they faced during recruitment (O'Reilly & Parker, 2013). To ensure data saturation, a larger amount of invitation should be extended to potential population audience than is required for the maximum participation of interviewees (Fusch & Ness, 2015). I sent multiple invitations out to potential participants, ensuring full participation for the pragmatic inquiry. Applying a rigor inquiry concept ensured saturation, as well as the reliability, validity, and dependability of the population and sample. J. M. Morse (2015) insisted data saturation is essential to establishing rigor, which is the concern of external evaluators who ultimately determine the worth of qualitative research. External evaluators of the data collection and analysis techniques provides creditability to qualitative research study (Cope, 2014). In addition, empirical data collected from other relevant studies can be analyzed to determine the effectiveness of census sampling size within the study (Berthod et al., 2017). To effectively explore the research topic and ensure data saturation, a pragmatic inquiry design was the optimal design for use in this study.

Population and Sampling

The populations selected for this study was the IT managers of e-commerce organizations. The population was located in the United States. Identifying the appropriate population and sample size are key elements in the conducting a success research strategy and gaining accurate findings for a study topic (Robinson, 2014). I used census sampling of selected organizations in the retail industry. In a pragmatic study, a

census selection method involves participation from all organizations in consideration. Census sampling allows researchers analyze members within targeted populations (Bossuyt et al., 2020). Researchers must identify and determine the sample size, which aligns best with their problem statement and address the desired research validity (Bengtsson, 2016). Developing the representative sample size requires the evaluation of potential bias (Enticott et al., 2017). To effectively represent the group affected by the problem, a census sampling method was used to select the sample size. Census sampling is an effective method to gain understanding of the research problem from a smaller population most familiar with the problem (Roy et al., 2015). Lucas (2014) findings indicated the use of census sampling must be conducted in a manner which generalization of the overall population is consistent with acceptable social research. Using census sampling, the populations selected for this study was IT managers in e-commerce organization. IT managers are the executive level officer responsible for; sponsoring, reporting, and executing the funding for the final solution. Qualitative study's do not have mandatory or minimum sample sizes. Sample size is based on element of the research strategy and expected quality of data (Elo et al., 2014). The sampling method used resulted in a sample size of five, which was determined based on the population size of e-commerce organizations. In a one-phase approach candidate screening effort, Yin (2014) recommended avoiding prolong screening of each individual candidate, which slows down the process and may become individual case studies themselves. Consideration of the potential harm to interviewee's leadership position, valuable time, confidentially, and privacy within their organization must be respected. A qualitative

pragmatic inquiry research by Johnson (2014) exploring ethical issue associated with researchers shadowing healthcare CEOs demonstrated the need to consider the potential harm and unwarranted exposure of the participant. Johnson's research of top managers included a small sample size to satisfy ethical review requirements, but not overload busy managers. Johnson considered the rich data collected from the CEOs would be better than from a larger group, as long as the CEOs were given the confidentially and privacy they needed to participate in the research but not impact their workload. I took into consideration the mission impact to the IT manager within each of the organizations in the pragmatic inquiry. The sample size was determined based on the ability to have enough data saturation to compare strategies between organizations who have already implemented chip-and-PIN authentication technology. The IT managers were interviewed through an online collaboration tools or at a location within their organization, providing a setting where they can discuss matters confidentially and free from bias. The interview questions were provided to the interviewees prior to the session, allowing them time to gather their thoughts and reflex on their implemented solution strategies. Interviewing the IT managers enabled access to them and to other supporting resources they may provide, during the interview. The researcher asked open-ended questions and provided the interviewee the opportunity to elaborate on each question and follow-up questions. There was the potential to collect briefing material, design notes, and other artifacts used in their implementation strategy.

Collecting information from interview sessions, briefing materials, design notes, and other data artifacts, provided sufficient information to support my study. I gathered

enough information, conduct triangulation, and member checking to fulfill data saturation. Data saturation goals is the driving factor used in establishing the participant population size for theoretical saturation (Hennink et al., 2016). Drew (2014) conducted a study to determine the best means to overcoming barriers in qualitative interviews. Interviewing organizations elites can be challenging; however, results in rich data collected. Drew findings indicated the method and means the researcher engages the interviewees will determine the success of data saturation from interview sessions. Data and results from secondary data analysis can be helpful in validity and data saturation for studies (Moy & Murphy, 2016). Moy and Murphy (2016) studied the differences in survey data collected from primary verses from secondary collection methods. The secondary data provided additional critical information, discussion of collection methodology, and data comparison values. I sought out secondary and empirical data to augment the interview sessions, incorporated in my study. The answers from the interview sessions, additional empirical data, and artifacts assisted in accomplishing data saturation. An explorative investigation of organizations, using member checking, secondary data, and triangulation, provided ample amount of data saturation to compare the different strategic implementations of their organization's chip-and-PIN authentication solutions.

Ethical Research

I ensured that all participants agree to the studies agenda and conditions. I had each participant sign a consent form. The consent document is depicted in Appendix D. IRB are boards established by research organizations to ensure each research study is

conducted in compliance U.S. federal regulations, international guidelines, and ethic research standards. There was strict adherence to the ethical research standards, including proof of IRB approval. IRB approval is required to conduct studies involving collection of data from Human participants (Lunnay et al., 2015). Participants were informed of their rights and expected roles in the study. Beskow et al. (2014) demonstrated in their study the success achieved when informing participants of the efforts the researcher will take in protecting their rights and privacy. Describing the terms and possible risks, the consent form helped potential participants of the research to be aware of potential risk and helped them make a more informed decision on their willingness to participating in the study. The research strategy should provide protection of the participant's privacy and sensitive information (Mealer & Jones, 2014). The participants were briefed as to the nature of the study and their rights to change their mind later and withdraw if necessary.

Participants could withdraw at any time, during the study. In accordance with the consent form, participants were instructed on their right to withdrawal from the study. As a means to ensure the integrity of the findings, the withdrawal process and effect on data analysis should be addressed and documented in the study (Thrope, 2014). Participants could verbally or in written format notify the researcher that they no longer want to be involved with the study. Interviewees could verbally inform of their intent to withdraw from the study to me by phone or face to face conversations. Interviewees could write an email or a letter to indicate their intentions to end their participation. I would have acknowledged receipt of the withdrawal notification and confirm the nature of any future communications with the participant.

There was personal incentive or compensation for the participants of the study. Paying incentives to participants to participate in a research study is not unethical. Establishing the adequate amount to pay participants for an interview session was considered appropriate for this doctoral study. If financially well off, participants can feel insulted to be offered compensation for their efforts in a study (Killawi et al., 2014). For example in Killawi et al. (2014) study of compensating research participants in Qatar, offering a $30 dollar pre-paid mobile phone card could offend financially well off participants. The researchers decided to offer the compensation after the end of the study, to those who were interested in the $30 dollars pre-paid cards. Paying research participant may coerce their participation and influence their response to study questions. Polacsek et al. (2017) defined key terms, definitions, and assessments of what is acceptable when paying research participants. Other than the logistical cost for hosting the research interview session, paying an incentive could influence the participant's sincerity to be involved in the study (Polacsek et al., 2017). Participants were informed that their involvement is volunteer and provides financial incentive for their time. The consent form specifically stated that there is financial incentive for participating in the study.

Using a coding system, I separated the individual identifiable information from the research data, ensuring the integrity of the study data. Data and personal information should be instantly recoded with a random generated code (Turner et al., 2014). All electronic data was processed on my laptop. All transmission and storage of data was encrypted and remain encrypted while at rest. All data is stored on an external hard drive and secured in a safe, whenever study data is not being used. Orrell et al. (2013)

conducted a qualitative study, examining continence services for older people, from a service providers' perspective. Due to the private and sensitive nature of the Orrell et al. study topic, protecting participants and their client's information was of utmost priority to the researchers. Orrell et al. study emphasized the sensitivity of conducting a study and need to protect participants information at all stages of the research process. In comparison, an organization's IT security data is sensitive and requires protection. I explained the protection of private and sensitive data in the consent form, available in Appendix D. I demonstrated my commitment, intention, and ethical requirement to protect data, by providing my NIH Protecting Human Research Participants Certification Number 1794335 to the IRB. My NIH certificate is presented in Appendix C. I will maintain the data in a safe place for 5 years to protect the confidentiality of participants. Data and paper files should be stored in a locked filing cabinet, which can only be accessed by the researcher (Johnson, 2014). I secured the research notes, files, and external hard drive in a lockable fire safe cabinet.

Data Collection

Instruments

I was the primary data collector. I conducted all the interviews and gathering of study data artifacts. The effective collection of data is key to conducting a reliable research study. The beginning phase of the research process is collecting data (Rimando et al., 2015). In this qualitative pragmatic inquiry, a semi structured in-depth interview was used as the primary data collection instrument. I conducted the interviews using online collaboration tools and face to face methods, presenting open-ended research

questions to the IT managers within each organization. The findings of Wolgemuth et al. (2015) studies indicate that semistructured interviews encourage free and open discussions. Conversational interviews techniques between interviewer and interviewees provide more clarity and accuracy of response (Mittereder et al., 2017). Conducting face to face interviews results in more reliable and uncontested research data sources (Bowden & Galindo-Gonzalez, 2015). A well-established interviewing protocol framework can reinforce the reliability of the research (Patton, 2015). The research must ensure the questions are appropriate for the audiences and aligned with the theme of the study (Rimando et al., 2015). Prior to the interview session, the protocol process and questions were rehearsed, using the four-phase process to IPR process. The IPR process consists of; ensuring interview questions align with research questions, constructing an inquiry-based conversation, receiving feedback on interview protocols, and piloting the interview protocol (Castillo-Montoya, 2016). The protocol steps and interview protocol refinement processes are presented in Appendix C. The goal of the data collection instruments in a qualitative research study is to get a detail and in-depth understanding from the people experiencing the phenomenon (Neuman, 2014). To gather more in-depth personal knowledge and build a more conducive interviewing atmosphere, the majority of subquestions asked to interviewees was open-ended questions. Qualitative research methods making use of interviews with open-ended questionnaires is an effective means to obtain, analyze, and interpret the research data (Yii et al., 2014).

In addition to interviewing sessions, I collected documents, available secondary data, and existing organizational empirical data to support the data collected from

interview sessions, incorporated in my study. Secondary data sources strengthen the reliability of qualitative studies (Reddy, 2015). In Reddys' study he demonstrated and emphasized the uses triangulation of interview sessions, empirical, and archival data to strengthen the rigor of a pragmatic inquiry. The examination of secondary documents and artifacts helps to explore the experiences of the phenomenon (Colorafi & Evans, 2016). Colorafi and Evans used documentation and artifacts to support their data collection process in a qualitative descriptive approach. I believe secondary documents and artifacts helped to support data saturation. I used Microsoft Excel and Nvivo as document archival and electronic data management applications to store and harvest data during the collection process. Defelice and Janesick (2015) study of the use of technology in phenomenological research indicated that using tools like spreadsheets and word documents increased the efficiency of managing data within the studies. Microsoft Excel is a very effective tool to collect, create, and analysis qualitative research data (Defelice & Janesick, 2015). I used standard records and document management procedures to properly label, store, and archive documents.

Based on the study's semi structured data collection format, member checking was conducted to facilitate data saturation from the interviewees. Member checking is a method to ensure information was correctly recorded and interpreted, as stated by the interviewees during the session (Shipherd et al., 2014). Member checking techniques ensure the researcher doesn't impose their own interpretation of the interviewee's reflextions (Harvey, 2015). Conducting member checking empowers the interviewees, ensuring their interpretation of the questions and their answers are correct (Holmberg et

al., 2014). Member checking is a technique used to improve data collection, which was used to enhance the credibility and internal validity of the study. The six main IT managers focused questions and demographical background questions are listed in Appendix A.

Data Collection Technique

Data collected from the interview sessions was used to set the baseline and establish the supporting elements for the main themes. Additional data artifacts were collected by email messages, electronic file exchanges, person to person, or by registered mail. Primary data collection was be accomplished by recording each face-to-face interview sessions, either by voice or video recording. Recording detailed data helps to keep the researcher focused on the main themes of the study (Pinsky, 2015). Conducting a face-to-face interview allowed me to observe the non-verbal and facial expression from the interviewees. In a Mindfulness Meditation Training for Sports study conducted by Baltzell et al. (2015), it was crucial for the researchers to monitor the verbal and non-verbal expressions from the coaches, being interviewed. Baltzell et al. used audiotaping and transcribing techniques, ensuring interviewer reliability when conducting their study. I believe video or audio taping my interviewees provided the most reliable data. I scheduled the interview session to last at least 1 hour. A 1 hour initial interview session provided ample enough data to represent an organization's experience of the phenomenon. I was the primary transcriber of the interview recordings. A 45-minute interview recording session could yield up to 30 pages of transcribed information (Sutton

& Austin, 2015). Using the time and page count estimate from Sutton and Austin study, my interviews should yield approximately 40 to 45 pages transcribed information.

At the beginning of the data collection process, each organization's IT manager was sent an invitation letter requesting their participation in the study. After acceptance of the offer, interviewees were sent consent forms and copies of the interview questions. The interview session took place online. An interview session was scheduled for appropriately 1 hour. At a minimum, interviewees were presented with a copy of the interview questions, for submitting their written answers and additional comments as necessary. The interview began with an introduction of the intent of the study, protocol administrative announcements, review of the consent form, and the opportunity to decline continuation of the interview. The researcher recorded the session with an online recording system, based on organization's policies, permission, and availability. At the end of the interviewing session, the interviewee had the opportunity to provide immediate feedback. The recording was made available for review at the end of the session.

Conducting in-depth face to face interviews provides the advantage of making a more personal connection with the interviewee. The interviewer can better determine if the questions were understood or fully answered, by observing both verbal inflections and non-verbal gestures by the interviewee. Researchers can use face to face interview sessions to generate casual conversations, building trust in the interviewee (Pinsky, 2015). Holmberg et al. (2014) research findings indicated that interviewees appreciated the opportunity to interact with the interviewer, rather than answering the questions without the ability to verbally express themselves. Comi et al. (2014) study shows the

possibility of including visual technique into qualitative interviews, to gain a better insight into feelings about organizational change.

The most obvious disadvantage to doing an in-depth face to face interview is the fact that interviewees may not feel comfortable being interviewed. Bourne and Robson (2015) study inquiring on interviewing techniques for studies addressing sexual behavior demonstrated that participants feared judgment by the interviewer, even though their session data would be kept under strict confidence. Recording the interview session could discourage potential participants (Killawi et al., 2014). Online surveys and other anonymous methods of feedback allows interviewees to answer questions more freely, without being judged by the interviewer and observing their nonverbal gestures (Bowden & Galindo-Gonzalez, 2015). Another potential disadvantage of face-to-face semistructured interviews, is the possibility of the researcher imposing their ideas and limiting the personal insight or initiative of the interviewee (Rimando et al., 2015). As stated above, conducting a pilot study would reduce time spent on the actual study and reduce the available population for the final study interviews. Therefore, a pilot study was not requested or conducted.

I used member checking to enhance the richness of data collected and gain data saturation. Member checking of the notes and recording allows for confirmation of translated information (Harvey, 2015). Caretta (2016) used a pamphlet in her study to conduct member checking, which is one example of checking preliminary findings with informants. After initial and final drafts of the transcript were completed, I scheduled another interview session to conduct member checking with each interviewee. Each

interviewee was provided the opportunity to review and comment on the validity of the interpretation of their statements, which they made during their initial interview session. Member checking of the initial and consequential interview sessions provides the opportunity for immediate verification of the content (Birt et al., 2016). Once all the updates are verified and the interviewees were satisfied with their transcribed statement, data saturation was meet from that interviewees.

As a part of the data collection process, I collected any available documents, secondary data, and existing organizational empirical data, for the organization. To harvest the additional documents, secondary data, and empirical data, I requested access to documentations used in their implementation of their chip-and-PIN solution. Documents and data which I requested were; strategic plans, project charters, project management plans, technical working group meeting minutes, change advisory board formal decisions, decision briefing, test and evaluation results, and administrative data associated with their chip-and-PIN implementation. Email messages request and file transfer exchanges were the primary techniques used to get the additional documents and secondary data. I established an electronic journal to record documents, data files, and any other media provided as artifacts for the study. One possible disadvantage, to using this method to obtain paper-only document, was in the event that the organization does not want to send the documents by mail. In such a case, an on premises face-to-face interviewing session would have been necessary.

Data Organization Techniques

The data organization process was completed using both paper, and electronic data formats, supporting a logical thematic data analysis process. The initial process started with the storing of electronic logs and matrices, consisting of literature review, research questions, and drafts sections of research study. All paper documentation, notes, and other non computerized information media were converted into a data format accessible by computers and capable for coding. After conversion to an electronic format those documents were archived in a lockable fire safe cabinet. Electronic filing and data storage provide convenient means to quickly develop, record, index, and manipulate research data (Khan, 2014). Digital data was easy to copy and manipulate, allowing more innovative method to analyze research studies (Childs et al., 2014). DeFelice and Janesick (2015) used Call Graph and Audacity applications to record and quickly edit the recording of their interview sessions, demonstrating the value of using electronic applications and tools to organize their study data. I used Nvivo software. The next data organization steps were recording and saving the interview sessions, using a voice recorder and taking notes. I used a journal to documents any extraneous or miscellaneous field notes. I used an online collaboration recording tools and Nvivo software programs to record, extract, and transcribed participant's answers. The recordings were saved to an external hard drive for storage and review. Appropriate folders were created on the hard drive to protect against data spillage or compromise of coded information. I used computerized software programs, Nvivo and Microsoft Excel, to code the transcribed data of each interviewee's response to questions. I established a coding system to protect

the privacy of the participating organizations. Protecting participants, by masking their identity is an essential requirement in qualitative analysis (Fielding et al., 2013). Coded research information can be indexed and classified, to support the research's main themes (Pierre & Jackson, 2014). Coded information presented in Microsoft Excel spreadsheets can be put through a rigorous and accelerated data reduction technique, increasing the efficiency of the data analysis (Watkins, 2017). During the evaluation of the appropriate software to conduct coding and analysis, NVivo software was taken into consideration. Consider easy to use, researchers can collect, organize, and analyze various types of research data with NVivo software (Castleberry, 2014). In comparison to other software analyzing tools, NVivo requires more interactions from the researcher in the analysis process (Sotiriadou et a., 2014). Zamawe (2015) used NVivo software in his study to edit the recording of both video and audio files. NVivo software is considered reliable and often used for thematic analysis (Derobertmasure & Robertson, 2014). Given the ease of use with Microsoft Excel spreadsheets in comparison with the required addition interactions from the researcher in the NVivo software analysis process, Microsoft Excel spreadsheets was initially used for this study. However, Nvivo was used to refine the coding and selection of emerging themes.

The coding of information was an iterative process, requiring the continuous organization of coded revisions of interview transcripts. To preserve the integrity of the research study and the ability to defend the research's findings, information, and data pertinent to the study must be protected. In addition to the coding process, I implemented physical security of paper documents and data files, created during the study processes.

These security measures are mandatory ethical compliance requirements under IRB approval (Wolf et al., 2015). Research institutions have formalized protocols for the ethical treatment of research participants (Greenwood, 2016). Interviews, notes, and recordings produce detailed data on participants that may present risks to them (Jordan & Gray, 2014). Documents were maintained in a folder labeled with the appropriate confidential and privacy designations. In addition, paper documents were scanned into electronic format and afterward destroyed, as a precautionary measure. Electronic data was stored on an external hard drive. All documents and data collected during the research study will be stored in a locked container for 5 years.

Data Analysis Technique

I used a thematic data analysis process to explore the themes found within the datasets created from the interviewing sessions with participants. A TA method is an effective qualitative research data analysis design, used to focus on gathering the experience of the participant of the study, subjectively (Firmin et al., 2016). Fugard-Pratt and Potts (2015) findings indicated that the thematic analysis is appropriate for research studies conducted with multiple participants. My research study involves multiple participants and aligned with the methods used in Fugard-Pratt and Potts study. Conducting several iterations of the thematic analysis process perfected the quality of data analysis within my study. In Kissil and Nino (2017) study, several reiterations of the thematic analysis process were needed to gain the final results. The thematic analysis process allowed me to efficiently code, categories, assess, and compare the data patterns and themes within the study.

Using TA, I reviewed the recorded semi structured interview sessions consisting of 11 open-ended questions. Semistructured interviews allowed the interviewee the ability to request further clarification and reflect on any additional ideas they may have brought up themselves during the interview (Drew, 2014). I used online collaboration tools and Nvivo software programs to download and transcribed the participant's answers. Post-coding analysis is the process of linking themes within the data to theories (Pierre & Jackson, 2014). I analyzed the transcribed and coded data, produced by NVivo and Microsoft Excel software programs. By applying the six phase thematic analysis method Caton and Chapman (2016) were able to overcome the complexity and challenges to determining their emerging themes. In their study, Caton and Chapman were able to establish major themes from their research data, using the thematic analysis method. I analyzed patterns and developed themes found within the coded data. I applied the six phases of the thematic analysis process: becoming familiar with the data, generating initial codes, searching for themes, reviewing themes, defining and naming themes, and producing the report. These steps and expected results are listed in Table 2.

Table 2

Thematic analysis process

Phase	Description	Result
1	Becoming familiar with the data	Preliminary understanding of answers/data and patterns
2	Generating initial codes	Create, define, and defend coding methodology
3	Searching for themes	Develop list of possible themes from coded data patterns
4	Reviewing themes	Validate accurate themes from specific data patterns
5	Defining and naming themes	Finalize themes and explain correlation to research problem
6	Producing the report	Final report and interpretation of results of data analysis

I used the results from the thematic analysis process to define and align the final data themes with the three main elements of the research's conceptual framework. A thematic approach produces a leaner set of measurable facts, by reducing the excessive context collected during the interview (Kerwin-Boudreau & Butler-Kisber, 2016).

I used a methodological triangulation process, to ensure rigor within the study. Three different data collection processes provided the expected rigor. Ponterotto (2014) insisted that triangulation of both data sources and research methods are principal

elements to the iterative research process. Brown et al. (2015) used triangulation to bring rigor into their mixed method study of nine dimensions, with 107 participants. Triangulation is an effective method to validate the most convincing research findings, for multiple types of research designs (Modell, 2015).

After using triangulation to compare the datasets collection analysis, I aligned the major emerging themes with the elements in the conceptual framework. Using a framework assist the researchers with organizing data analysis in a format to intelligently present the findings (Green, 2014). I compared and contrasted the data analysis result with the three applicable diffusion of innovation theory levels: decision, implementation, and confirmation. The innovation diffusion theory is an optimal framework to address emerging technology (Cegielski et al., 2013). Using the TA method, I analyzed patterns within each theme. I contrasted and compared the elements supporting each theme against the three major themes: decision, implementation, and confirmation. I categorized the multiple themes into one of the three major themes. The final comparison of themes provided insight on the strategies used in each organization, to implementation chip-and-PIN technology. In the final analysis stage, the ability to effectively classify and interpret the emerging patterns enhanced the ability to compare the resulting themes with the phenomenon related to the purpose of the research study.

Reliability and Validity

Reliability and validity are essential criteria to establish trustworthiness in academic research (Olson et al., 2016). Reliability relates to the consistency of a measure. Reliability is achieved when the same responses occur each time the test is completed

(Faris, 2017). Validity is the methodologies and processes used to determine the final conclusion of a study's measurement are aligned with its inference. Validity in qualitative studies is measured using four criteria: dependability, credibility, transferability, and confirmability. Validity ensures that the findings are applicable to other similar case studies (Baskarada, 2014). In my qualitative pragmatic inquiry, I employed the four validity criteria to perfect the rigor and trustworthiness of my study.

Dependability

The trustworthiness of the content within a research study is critical to the acceptance of the findings and potential implications for affecting change. Dependability is an important aspect to supporting validity, ensuring confidence about the findings of the research (Flower et al., 2016). I documented my research processes, maintain field notes, and audit logs to provide dependability to this research study. Member checking is an enabling approach to establishing triangulations of data and dependability of findings (Birt et al., 2016). Participants, of the study, were given the opportunity to validate their input, by reviewing their transcripts for errors or misunderstanding. Researchers and participants must come to a consensus on the interpretation of the data to validate the integrity of the outcome (Noble & Smith, 2015). Member checking establishes dependability by showing an external validity of the researcher's interpretation of the participant's experience. I used member checking to ensure participants interview information is accurately transcribed. Morse (2015) insisted that using iterative credibility practices; peer debriefings, member checking, and triangulation, support the

overall dependability of the study. Readers must feel the information in the research is dependable and peer reviewed, by subject matters experts in the field.

Creditability

Validation of information in a research study will be established using credible data collection and data analysis techniques. Credibility is shown when the methods used to gain and verify the research information is trustworthy (Boesch et al., 2013). I followed the participant recruiting and interviewing protocol, ensuring each participant is a qualified subject matter expert and given the full opportunity to answer each question to the fullest extent. Interviewing a group of subject matter experts is the best way to gather information and build credibility, to support a research topic (Sutton, & Arnold, 2013). In addition, having extensive experience in a particular field will make it more difficult for researchers to not engage in biases. I used coding as a method to reduces my potential bias and influence on the analysis of the data collected. Member checking and conducting an audit trail are essential elements to reduce bias and distortion of the study findings (Lub, 2015). Developing an effective coding system and using it when interpreting the collected data will assist in limiting the personal bias from the researcher (Sutton & Austin, 2015). I used member checking to assist with achieving creditability.

Transferability

The validity of a research study includes the ability to use the methods of the study to benefit further studies. I included the extensive information, background, data collection methods, and analysis technique to facilitate transferability of the study's findings. Transferability provides readers with descriptions of context and background of

the research study data (Hoyland et al., 2017). Transparency of the content, participants, and data analysis rigor equates to transferability (Connelly, 2016). I defined and described the methods and design used for conducting the research; conceptual frameworks, protocols, and data analysis techniques. Aligning the theory and conceptual framework of the study with the findings makes the study more transferable to other studies (Colorafi & Evans, 2016; Reilly, 2013). To ensure transferability of the themes, concepts, processes, and finding within this study, the interview techniques, questions, data coding, and analysis will be designed in formats and a framework applicable for use in other research topics. In this study, I used proven processes, methodologies, theoretical and conceptual frameworks such as; DOI theory, protocol and IPR process, and thematic analysis method.

Confirmability

A quality research study is developed from factual data and free from bias. Research findings which contradict the values of the researcher might suffer from personal and selective citation bias. Confirmability methods are used to ensure the research study and findings are not affected by potential bias by the researcher (Kornbluh, 2015). Triangulation of multiple data sources can provide other perspectives and remove bias from the researcher (Olson et al., 2016). In contrast to the standard validity framework used in a quantitative study, qualitative research is not based on traditional criteria for judging validity using variables and independent variables. Therefore, confirmability in a qualitative study requires the study to be confirmable by and external party. When conducting qualitative research external validity is of utmost

importance (Safarnejad et al., 2018). Confirmability of a research study is established when credibility, transferability, and dependability are all achieved (Mavhandu-Mudzusi, 2018). Conducting processes; member checking of interview transcriptions, transcript reviews, documenting the check and rechecking process, keeping audit logs, obtaining peer review, and triangulation will satisfy confirmability in the research study (Lub, 2015).

An effective research study must convince the reader that a sufficient amount of data was gathered and analyzed to produce reliable findings. To ensure data saturation, a larger number of invitations were extended to potential population audience, than is required for the maximum participation of interviewees. Fusch and Ness (2015) recommends researchers consider more people than normally expected to reach data saturation. I made sure all research questions were completely answered during the interviewing sessions. Data saturation can be considered met when further data collection and analysis yield little or no change to possible outcome (Constantinou et al., 2017). Ferreira et al. (2015) study on ethical consideration for conducting research emphasizes the point of data saturation, where the value of the data collected does not out weight the possible harm to participants. Saturation is a tool used to complete the data collected to support the study (Reilly, 2013). I refined the data collected from interviewing sessions with additional member checking interview sessions, ensuring data saturation. I exhausted all data collection efforts, until there is no longer any new information to benefit the study.

Transition and Summary

In section 2, I presented detail descriptions of the purpose, design, literature review, and information processing techniques contained within the project of the doctoral research study. The roles of the researcher, study's participants, and ethical parameters were defined in this section. The conceptual framework, data collection, and data management techniques methods were outlined in detail, to establish reliability and validity in the research study. In the next section, I discussed the final analysis and summary of the findings of the research. The discussions will include: a documented comprehensive review of the data findings, a final comparison of the content against the applicable conceptual framework, and a summary of the findings as they relate to the application in professional practice, potential for improvement in social change, and suggestion for implementing the recommended actions. Then, I made final closing comments on; recommendations for further research, the impact the study has on the researchers, social change, and concluding message.

Section 3: Application to Professional Practice and Implications for Change

Overview of Study

The purpose of this qualitative pragmatic study was to explore strategies used by IT managers to transition their e-commerce organizations to chip-and-PIN credit card authentication infrastructures. Data were collected from semi structured interviews with IT managers with 16 to 35 years of IT experience in e-commerce organizations located within the United States who shared their experience in developing and implementing strategies in chip-and-PIN credit card authentication infrastructure technology. My goal was to explore in-depth the strategies and transition events of IT managers. To protect their privacy, each participant was coded as a number preceded by the letter P. To achieve data saturation and data integrity, I used the triangulation methodology with publicly available data, journal notes, and existing organization documentation in addition to the participants' interview responses. Using the TA process, I analyzed patterns and discovered the major emerging themes: that a successful implementation strategy is required; the development and buy-in of critical elements defining the business needs and scope within the organization, attaining PCI DSS regulatory compliance; and confirming the value to the business and customer experience. The findings were in alignment with the DOI conceptual framework used in the study. The summary of the emergent themes and findings in the study supported by current, peer-reviewed literature resulted in the following presentation of findings.

Presentation of Findings

The research question guiding this study was: What strategies are used by IT managers to transition their organizations to chip-and-PIN credit card authentication infrastructures? My goal with this research question was to identify strategies that IT managers use to efficiently transition their e-commerce organizations to a chip-and-PIN credit card authentication platforms. In this subsection, I discuss the emerging themes, their alignment with the conceptual framework, and the current literature supporting the findings. From analyzing the data collected for the study, the following three major themes emerged from all participants that were further supported by the associated minor themes: (a) elements influencing the appropriate selection of strategy, (b) implementation of PCI DSS regulatory compliance, and (c) value to business and customer experience.

Theme 1: Elements Influencing the Appropriate Selection of Strategy

Elements influencing the appropriate selection of strategy was the foremost theme indicated in the data. Five of the six participants stated that the key to having a successful strategy was to determine the scope of the problem: business need, security risk, technology gap, current resources, available funding, and completion timeline. P6's views were in agreement with the other five participant statement but communicated that his organization was more of an earlier adopter of technology despite other influencing elements. Given that most projects would have the same generic elements in developing a strategy, I decided to do a more granular analysis of the unique elements particular to their chip-and-PIN credit card authentication infrastructures strategy. From further analysis, I was able to identify four minor themes more applicable to the research

question. The minor themes were fraud and liability cost, increased credit card security, regulatory compliance, and modernization of POS systems.

Fraud and the cost to recover from incidents was one of the most important elements considered in determining the right strategy. Four of the five participants stated that informing and providing statistics about fraud and its cost was effective to get stakeholder buy-in from the C-suite decision makers. P4 stated that "it is unfortunate but, communicating fear of fraud and liability cost was a very effective way to persuade stakeholder buy-in within my organization."

Improving credit card security was a consistent and required element addressed in the data and was requested as a requirement by the IT security departments in most organizations. Any efforts to reduce vulnerabilities to the security posture of the organization were a critical element of the strategy.

Regulatory compliance was another important element for organizations to include in their strategy. Implementing a chip-and-PIN credit card authentication infrastructure would improve security; however, it was mandatory for organizations to meet the PCI DSS regulatory compliance. In addition, meeting the compliance would reduce the liability to the organization should credit card fraud occur during their sale transactions. Explaining the benefits of being in PCI compliance was an effective communication strategy and a critical strategy element when persuading stakeholders on the benefits of chip-and-PIN credit card authentication infrastructures.

The modernization of POS systems was another element critical to the strategy. In the larger organization, this element was important; however, it was not seen as such a

big challenge and was expected as part of their strategy. For the smaller organizations, modernization of their POS systems was an element that could determine the survivability of their company. Their noncompliance could result in fees and potential liability costs of fraud incidents.

All participants made multiple references to the individual elements these minor themes because they affected their organization and strategy (see Table 3 for frequency of themes). Overall, all six participants indicated the importance of validating, communicating, and getting buy-in on all the minor elements, resulting in a comprehensive and inclusive strategy.

Table 3

Frequency of First Major Themes: Elements Influencing the Appropriate Selection of Strategy

Thematic category: persuasion & decision	*n*	References	Documents
Fraud & liability cost	6	23	2
Increased credit card security	6	35	3
Regulatory compliance	6	32	3
Modernization of point-of-sales system	2	16	1

There is current literature supporting the major theme elements influencing the appropriate selection of strategy. Understanding the scope and risk of the requirement is a step organization must use to start the strategy development process. Managers in the current study employed various strategies to communicate the security and liability cost risks to their organizations. It is important to understand the impact of cybercrime to stakeholders and provide them with adequate information on the methods for practical

applications to protect credit card users (Arief & Adzmi, 2015). Understanding the security requirements of the new product helps with the development of a process and search for business dependencies in the collaborative innovation strategy (Chung, 2020).

Fraud and the cost to recover from incidents were two of the most important elements that were used in the strategy to gain stakeholder buy-in. Some businesses do not understand IT security and do not adhere to good security practices (Clapper, & Richmond 2016). Some retailers have not fully converted to the full implementation, forcing customers to use the older magnetic strip methods to authenticate their purchases (Bush, 2016). Organizations implementing chip-and-PIN solutions must meet the PCI DSS (2018) regulatory compliance mandates that apply to all system components included in or connected to the cardholder data environment.

The modernization of POS systems was critical to advance the strategy. In some instances, the modernization strategy and costs, include platform systems and hardware that is not only dedicated to the POS systems. Network components, including, but not limited to, firewalls, switches, routers, wireless access points, network appliances, and other security appliances (PCI DSS, 2018). Small businesses with limited funds, datacenter infrastructures, and network bandwidth connections may not be able to gain PCI compliance. Small-scale organizations often lack adequate capacity and resources to evaluate, learn, establish, and set aside finances to cater for uncertainty of the technology in future (Taha et al., 2018). The recent literature aligns with the findings of this study and confirms the need to establish elements influencing the appropriate selection of strategy.

The process of validating, communicating, and getting stakeholder buy-in on all critical elements in the selected strategy also aligns with the conceptual framework of this study. The IDT provides tools to determine the factors, uncertainty, resistance, and rate of diffusion of a technology (Zsifkovits & Gunther, 2015). The DOI theory provides a framework representative of the types of users commonly found throughout the world regardless of economic status and allows for a structured analysis of constructs affecting the decision to adopt an innovation or technology (Shaw et al., 2022). In the first three phases of the DOI theory, Rogers (2003) prescribed the need to make known the conditions, needs, characteristics, and desired outcome when studying the effect of an innovation and its acceptability by society. Leite (2022) confirmed that innovation is driven by the activities of searching, acting, and convincing actors of an opportunity to develop innovative solutions. My analysis and identification of the elements influencing the appropriate selection of a strategy are aligned with the first three phases (i.e., awareness, persuasion, and decision) in the innovation-decision process. Leite found convincing was present in every phase of the innovation. However, the findings in the current study indicate that persuasion was mostly used in the activities to gain a decision on the final selected strategy. Leite found it necessary to convince others about the idea and, therefore, encourage them to collaborate, convincing others to talk positively about the project after the implementation phase, such as the public officials and the local and international media. Zhang et al. (2017) emphasized the importance of each stakeholder and their efforts to bring about IT innovation acceptance within their organization. Participants in the current study used the individual elements to inform stakeholders of

the potential fraud, liability cost, regulatory noncompliance fees, credit card security risks, and technology gaps in their POS system to gain a viable implementation strategy. The appropriate understanding of the threats and an organizational commitment to security have a significant and positive influence on users' intention to comply with corporate security policies (Forsyth, 2020). In the literature, Coodarzi et al. (2021) confirmed that providing information on environmental technologies help potential adopters overcome some of the barriers against eco-friendly options, such as their higher cost or inferior aesthetics.

The trustworthiness of information sources plays a significant in developing the best strategy. Innovation stems from a knowledge recombination of prior discoveries and applications, and the individual capacity to search for knowledge over both familiar and unfamiliar technological domains is also likely shaping fundamental processes in creativity, problem solving, and innovation within organizations (Van Knippenberg et al., 2015). These elements supported the data analysis showing the emerging minor and major themes. The minor themes from the data analysis show how participants informed and persuaded their e-commerce organization to make a decision favorable to implement chip-and-PIN credit card authentication infrastructures.

Diffusion is a method of communicating new ideas to people in a social system (Scott & McGuire, 2017). Therefore, the DOI theory aligns with and confirms why the identification of elements influencing the appropriate selection of a strategy is fundamental to a successful implementation strategy.

Theme 2: Implement PCI DSS Regulatory Compliance

Implementing PCI DSS regulatory compliance was the most prominent major theme. All six participants summarized the main reason for their strategy was to meet PCI DSS regulatory compliance. PCI standards are mandated by the card brands, and the administration and development of standards are managed by the Payment Card Industry Security Standards Council (PCI DSS, 2018). The standards were created to protect cardholder data and to reduce credit card fraud. The PCI DSS's goal is to protect cardholder data wherever it is processed, stored, or transmitted (Nagar et al., 2021). P5 indicated PCI DSS regulatory compliance as the number one reason for his organization to support the strategy and expedient implementation of chip-and-PIN credit card solutions. Despite the high number of references to fraud by P1, P2, P3, P4 and P5, the most important factor was to be in compliance with PCI DSS standards. When an ecommerce organization is PCI DSS compliant, the liability for the fraud incident is placed on the card issuer (Clapper & Richmond, 2016). The e-commerce organization must ensure their POS systems is capable of accepting and conducting the chip-an-PIN transaction. Once the e-commerce organization has passed the PCI DSS attestation, they are relieved of the liability from fraudulent activities committed with a chip-enabled transaction. The bank that issued the credit card is responsible for ensuring the user of the card is validated by the chip-and-PIN POS transaction. The reduction in liability cost is a major motivator for organizations to implement the more secure transaction.

The implementation of PCI DSS regulatory compliance theme was further supported with four minor themes emerging from the data analysis: investment cost,

internal implementation, external outsource implementation, and modernization of POS system (see Table 4 for frequency of themes). Three of the six participants stated that investment cost was not much of a factor after getting stakeholder buy-in. P5 indicated that a thorough research of the equipment and technical support provider is critical to the success and maintenance of the final solution. P5 stated that he has witnessed other agencies trying to implement cheap and minimum standard solutions that failed and ended up costing more at the end. P3 stated that "sometimes it is frustrating because you show them the security risks and cost to other organizations to recover from their incident/breach and they still don't do it because they think it cost too much." Once again, investment cost was an issue for some of the smaller organizations with limited capital spending.

When analyzing the data in reference to internal or external outsourcing implementation strategies, two of the six participants insisted that their strategy would be implemented internally. The other four participants recommended that the implementation be outsourced to consultants and subject matter experts certified to in the PCI DSS skillsets. P4 recommended that organizations who plan on using internal staff to do the implementation should bring in consultants and POS system vendors to train their internal staff first. Dobrosielski (2019) insisted that focusing on people, calling them a human firewall and the most valuable asset in protecting against fraud, should be the main priority in implementations of security solutions.

Another important benefit from achieving PCI DSS regulatory compliance is the requirement to upgrade from outdated POS equipment and systems that do not meet the

minimum data security standards. Modernization of POS systems was another minor theme the emerged from the analysis of the data. As organizations started to understand the requirements outlined in the PCI DSS regulatory compliance, it became apparent that their current POS systems needed to be upgraded or updated, depending on the age of their systems. Some organizations were fortunate and only required software updates, while other organizations' hardware and software both required total replacement.

As significant as implementing PCI DSS regulatory compliance is to a successful strategy, four of the six participants did not initially come to that conclusion until they reflected on and summarized their interview sessions. The analysis of the data and minor themes indicated PCI DSS regulatory compliance was a major theme, if not the most important theme.

Table 4

Frequency of Second Major Themes: Implement PCI DSS Regulatory Compliance

Thematic Category: Implementation	*n*	References	Documents
Investment cost	6	21	1
Internal implementation strategy	5	8	1
Outsourced implementation strategy	4	4	0
Modernization of point-of-sales system	6	16	1
Meeting regulatory compliance	6	32	2

The literature supports the theme that ecommerce organization should implement PCI DSS regulatory compliance. In 2018, the number of such chip-authenticated card payments reached 48.8 billion, a substantial increase from the 1.4 billion in-person chip-

authenticated card payments in 2015 and larger than the 37.3 billion in-person card payments without chip authentication in 2018 (Gerdes et al., 2019). Organizations without a successful chip-and PIN POS system is at a higher risk to be liable for fraudulent credit card activities. The primary benefit of complying with PCI DSS is the reduction in risk associated with a data breach (Clapper & Richmond, 2016). Implementing the PCI DSS required organizations to invest into new authentications capabilities to enable chip-and-PIN multifactor authentication. Standardization bodies like the National Institute of Standards and Technology and payment card industry have proposed a set of guidelines concerning the digital identity management through (Sinigaglia et al., 2020). Organization seeking PCI DSS regulatory compliance must be assessed by a third party evaluator certified to conduct PCI assessment. Security compliance practices ensures organizations are adhering to established security controls (Choi et al., 2018). At least annually and prior to the annual assessment, the assessed entity should confirm the accuracy of their PCI DSS scope by identifying all locations and flows of cardholder data, and identify all systems that are connected to or, if compromised, could impact the data loss (Payment Card Industry Security Standard Council, 2018). Organization should upgrade their outdated POS equipment and systems, which no longer meet the minimum data security standards. Websites are one of the avenues hackers use to harvest and extract customer's PII and financial data. E-commerce merchants who must be compliant with the PCI DSS can use an approved scanning vendors to automatically certify that their websites meet some parts of the PCI DSS (Kellogg et al., 2020). Increased use of either chips or PINs separately can increase

the security of card payments, while the use of a chip and PIN together can further reduce the risk of third-party payments fraud (Gerdes et al., 2019).

The implement PCI DSS regulatory compliance theme aligns well with the DOI theory conceptual framework. The phases of the innovation diffusion process assist in identifying roles; innovator, adopters and, intermediaries essential to applying the technology (Caiazza & Volpe, 2017). The fourth phase in the DOI theory is the implementation phase, which directly coincides with the second emerging major theme from the data collected within my study. Utilizing the innovation-decision process, the next logical step is to implement the strategy for the expected outcome. Regulatory collaborations are valuable, in that they aid organizational compliance with regulatory enforcement actions (Desai, 2016). To document the goals of the research questions, participants were asked to provided data describing the implementation of their strategies. Six out of six participants summarized the main reason for their implementation strategy was to meet the PCI DSS regulatory compliance. The current literature and conceptual framework confirm that implementing PCI DSS regulatory compliance is an integral part to implementing a successful chip-and-PIN credit card authentication infrastructure.

Theme 3: Value to the Business and Customer Experience

The third major theme that emerged from the data analysis was the value to the business and customer experience. This major theme was derived from the data analysis of four minor emerging themes. The minor themes were customer usage and satisfaction, improved credit card payment process, meet regulatory compliance, and modernized POS system (see Table 5). Five out of six participants indicted that the value to the business

was more associated with the fiduciary return on investment, either short or long term. Their C-suite leader's biggest concern was how soon would the cost of the chip-and-PIN implementation be recuperated and how to measure the expected return on investment. P2, P3, P4, and P5 indicated the internal IT staff had a different view of valuing return on investment. The IT staff understood the hours and tasks involved in remediating fraudulent incidents and preventing breaches without the increased security option of chip-and-PIN infrastructure. The IT staff were also concerned about the addition efforts and cost to maintain the older and failing systems. For them, a modernized POS system was the confirmation they expected, considering that as a true and tangible business value. All six participant did acknowledge that a major fraud incident or breach would be detrimental for their organization's brand and name, causing potential business devaluation. When addressing business value, P6 provided a totally different aspect and view. P6 stated that customer loyalty and brand name recognition was how they measured value. Giving customers the best experience was most important to their company. Value to the customer experience was another part of the third major theme. It is important to point out that the participants had a variety of views on this data point. The first observation was the definition of customer. Some participants only consider the external customer requesting services or goods from their organization. Concern from a customer service perspective was whether, the customer will use the new chip-and-PIN POS systems, the authentication process would increase the time customers needed at the POS systems for checking out, and the remedy if the customer doesn't remember their PIN. Based on the data analysis, those concerns were easily confirmed. P5 was the only

responded that stated that the customer's increase transaction wait times for completing transactions were slightly noticeable, if at all, were in very larger retail stores or small businesses with limited network bandwidth connections. P5 and P4 expressed a different view of customers. They considered internal stakeholders as customers. For example, they consider the cashiers at the POS to be important internal customer. Cashier were the organizations representative to the external customer. The cashier would need to assist the customer with any problem associated with the sales transaction, including potential chip-and-PIN errors. They need to be trained on customer the support aspect of the chip-and-PIN POS systems. Another internal customer was the IT security staff. The implementation of the new system should increase the security posture within the organization and reduce the workload of the IT security staff.

Table 5

Frequency of Third Major Themes: Value to the Business and Customer Experience

Thematic category: confirmation	*n*	References	Documents
Modernized point-of-sales system	6	16	0
Customer usage and satisfaction	6	32	1
Meet regulatory compliance	6	32	3
Improved IT security posture	6	35	2

The recent literature supports the emerging value to the business and customer experience theme. IT enables an easy and extensive matching that facilitates the creation of value and the rapid development of the phenomenon or innovation (Frey et al., 2019). A firm's IT use for knowledge search strengthens internal innovation benefits, which, in turn, lead to an improvement of innovation performance (Hensen & Dong, 2020). Well-

developed IT strategies and IT investments increased the performance of an organization (Mithas & Rust, 2016). Based on the ability to expose innovation and critical characteristic, Shree et al. (2021) used DOI and Technology-Organization-Environment framework to identify and measure the contributing factors for adoption of digital platforms in business to business organizations. Value to the business is often focus on what is the immediate return on investment, instead of the long-term value the innovation can bring to society. Legal, economic, technical, and cultural barriers degrade the process of diffusion (Caiazza, 2016). Too often, IT innovation incentives are not sufficiently strong because organizations see limited benefits in the adoption of new IT relative to its cost (Zweifel, 2021). C-suite leaders can hinder the implementation of required security innovation because of not understanding or relating it to the long-term business value. Vuori and Huy (2016) study showed managers were afraid of external competitors and shareholders, while middle managers were mainly afraid of internal groups, including superiors and peers. Although there may be a high initial investment cost to implementing a chip-and-PIN POS systems, managers must communicate the benefits and long-term business value to financier and executive board members. Firms that want to achieve a competitive advantage based on their IT resources have also learned to effectively combine their IT resources in order to create overarching goals (Wiesbock et al., 2020). Although there may be a high initial investment cost to implementing a chip-and-PIN point-of-sales systems, managers must communicate the benefits and long-term business value to financier and executive board members. When implementing innovation, managers are key decision makers and should champion innovation to drive

positive business value. Vuori and Huy indicated that shared emotions can hinder the subsequent integration of attention, influencing innovation processes and outcomes and resulting in temporal myopia—a focus on short-term product innovation at the expense of long-term innovation development. Wan and Zhang (2014) argued managerial steps can lessen concerns about "cheap talk" and the limitations of mere words to repair trust after a violation or incident. Value to the customer experience is an important factor in the implementation of new technology innovation. Jamshidi and Hussin's (2016) finding showed the alignment of customer satisfaction with services has a noticeable final impact on social influence. The potential adopters are inclined to gather information before purchasing, which corresponds to the knowledge and persuasion stages in the innovation diffusion model (Zhang et al, 2022). Credit card information and habits of consumer's usage are maintained in databases, presenting increased risk to customer privacy (West & Bhattacharya, 2016). Customer must feel comfortable using payment card systems and trust that the ecommerce organization is protecting consumer data privacy. Customer will share their experience with others, impacting on overall social influence. Information sources have several effects on sustainable behavior and the adoption of environmental technologies by users (Goodarzi et al., 2021). Improved security in credit card payment processes is a value to the customer experience. EMV transactions at chip POS terminals provide more security of consumers' personal data than magnetic strip POS transactions. In addition, EMV card transactions transmit data between the merchant and the issuing bank with a special code that is unique to each individual transaction (Federal Bureau of Investigation, 2015). Value to the business and customer experience requires all members

of the organization to be engaged with the innovation. In some cases, it requires a major organizational culture change. There is a crucial need to continue analyzing human aspects in information security, because technology alone cannot deliver complete security solutions (Ashish et al., 2017). A successful of PCI DSS implementation depends on the capability of the organization's information security in providing the effective safeguard of their information asset, while cardholder data security is the main concern (Yulianto et al., 2016). As P4 stated in the interview sessions, "you should always look at it from the customers point of view." The recent literature aligns with the findings of the data analysis and confirms the value to the business and customer experience theme.

The theme value to business and customer experience aligns with the conceptual framework. Evaluating the value to these two main constructs is a method to confirm that the implemented innovation is being used and customers are satisfied with the solution. The fifth phase of Roger's (2003) DOI theory is confirmation. The phase in the diffusion of innovation process where expected outcome of the innovation is validated and confirmed, either as accepted or rejected. Stages in the theory were effective in measuring the status of organizations and adopters within the innovation network (Valente et al., 2015). The measure of an adequate level of protection is an indicator of the cybersecurity awareness aspects of an organization's business processes in the short, medium, and long term (Sulistyowati et al., 2020). In their study of collaboration networks, team communication dynamics, and diffusion of education in the process, Woodland et al. (2021) found the diffusion of innovation theory was effective in

measuring team's innovation adaptation and educational diffusion within the social network analysis. When asked to of the status of their chip-and- PIN implementation, all six participants in the study stated they were able to successfully implement chip-and-PIN credit card authentication infrastructures within their ecommerce organizations. In 2018, the number of such chip-authenticated card payments reached 48.8 billion, a substantial increase from the 1.4 billion in-person chip-authenticated card payments in 2015 and larger than the 37.3 billion in-person card payments without chip authentication in 2018 (Gerdes et al., 2019). The overall indication in the United States is trending favorable to the successful implementation of chip-and-PIN credit card authentication infrastructures within ecommerce organizations. Smith et al. (2018) implied that observability characteristic implies the perceived visibility of innovations to others. Successful innovation networks emerge not solely from a business goal, but also from a social goal and can still generate business opportunities for companies (Zhang et al., 2022). The measurement and confirmation of improvements in chip-and-PIN credit card implementation globally, within the United States and within the population of my study shows that the findings align well with the conceptual framework for this study. These findings confirm and provide evidence to the application of concepts found in existing literature and executed as best business IT practices, within ecommerce environments.

Application of Professional Practice

This study helps IT managers to better understand the complexity of innovation and the process connected to developing an effective chip-and-PIN credit card implementation strategy. The findings of the study inform IT managers on the ways

which they can garner leadership support and resources to implement successful credit card security measures. To prevent costly liabilities charges and harm to their brand names, organizations must improve their ecommerce infrastructure security posture, reduce credit card fraud, and protect consumer's PII. Consumers depend on organization to ensure their transactions and payments are conducted using the most secure technology. Implementation of PCI DSS regulatory compliance is a proven technology standard, which give all stakeholders trust in the payment process. The research study provided an informative set of findings to fill the IT knowledge gap for consumers, managers, and security professional required to implement and maintain chip-and-PIN credit card authentication infrastructures in their ecommerce organizations. IT managers have a baseline strategic roadmap they can build on, adjust to their unique requirement, and follow. The study provide strategies IT managers can use to improve the efficiency of their current payment system security processes and help to upgrade implemented legacy credit authentication technology. Organization leaders can use the study findings to establish key indicators for measuring the value to their business, workforce, and customer experience. Organization can use this study to communicate their efforts to secure consumers from fraud and efforts to implement a more secure cybersecurity postures for all stakeholders. Using the findings from this study, credit card users can be informed and make better credit card selections. Credit card issuing providers can use this study to advertise the benefits of their chip enabled credit cards, contrasting added security value against their competitors. In addition, the study's results can be used as an IT strategic template to efficiently transition other nations to the same credit card

authentication platform, securing both consumers utilizing credit cards and vendors providing services within the global e-commerce market.

Implication for Social Change

The outcome of the study will contribute to positive social change through the potential of protecting businesses and consumers from credit card fraud. Consumers using chipped credit cards will reduce the risks of credit card fraud and financial liability to merchants, resulting in lower administrative cost and fees levied against all stakeholders in the e-commerce process (Robertson, 2014). The study will help to inform individuals about the current status of the IT innovation processes of chip-and-PIN credit card authentication. Members in our society can use their increased IT knowledge to communicate, demand, and insist that businesses which they patronize, and their business partners increase credit card security with chip-and-PIN authentication infrastructures. Paying for services with the more secured chip-and-PIN credit cards will be safer when conducting business with local and international service providers. Once the chip-and-PIN credit cards authentication infrastructures are fielded throughout all financial and business institution globally, individuals traveling worldwide would have easier and safer access to their buying power, reducing their risks of potential credit card fraud. Informed credit card users, their vendors, and banking institutions will be on a more secured e-commerce security platform, reducing identity theft crimes committed within our society. Additionally, the study's results can be used as a strategic template to efficiently transition other nations to the same credit card authentication platform, securing both consumers utilizing credit cards and vendors providing services within the global e-

commerce market. Securing the electronic exchange of funds conducted using chip-and-PIN authentication technology will reduce credit card fraud and crimes conducted within society.

Recommendations For Action

With the regulatory mandate to implement secure ecommerce credit card transaction authentication platforms, IT manager must develop and implement strategies to provide those secure and safe POS computing environments. As credit card fraud increases, consumers are losing confidence in the protection of their credit, PII and banking systems. They suffer financial loss and possible bankruptcy, as a victim of a credit card fraud/data breach. Organizations and their POS service providers are obligated to paid for the liability cost associated with credit repair and PII protection for those fraud victims, impacting the overall ecommerce system. These security threats are having a macroeconomic impact on the global payment card industry (Banka, 2017). The purpose of my study was to explore strategies used by IT managers to transition their e-commerce organizations to chip-and-PIN credit card authentication infrastructures. Findings from my study can provide IT managers with the strategies they lack to move forward with their implementation. I recommend the following actions on the part of IT managers:

1. IT managers should take inventory of their current credit card authentication infrastructures, systems, and platforms.
2. Identify the risks and gaps within their environments.
3. Compare their organization with elements required in the regulator compliance policies/guidelines.

4. Develop a scope, project charter, and strategy (use element or themes from the study findings).

5. Develop and present course of actions (COA) and cost estimates to decision maker within the organization, communicating the risk, cost, and strategy to get executive level sponsorship and business units stakeholder buy-in.

6. Seek internal of external resources to plan and conduct the implementation

7. Execute the implementation plan and confirm operational capabilities

8. Document execution, review, and conduct continuous improvement

Although not an all-inclusive list, the action listed above address some of the major findings provided by the data collected and viewpoints of participants within the study.

Upon approval, I will provide a one to two page summary of my study and recommendations to the participants and their organizations. I plan to publish the findings of this research in academic and professional journals. I will present briefing and lectures on the findings of this study to ecommerce businesses, IT security forums, IT associations and technical symposiums. I will disseminate summaries of the findings to financial and cybersecurity professional groups on LinkedIn and similar networking platforms. I intend to share this study and findings with the cybersecurity, crime, fraud prevention, law enforcement community, and professional practice writ large.

Recommendation for Further Research

The literary review and findings from the study revealed several security and information body of knowledge gaps within the protection of e-commerce authentication platforms. There is a need for further research in the biometrics application to two factor

authentication of credit card POS transactions. Two-factor authentication is a proven technology for securing IS. Combining biometrics technology as one element in the two-factor authentication process increases the security capability and complexity. Biometric authentication includes the use of; fingerprints, iris scans, face, and voice recognition (Martinovic, et al., 2017). PCI systems can benefit from the dual usage of biometric system for both data collection and user authentication (Choi & Park, 2015).

In addition to the study of biometrics authentication, there is a need for further research on the security methods for protection of contactless payments and CNP credit card transactions. One of the growing security problems with credit card transactions is the CNP vulnerability. Without the actual credit card being present during the transaction, other nontangible factors must be validated, requiring the vendor to depend on the verbal confirmation of the person making the CNP transaction. Pouwelse and Bruggink's (2016) address the growing complications of securing credit card transactions by CNP transaction fraud, within a study. Pouwelse and Bruggink study indicate that card fraud is a key cybercrime activity, with a full-scale underground economy. Biometric authentication and CNP was identified as above scope and outside the limits of this study. However, these two topics are rife for a doctoral level study.

Reflections

During my Walden University doctoral study evolution, I had the opportunity to; discover my weaknesses, find my inner strengths, develop humility, patient, and endurance. Conducting this study gave me the opportunity to meet and work with a diversity of students and instructors, allowing me to see subjects and ideas from different

points of views. I felt the most overwhelming and challenging aspect of doing the study was the recruitment of participants. The COVID 19 Pandemic effected my access to potential participants and created the need for me to use online and virtual communication collaboration tools, for both recruiting and interviewing participants. In addition, multiple nationwide cybersecurity threats and attacks, during my study, created barriers to IT managers and their willingness to discuss their organization's IT security postures and strategies to protect their computing environments. Another element which surprised me was the clarity of the data to confirm the increased practice of organizations outsourcing/utilizing external service providers for their POS strategies and solutions, limiting their liabilities and efforts to provide internal services.

Given my many years of experience in the IT security field and currently working in an organization with POS systems and infrastructure, I was initially concerned that my potential bias would challenge the objectivity of my study. However, using the semi structure interview sessions with open-ended questions gave me the opportunity to be more of a listener than a talker, limiting the chance for me to influence the participants of the study. Despite some of challenges I faced both personal and academic in the pursuit of this doctoral study, I will use those enlighten learning experience in future analysis, development, and implementation of emerging IT solutions, throughout my career.

Conclusion

IT managers are responsible for providing the most secure e-commerce computing environments for their organization's users, both internal stakeholders and external consumers. Some IT managers lack strategies to transition their e-commerce

organizations to chip-and-PIN credit card authentication infrastructures. A federal and financial institution compliance mandate required organization to implement, the more secure, chip and PIN capability by fall of 2015. However, some retailers have not fully converted to the full implementation, forcing customers to use the older magnetic strip methods to authenticate their purchases (Bush, 2016). The two-factor authentication process, using chip-enabled terminals with a secret PIN, provides a more secure electronic payment transaction. Secure authentication is accomplished when a user must use two different identity factors to complete the authentication process (Kaur & Pathak, 2015). With the appropriate strategy, IT managers can efficiently transition their e-commerce organizations to a chip-and-PIN credit card authentication platforms, increasing the security of the consumer's credit card payment experience. The study's findings can be used as an IT strategic template to efficiently transition other nations to the same credit card authentication platform, securing both consumers utilizing credit cards and vendors providing services within the global e-commerce market.

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Appendix A: Interview Guide

Interview/Survey Questions

Background questions: Demographic

1. How long have you been working in the Information Technology (IT) field?
2. What is your experience with IT security?
3. Do you have any certifications in IT security?
4. How long have you been with your organization?
5. What roles do you play in the planning, selection, and implementing IT security systems, within your organization?

IT Managers Strategic Focused Questions

1. What strategies have you used to successfully implement chip and PIN credit card authentication infrastructures?
2. What strategies have you used that were not successful in the implementation of chip and PIN credit card authentication infrastructures?
3. What challenges did you face in implementing chip and PIN credit card authentication infrastructures?
4. What strategies have you used that were successful in gaining stakeholder buy-in for implementing chip and PIN credit card authentication infrastructures?
5. How have your implementation strategy for chip and PIN credit card authentication infrastructures impacted the security posture in your organization?
6. What additional information would you like to share about the strategies used to implement chip and PIN credit card authentication infrastructures?

Appendix B: NIH Certification for Protecting Human Research Participants

Certificate of Completion

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

Date of completion: 07/06/2015

Certification Number: 1794335

Appendix C: Protocol and Interview Protocol Refinement (IPR) Processes

Protocol steps:

- **Send out invitation to potential participants**
- **Schedule interview session and location**
- **Send out consent form and interview questions**
- **The Four-Phase Process to Interview Protocol Refinement (IPR)**
  - The interview protocol framework is comprised of four-phases:
    - Phase 1: Ensuring interview questions align with research questions,
    - Phase 2: Constructing an inquiry-based conversation,
    - Phase 3: Receiving feedback on interview protocols
    - Phase 4: Piloting the interview protocol (not recommended for this study)
- **Conduct interview session**
  - Explain study, intent and significant
  - Review consent forms
  - Confirm permission to continue interview
  - Present open-ended questions and encourage in-depth answers
- **Conduct member checking on-site**
  - Review video and audio recording immediately on-site

Submit draft and final transcripts for validation and error checking

Appendix D: Copyright Permission for Graphics

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Doctoral Candidate
D.I.T Program
Walden University
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