CPAS AS DATA ANALYSTS: HOW LOUISIANA ACCOUNTANTS RESPOND TO DATA-DRIVEN BUSINESS PARADIGMS

by

Janis Weber

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_____ Date:_____

Dr. Teresa Lynn Bounds, Dissertation Chair

_____ Date:_____

Dr. Stanley Self, Dissertation Committee Member

_____ Date:_____

Dr. Edward M. Moore, DBA Program Director

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Final Dissertation Review

_____ Date:_____

Janis Weber, Doctoral Candidate

_____ Date:_____

Dr. Teresa Lynn Bounds, Dissertation Chair

_____ Date:_____

Dr. Stanley Self, Dissertation Committee Member

_____ Date:_____

Dr. Edward M. Moore, DBA Program Director

_____ Date:_____

Dr. Brad Stockmeier, APA Certified Editor

Abstract

This study considered challenges confronting Louisiana Certified Public Accountants, relating to technological changes to accounting information systems, which necessitated the use of advanced analytical tools. The research emphasized the problem of accountants' lack of preparedness to use big data analytics in accounting work. The project focused on practicing accountants in Louisiana, to gain their perspectives about big data analytics in accounting, the competitive impact technology shifts have on accounting practice, and preparedness to use accounting analytics in accounting work. The research methodology chosen was a qualitative case study design, which allowed consideration of opinions and perceptions of the individuals experiencing the challenges. This qualitative, exploratory research permitted deeper understanding of the underlying circumstances that contributed to the problem and helped identify potential solutions to the problem.

Keywords: Accounting information systems, preparedness, accounting analytics, qualitative study, accountants' competency

Dedication

This project is dedicated to my amazing God, my constant source of strength.

Acknowledgments

I am grateful to everyone who helped me, encouraged me, prayed for me, and otherwise supported me as I have completed this project. I mention but a few, but I appreciate all who contributed to this effort. First, I acknowledge the Holy Spirit of God, who was my ever-present help, during each step of this process. Next, I acknowledge my loving and supportive husband, Toby, who constantly believed in me, undergirded me with his prayers, and served as my expert sounding board on untold numbers of occasions. I appreciate my children, Kara, Melody, Josiah, and Isabel, for thousands of incidences of sacrificing, praying, editing, encouraging, and understanding, enabling me to devote a great deal of my time to this work. I am thankful for my encouraging and supportive dissertation chair, Dr. Teresa Lynn Bounds, who invested much prayer, academic expertise, and creative energy into me and this project of ours. I also thank the faculty and staff of Liberty University for their relentless support and guidance throughout the doctoral program.

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List of Acronyms

AAA	American Accounting Association
AACSB	Association to Advance Collegiate Schools of Business
AICPA	American Institute of Certified Public Accountants
AIS	Accounting Information System
CGMA	Certified Global Management Accountant
CPA	Certified Public Accountant
ERP	Enterprise Resource Planning
IBM	International Business Machines
IOT	Internet of Things
IRB	Institutional Review Board
IT	Information Technology
LCPA	Louisiana Society of CPAs
MIS	Management Information System
NASB	New American Standard Bible
NASBA	National Association of State Boards of Accountancy
NLT	New Living Translation
RFID	Radio Frequency Identification
SCM	Supply Chain Management

Section 1: Foundation of the Study

As business organizations have adapted operational processes to implement technology-driven advancements, the complexity of methods and tools used to manage and report activities has progressed at a rapid pace (Pickard & Cokins, 2015). These technological changes also impacted the underlying data sources that accountants used to perform services for organizations, forcing a reevaluation of the competencies required by Certified Public Accountants (CPAs) (Richins, Stapleton, Stratopoulos, & Wong, 2017). Further, professional and academic literature document that many companies' accounting information systems (AIS) provide enhanced data, facilitating improved and expanded accounting service opportunities, to increase competitive advantage to CPAs, and to simultaneously increase competitive advantage to the organizations they serve (Janvrin & Watson, 2017).

This research elicited interest from accounting practitioners, researchers, educators, and business managers due to the crucial analytical and advisory role that CPAs maintain in most business enterprises (Smith, 2015). The investigator explored the problem of practicing CPAs' unpreparedness to use big data analytics in accounting services, with emphasis on identifying the underlying reasons for the problem. Cao, Chychyla, and Stewart (2015) defined (a) big data as quantities of information that are so cumbersome or so intricate that standard analysis procedures cannot process them, and (b) big data analytics as a process involving inspection, cleaning, transformation, and modeling of big data, to collect useful information for decision making.

Many university accounting programs have implemented increased technology training to better prepare new CPA profession entrants. Meanwhile, the existing CPA practice community remained unprepared for the advent of big data analytics in accounting (Richins et al., 2017).

This research identified obstacles to practicing CPAs' preparedness to use big data analytics as part of their normal accounting functions.

Background of the Problem

The investigator explored a potential disruption to CPAs' normal accounting practice and methods, with the emergence of big data. This obstacle affected information systems used by CPAs in private and public accounting practice, challenging these professionals to incorporate data analytics into traditional accounting services. This study included an evaluation of accountants' state of readiness for this technological shift to big data (Nielsen, 2018). Researchers attested to a need to apply data analytics tools to available data relating to the accounting functions CPAs perform, to assess the impact of the underlying business transactions (Cao et al., 2015; Nielsen, 2018; Richins et al., 2017). Some researchers warned that failure to confront this challenge threatened CPAs' ability to maintain their established management support and management advisory roles in their organizations, and in the broader business environment (Richins et al., 2017).

Accountants maintain an inherent obligation to support business enterprises through the interpretation and utilization of the AIS, which is the infrastructure that tracks and summarizes business transactions, combining that data with nonfinancial information, to facilitate quality management decisions (Richardson, Chang, & Smith, 2018). Richins et al. (2017) warned that even though practicing accountants were equipped to analyze company information in the traditional format, the demands of emerging technological changes required service adaptations and expanded proficiencies, to enable accountants to continue providing useful data analysis and interpretation functions, in the present and into the future. Janvrin and Watson (2017) stressed the continued responsibility that accountants bear, to assimilate and interpret information for

internal and external decision-makers, in an evolving era of data-driven management that includes an immense volume of information.

Cao et al. (2015) stated the inevitability of utilizing big data analytics to increase effectiveness and precision in financial accountants' auditing applications, because these tools allowed an analysis of all transactions, rather than relying on sampling techniques. Smith (2015) observed marked shifts, due to data profusion, demanding increased interpretive quantitative analysis, which he contended required managerial accountants (a) to utilize their existing competencies fully, and (b) to expand their skills and training to utilize the available data for better decisions. Implementation of big data analytics stands to increase the effectiveness of many traditional accounting services, such as costing, inventory management, internal audit, internal controls, and independent audit (Cao et al., 2015; Carillo, 2017; Nielsen, 2018; Richins et al., 2017).

Problem Statement

The general problem studied was the lack of preparedness of practicing CPAs to use big data analytics as part of their normal accounting functions, resulting in competitive disadvantage in their profession (Richins et al., 2017; Cao et al., 2015; Nielsen, 2018). Richins et al. (2017) noted this deficiency and deemed additional education and training a requirement for accountants to maintain technical competence, suggesting accomplishing this additional instruction by (a) continuing professional education for current accounting practitioners, and (b) enhanced university training of new accountants. Likewise, Cao et al. (2015) stated that most CPAs who performed financial audits lacked the training and experience needed to perform big data analytical functions, which were essential tools needed to utilize the available data for enhanced audit services. Nielsen (2018) further asserted that accountants who wished to compete in a data-

intensive business environment must obtain additional training, specifically relating to matters of (a) information technology (IT), encompassing programming, data mining, data management, and business intelligence; (b) statistics, such as regression and correlation applications; and (c) econometrics, which involved the combined use of math, statistics, and computer science, applied to economic data to develop real-world solutions for challenges businesses encounter. The specific problem studied was the lack of preparedness of currently practicing CPAs in Louisiana to use big data analytics.

Purpose Statement

The purpose of this qualitative case study was to add to the accounting body of knowledge by exploring the reasons for currently practicing CPAs' lack of preparedness to use big data analytics as part of their normal accounting functions. The investigator studied perceptions and attitudes of currently practicing CPAs in Louisiana about (a) their levels of readiness to implement data analytics in their ongoing accounting work functions, and (b) the impact that their preparedness or lack thereof might have on their competitiveness in the current and future business marketplace for CPAs.

Nature of the Study

For this qualitative case study, the investigator attempted to understand challenges that currently practicing CPAs experience in the performance of their work, as businesses implement advanced data-driven systems to track and analyze transactions, about which CPAs must assess and report (Richins et al., 2017). Stake (2010) suggested that the qualitative research method was most appropriate for developing or exploratory research because it focuses on studying the subject matter more holistically, unlike quantitative research, which depended on the availability of numerically measurable criteria for all analyses. Accordingly, the subject matter of this

research was appropriate for a qualitative study because (a) this was an emerging problem, so academic research on the matter is limited, and (b) the concept of accounting data analytics may have been unfamiliar to study participants unless they have been directly involved in the use of these new analytical tools. For this qualitative research project, the investigator chose the case study methodology to describe the participants and their views relating to challenges they encounter, and thereby to understand the problem more completely (Creswell & Poth, 2018).

Other than qualitative studies, two other options remained prevalent for applied business research, including (a) quantitative studies, which assessed relationships between numerically measured variables, to identify correlations and causation, and (b) mixed studies, which combined the features of qualitative studies and quantitative methodologies (Gawlik, 2016). Barczak (2015) described a significant difference between quantitative and qualitative studies, by the underlying scientific methodology used in each, because (a) quantitative studies used deductive methods, testing and verifying previous theories, whereas (b) qualitative studies relied on inductive reasoning, thereby generating new theory about a topic.

Using the quantitative approach to study Louisiana CPAs' preparedness to include data analytics in their accounting work would not have been appropriate because of (a) no feasible way to quantify the level of preparedness of CPAs, and (b) early stage in development of the shift relating to accounting data analytics, with a limited base of established academic theory (Barczak, 2015). These factors combined to favor a qualitative study over a quantitative study, because the qualitative methodology allowed assessment of non-numeric factors, such as perceptions and attitudes (Creswell & Poth, 2018; Stake, 2010). For the same reasons that quantitative was not the best choice for this study, a mixed-method approach was also

inappropriate, because that methodology was only optimal if both the qualitative and quantitative methods were useful to the study (Creswell, 2014; Morgan, 2018).

Multiple research designs further differentiated the study, including (a) narrative, (b) phenomenological, (c) grounded theory, (d) ethnographical, and (e) case study designs (Creswell & Poth, 2018). Case study design was most appropriate to enable the investigator to study the feelings and attitudes of Louisiana CPAs, as they were confronted with this potential disruption to the normal accounting services paradigm, which (a) arose from increased information availability and (b) represented an opportunity to improve their work functions (Janvrin & Watson, 2017). The case study methodology allowed the investigator to explore the problem in a holistic, exploratory manner. Other qualitative designs were not chosen because (a) the narrative design applied to a study of events that transpire in chronological order; (b) the phenomenological design reported on the effects of a single event, and its impact on the individuals who experienced it; (c) the grounded theory design, similarly to phenomenology, assessed the impact of a particular phenomenon but summarized the combined perceptions of all of the participants; and (d) the ethnographical design pertained to cultural mores, shared experiences, and other behavior patterns common to an ethnic group (Creswell & Poth, 2018).

Research Questions

The following definitions preceded the research questions, to provide clarity to study participants. The definition of big data analytics originated from Cao et al. (2015), who explained (a) big data as quantities of information that are so cumbersome or so intricate that standard analysis procedures cannot process them and (b) big data analytics as a process involving inspection, cleaning, transformation, and modeling of big data, to collect useful information for decision-making.

RQ_1. How do Louisiana CPAs incorporate big data analytics as part of their normal accounting functions?

RQ_2. To what extent does using big data analytics as part of normal accounting functions affect competitive advantage for Louisiana CPAs?

RQ_3. To what extent are Louisiana CPAs equipped to use big data analytics as part of their normal accounting functions?

Conceptual Framework

The conceptual framework of this qualitative research guided the study, to ensure that it supported the foundations of the research, especially the problem statement, purpose statement and the research questions (Grant & Osanloo, 2014). The conceptual framework provided a link to connect the study to existing research and demonstrated how the selected theories or concepts interconnected (Regoniel, 2016). Three theoretical concepts supported this study (a) agency theory, (b) adaptive leadership theory, and (c) accountants' competency. This conceptual framework section addressed each of the selected concepts and then considered ways that they related to one another, in the context of this study.

Agency theory.

Agency theory occurred in circumstances in which an agent, such as a CPA, acted in the interest of a principal, such as a client (Jensen & Meckling, 1976). The theory highlighted the inherent risk of the agent's decision making and judgment being tainted toward his own will, self-preservation, and personal benefit (Hahn, 2007). Awareness of this preponderance demanded accountants to maintain professional integrity, to prevent acts of self-interest from harming clients, by prioritizing client satisfaction (Tan & Lee, 2015). In the context of this study, the agency theory applied to a potential desire or need by the client to use big data analytics, a

desire that the CPAs may or may not have shared. However, the integrity standards, mandated by institutional CPA organizations such as the American Institute of Certified Public Accountants (AICPA), mitigated the risks of self-interest by the CPAs at the expense of the client, by requiring updated competencies (AICPA, 2014).

Adaptive leadership theory.

Adaptive leadership theory referred to adjusting to circumstantial changes, enabling survival in tumultuous times (Heifetz, Grashow & Linsky, 2009). This change management concept directly applied to the study of CPA preparedness for big data analytics, due to the continual inundation of information availability and the pressure CPAs encounter to utilize that data to improve business operations (Ballou, Heitger, & Stoel, 2018). Adaptive leadership constructs, in conjunction with design elements of creativity and innovation, have advanced individuals or organizations toward much greater heights than they would have reached without the change (Muluneh & Gedifew, 2018).

Accountants' competency.

Accountants must comply with the competency requirements of institutions that regulate the profession, such as state boards of accounting, the Financial Accounting Standards Board, the AICPA, and various trade associations, such as state societies of CPAs and the American Accounting Association (AAA). As an example, the AICPA publicized a list of technical competencies that CPAs should possess and maintain. These recommended technical competencies, many of which involve analytics capabilities, included (a) risk assessment, analysis, and management, (b) measurement analysis and interpretation, (c) reporting, (d) research, (e) systems and process management, and (f) technology and tools (AICPA, 2019b). Ensuing the advent of big data analytics, AICPA's blueprints of future CPA exam composition

included notification that questions about data analytics would appear on the CPA exam, starting July 1, 2019 (AICPA, 2019a). Likewise, the AAA organization has repeatedly warned accounting educator members that students entering the accounting profession required training in big data analytics (Janvrin & Watson, 2017).

Inter-relationships of concepts.

The precepts of agency theory, adaptive leadership theory, and accountants' competency represented the research issues and the various responsibilities that CPAs considered when assessing their state of readiness to use big data analytics, to enable and enhance their normal accounting work. Specifically, agency theory was the underlying issue behind the first research question, concerning whether the CPA was using big data analytics and the reasons they considered it best to engage or avoid this technological change. Agency theory indicated that the CPA represented both their interest, as the agent, and their client's interest, as the principal, but had a professional obligation to do what was best for their client, even if it was not the favorite path for the CPA's benefit (AICPA, 2014; Jensen & Meckling, 1976). Adaptive leadership theory connected to the second research question, by the fact that adaptive leadership was linked to adjustments required because of changing circumstances, such as the data profusion that materialized through technological advances (Heifetz et al., 2009). Finally, accountants' competency tied to the third research question, because CPAs were required to maintain proficient skills and ensure the provision of value-added services to businesses and society (AICPA, 2019a).

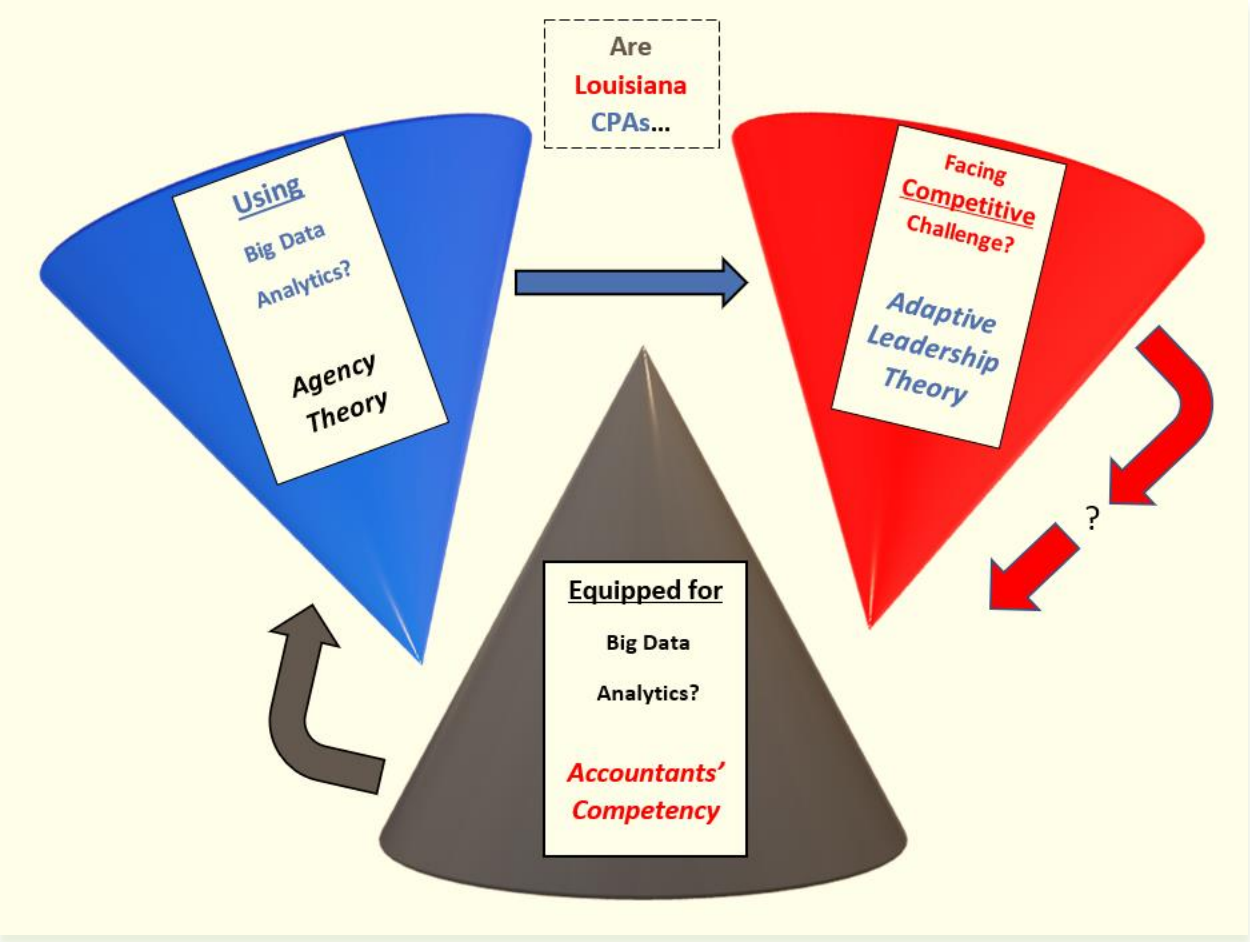

Figure 1. Relationships Between Concepts

Figure 1 visual depiction demonstrated the concepts' interrelatedness, as they affected big data analytics in accounting activities. The rotation pattern began with agency theory, which linked to research question one and connected to the CPA's use of big data analytics. The CPAs' decision to use big data analytics could be incentivized by competitive challenges, which associated with the second research question and theoretical concept, adaptive leadership theory. Adaptive leadership, represented by a rightward rotation of Figure 1 diagram, applied to CPAs who faced competitive challenges caused by technology advancements, and the effect that use of big data analytics may have on their competitiveness. Finally, accountants' competency, the third

rotation in the Figure 1 conceptual pattern and linked to research question three, aligned with how equipped CPAs are for big data analytics, which could constrain the CPAs' ability to use the technology-based tools in accounting functions. Thus, the adequacy of the accountants' competency may limit the degree of use of data analytics, depicted in Figure 1, by the return to the first position of the circular rotation.

Conceptual framework summary.

This conceptual framework depicted three applicable theoretical or conceptual ideas from existing literature and described how those concepts related to and supported this study about the preparedness of currently practicing CPAs to incorporate big data analytics into accounting functions. The study correlated agency theory, adaptive leadership theory, and accountants' competency concepts to the issues encountered by CPAs, encompassing the disruptive effect of data-driven business dynamics. Finally, the conceptual framework diagram and description conferred how these three concepts converged to inform the state of accounting practice relating to this study.

Definition of Terms

Big Data: Big data is quantities of information that are so cumbersome or so intricate that standard analysis procedures cannot process them (Cao et al., 2015).

Big Data Analytics: Big data analytics is a process involving the inspection, cleaning, transformation, and modeling of big data, to collect useful information for decision making (Cao et al., 2015).

Certified Public Accountant (CPA): A CPA is an individual who has (a) obtained an education of at least a bachelor's degree, with specific accounting and business courses included, (b) passed the CPA examination, to attest to a minimum level of competency relating to

accounting topics, (c) gained experience of at least one year, under the supervision of a licensed CPA, and (d) been approved for CPA certification by the regulatory board of accountancy in their state of residence (NASBA, 2019).

Assumptions, Limitations, Delimitations

Assumptions.

The investigator assumed that participants would respond truthfully to questions presented to them, with no verification of truthfulness performed. Assuring participant anonymity encouraged participants' honesty, mitigating participant exposure to confidentiality risk. Secondarily, an assumption of equivalent participant background existed because all participants were licensed CPAs, indicating the attainment of a common minimum competence by education, examination, and experience.

Limitations.

***Limited participant pool*.** The qualitative interview surveyed only members of the Louisiana Society of CPAs (LCPA). Therefore, the potential pool of interviewees excluded Louisiana CPAs who were not members of the LCPA.

***Limited sample size*.** The sample size was too small for generalization of the findings across broader populations of CPAs. However, the findings provided insight for understanding the problem of CPAs' lack of preparedness for big data analytics, which exemplified the broader population, as well as the sample group.

***Limited interview scope*.** The interview process may have been too limited to reveal all the potential reasons CPAs lacked preparedness for big data analytics. Further research could present additional questions to CPAs and thereby obtain a clearer understanding of the problem.

Delimitations.

A delimitation boundary on the study existed by the selection of the subgroup of Louisiana CPAs that were associated with the LCPA, and within that group, a narrow sub-section that included only currently practicing CPAs.

Significance of the Study

This study contributed to the accounting body of literature by revealing expectations for CPAs to serve the emergent business community, in which IT activities and traditional accounting functions are profoundly integrated. Further, this research demonstrated that the underlying theories and concepts of the study aligned with biblical precepts, through the use of multiple analogies and scriptural references. The study demonstrated significance to the whole accounting profession, as well as to individual CPAs, by providing insight into how practicing CPAs related to the changing dynamic of data-driven business operations.

This section conferred how the study addressed gaps in accounting literature by broadening understanding of the state of practicing CPAs for this shift to using big data analytics. Secondarily, the section provided links between this study and biblical principles, with scriptural substantiation. Finally, this section connected the study to accounting, which is the investigator's academic field of study, with emphasis placed on the future of the accounting profession.

Reduction of gaps.

This study applied a combination of agency theory, adaptive leadership theory, and accountants' competency constructs to examine an issue that confronted the accounting profession in a very practical way but lacked adequate evaluation in the academic or professional literature. The study acknowledged the competence of practicing CPAs to use data from

companies' AIS to analyze business operations for many operational purposes (Janvrin & Watson, 2017). Some researchers indicated that CPAs lacked training in the use of modern IT tools, which were prerequisites to employing big data analytics (Richins et al., 2017).

Emphasis in accounting literature had been given to the disruption that big data analytics has brought to traditional accounting practice activities (Cao et al., 2015; Janvrin & Watson, 2017; Nielsen, 2018; Richins et al., 2017; Schneider, Dai, Janvrin, Ajayi, & Raschke, 2015; Tschakert, Kokina, Kozlowski, & Vasarhelyi, 2016). However, the authors reported most of the focus had been on intervening at the pre-certification level, to prepare future CPAs to support an accounting paradigm shift that incorporates big data analytics in accounting functions. The investigator explored the position of experienced CPAs, to ascertain their level of readiness to use big data analytics, with interest in the underlying reasons that CPAs express for their state of preparedness.

Biblical integration.

Agency theory. The biblical concept that correlated to agency theory, as applied to this study, centered around individuals valuing others and putting others' needs and desires before their own. Matthew 20:28 (New Living Translation, NLT) admonished believers to humbly serve others, urging them to follow the example of Jesus, explained as "…for even the Son of Man came not to be served but to serve others and to give his life as a ransom for many". Agency theory described the natural tendency of humans to serve their self-interest, providing a sharp warning to Christians, to guard against the constant potential that greed and selfishness could be the motivation for any action or inaction that existed (Torvend, 2016). As the accountants in this study confronted changing business conditions, some clients expected them to perform services using big data analytics. This transition mandated that CPAs decide whether to comply with

those clients' expectations or to maintain their existing services offerings (Pickard & Cokins, 2015). Hardy (1990) advocated a mindset change for work, toward those activities that benefit society, as a higher priority than individuals' desires. Similarly, the Bible alluded to believers' responsibility to meet reasonable expectations of clients, especially in cases in which the client has a demonstrated need for the information the CPAs' expanded services could provide, "…give to everyone who asks of you…" and "…treat others the same way you want them to treat you…" (Luke 6:30-31, New American Standard Bible, NASB).

Adaptive leadership. Relating to the adaptive leadership theory, biblical precepts involving creativity and adaptation applied. In the accounting profession, researchers have noted a state of transition involving the adaptation of professional services to include big data analytics (Janvrin & Watson, 2017). When the Pharisees asked Jesus why his disciples did not fast, as was expected by their custom, Jesus advocated a change to an existing practice, when circumstances warrant the shift (Mark 2:22, NASB). He stated, "No one puts new wine into old wineskins; otherwise the wine will burst the skins, and the wine is lost and the skins as well; but one puts new wine into fresh wineskins" (Mark 2:22, NASB).

Adaptation and innovation are important concepts that Van Duzer (2010) addressed, describing a crucial purpose for business as the responsibility to serve humanity and promote the common good of society, through enhancements of products and services that they offer. Van Duzer (2010) further explained that innovative ideas used in business portray an extension of the creativity God started when He designed the earth and that these creative activities represent a critical continuing mission for followers of God. The adaptive concepts of creativity, ingenuity, and innovation were exemplified in this study by the paradigm shift to (a) utilize the abundance of available data, (b) perform accounting functions in more effective ways, and (c) provide

companies with practical help to make their businesses more profitable, productive and responsive (Schneider et al., 2015).

Accountants' competency. Accountants' competency correlated to scripture by CPAs providing quality service to clients and delivering excellence in every job that they undertake. Keller and Alsdorf (2012) exhorted believers to maximize their investment of time, talent, and energy into every endeavor they undertake, because when believers delivered quality, it reflected positively on God. Likewise, scripture states, "Whatever you do, work at it with all your heart, as working for the Lord, not for human masters" (Colossians 3:23, New International Version). Specifically relating to upgrading accountants' skill set to allow the use of big data analytics, the wisdom of Proverbs addressed the value of being good at one's chosen profession, "Do you see any truly competent workers? They will serve kings rather than working for ordinary people" (Proverbs 22:29, NLT). Overall, Deuteronomy 6:18 (NLT) summarized the biblical mandate for excellence, instructing believers to, "do what is right and good in the Lord's sight, so all will go well with you".

Relationship to the field of study.

Accountants' primary functions in organizations, whether they be internal or external accountants and whether their work includes financial or managerial accounting functions, involved analysis, interpretation, and presentation of numeric values related to pivotal business operations (Janvrin & Watson, 2017). Due to technological advancements, the operations of business organizations have shifted toward data-driven processes and operational systems (Carillo, 2017). Consequently, the management and accounting analysis needed to make good decisions and to perform accounting functions has changed as well, requiring broader and more technology-related analysis skills (Richins et al., 2017). Professional literature emphasized (a)

the urgent demand for and (b) the corresponding opportunities relating to accounting services that included big data analytics capability (Pickard & Cokins, 2015; Schneider et al., 2015; Tschakert et al., 2016).

Professional accounting organizations have increased pressure on their members to utilize big data analytics, with strong warnings of a loss of competitive advantage to CPAs who fail to do so (AACSB, 2014; Alawadhi et al., 2015). For instance, the AICPA published a book, written by a group of two dozen member-CPA experts, which guided how CPAs could and why CPAs should use data analytics in the performance of independent audits (Alawadhi et al., 2015). Correspondingly, the Association to Advance Collegiate Schools of Business (AACSB), a prominent university accreditation organization for business programs, issued a White Paper in 2014 in which they urged accounting faculty members and accounting programs to expand their education and training for accounting majors to include extensive data-focused competencies, such as data analytics, mining, reporting, and storage (AACSB, 2014).

Significance of the study summary.

This section discussed how this study would reduce the gaps in accounting literature through consideration of existing CPAs' state of preparedness for big data analytics. Next, the section presented a Biblical connection to the study, by applying scripture passage correlations to the underlying concepts of the study. Finally, this section provided a brief of the relationship that this research has to the field of accounting and the future of the accounting profession.

Literature Review

This study examined the transformation of business operations caused by technology advances such as big data analytics and the impact those changes had on the management of organizations and accountants' responsibilities, as support professionals. This literature review section presented a synthesis and analysis of related studies, to enhance understanding of the nature and significance of the investigator's study. This review included three literature topic sub-sections, including (a) expanded information availability generated demand for big data analytics, (b) potential uses of big data analytics in normal accounting functions, and (c) professional competency shift necessitated modern technology skills for CPAs. The fourth subsection presented themes and perceptions from the review of writings on these topics, followed by an overall summary of the literature review. The first literature topic referred to the CPAs' obligation to meet the needs of organizations they serve, and the impetus that organizations' technological changes impose on the related accounting functions, an application of agency theory. The second topic highlighted specific uses that technology-proficient CPAs identify for data analytics in normal accounting work, an implementation of adaptive leadership theory. The third literature topic delineated competency skills upgrade that CPAs need, to equip them for big data analytics in accounting services, associated with expectations of CPAs' professional competency requirements.

Expanded information availability generated demand for big data analytics.

This three-part subsection summarized research findings of the complications that confront CPAs and the businesses they support, resulting from technology improvements. This portion of the review served to (a) highlight the significance of technology advancements, (b)

discuss the effect these improvements have on companies' competitive advantage, and (c) identify instances of functional disruption for accountants, caused by the technological changes.

Magnitude of the paradigm shift toward data-driven business operations.

Technological advances have induced a transformational impact on organizations, resulting in a fast-paced profusion of information availability, referred to as big data (Kache & Seuring, 2017). This development presented a test to businesses to identify, extract, and utilize the most relevant components of the accessible data. Similarly, profuse data from multiple sources challenged businesses to control and utilize the information well, to maximize its usefulness (Addo-Tenkorang & Helo, 2016).

Sivarajah, Kamal, Irani, and Weerakkody (2017) provided an example of the extent and speed of data proliferation, citing examples of daily data produced in 2014, measured in exabytes, equating to billions of gigabytes, compared to expectations for 2020 daily data production, measured in zettabytes, equating to trillions of gigabytes. Some of the sources of the rapid increases in data production were computerized tracking of (a) sales, including product descriptions, quantities, price, sales date, and customer information; (b) cost of sales, including perpetual inventory, manufacturing information, and sales location; (c) customer behavior, including preferences, spending patterns, demographics, and purchase timing; and (d) real-time updating of tracked information (Waller & Fawcett, 2013).

Richey, Morgan, Lindsey-Hall, and Adams (2016) noted that the advent of big data expanded the type of available information, as well as the quantity of that data. In the past, systems included only structured data, presented numerically, relating to accounting and operations, but technology advances allow the collection of unstructured, unquantified data as well, such as documents, audio files, videos, and social media posts. This expansion to combine

structured and unstructured data enabled broader application for the information, specific to organizations' products, processes, and customers (Waller & Fawcett, 2013). Practically, the unstructured data facilitated the inclusion of qualitative data, in addition to traditional numeric product and customer data, such as (a) social media communication details, (b) real-time reports, (c) auto-identification codes and (d) embedded objects (Raguseao, 2018). The latter of these qualitative data capabilities enabled opportunities for integrated communications and connectivity between products and computer systems, which created new dynamics within business processes, and required new methods of analysis (Addo-Tenkorang & Helo, 2016; Kache & Seuring, 2017).

Many researchers agreed on four common facets of big data, referred to as the Four V's, characterized as volume, velocity, variety, and veracity (Addo-Tenkorang & Helo, 2016; Gunasekaran, Kuman Tiwari, Dubey & Fosso Wamba, 2016; Richey et al., 2016). The volume characteristic reflects the exponential increases in data quantity. The velocity characteristic referred to acceleration in the speed of data generation and processing. The variety characteristic linked to structured or unstructured types of data. The veracity characteristic indicated data integrity, quality, and trustworthiness. Addo-Tenkorang and Helo (2016) also included value-adding as a fifth big data characteristic, relating to data analysis and practical application.

A consensus of researchers portrayed big data as voluminous quantities of captured, categorized, and analyzed information, used for (a) improvement of operational business processes and (b) guidance for strategic business decision-making (Addo-Tenkorang & Helo, 2016; Richey et al., 2016; Waller & Fawcett, 2013). Raguseao (2018) highlighted the need for new skills to enable managers and analysts to convert this available data into a competitive advantage for the company. Similarly, Sivarajah et al. (2017) expressed the inadequacy of

established data analytics methods, due to (a) quantity limitations of those processes, (b) challenges related to incorporating qualitative data into analysis and (c) management demands for real-time reporting. Grover and Kar (2017) suggested using the five V's of big data characteristics, including value-adding, as a preferred resolution of the weaknesses in traditional relationship management systems, used for customer and supplier relationships.

Multiple researchers noted the power of combining big data and predictive analytics, to establish a basis for improved decision making (Gunasekaran et al., 2016; Hazen, Skipper, Ezell, & Boone, 2016; Waller & Fawcett, 2013). Wang, Gunasekaran, Ngai, and Papadopoulos (2016) explained that predictive analytics is a combination of mathematics and computer programming, used to gain insights toward the formation of patterns, allowing projections of potential future events. The authors touted big data predictive analytics as useful in problem solving, process planning, and sales performance. Moreover, Kache and Seuring (2017), noted significant process improvements attributable to predictive analytics applications.

Carillo (2017) also recommended using big data predictive analytics for competitive advantage and more effective production processes, but he further advocated its usefulness to guide innovation, through insights gained from the data, which could lead to innovative actions that increased company value. The author also identified big data skills shortages in most business management and analyst positions, rather than just in IT functions. Carillo's (2017) description of big data analytics differed slightly from other authors, in that it stressed cross-functional skills and multi-discipline experts who were data-proficient, enabling the entire business to be data-driven. Carillo (2017) envisioned big data analytics as a blend of business, math, artificial intelligence, machine learning, statistics, and data science, with all aspects of the business impacted by what he called digitalization. Similarly, Addo-Tenkorang and Helo (2016)

argued that value-added features of big data analytics enhanced competitive advantage, allowing targeted strategies based on data-infused insights.

Uses of information for business organizations' competitive advantage. Gupta and George (2017) assessed competitive advantage of big data analytics as less about (a) volume of data, (b) monetary investment, and (c) technological infrastructure, and more about (a) organizational big data analytical capabilities, (b) managerial competence, and (c) a firm culture that values big data insights. Hazen, Boone, Ezell, and Jones-Farmer (2014) advocated big data analysis to access and analyze operational information, for increased productivity and efficiency. The authors described ways for businesses to correct operational deficiencies and thereby increase profitability, using the minute details collected by the computerized records of production processes, sales efforts, and customer interactions. Richey et al. (2016) further designated the benefits of big data analytics to facilitate visualization and to enhance responsiveness. Waller and Fawcett (2013) described information as the key to better decision making and higher profits, utilizing big data analytics in business activities such as forecasting, inventory control, transportation services, and human resources.

Wang et al. (2016) explained specific applications of big data analytics, including descriptive, predictive, and prescriptive, citing descriptive as least complex and prescriptive as most advanced, and providing insights to aid strategic development and decision making. The authors endorsed big data analytics for supply chain management (SCM), to minimize inefficiencies in production, transportation, and customer relations. Some examples provided for descriptive analytics included sales forecasts and inventory management. Predictive analytics examples included data mining and forecasting for sales projections and purchasing. Prescriptive analytics examples, such as customer and supplier relationships, network infrastructure, and

transportation, utilized algorithms to optimize complex alternatives relating to customer and product decisions (Wang et al., 2016). This section included further discussion and consensus opinion for several of these issues, followed by a collection of cautionary observations that some authors issued relating to potential risks, challenges, or deterrents relating to utilizing big data analytics.

Operations. Managers and consumers have known about some components of big data analytics, such as big data in marketing, but the comprehensive applicability of the analysis tools was not evident in the initial stages of big data analytics development (Addo-Tenkorang & Helo, 2016; Carillo, 2017; Hazen et al., 2016; Waller & Fawcett, 2013). For example, companies' retail marketing departments have benefited from big data analytics, in a very public way, by collecting patterns of consumer behavior, which allowed companies to customize product and service offerings, to align with customer preferences (Wang et al., 2016; Zeng & Glaister, 2017). SCM has likewise benefitted from big data analytics, by the integration of supplier, manufacturer, warehouse, and retailer distribution channels, through big data inclusion in enterprise resource planning (ERP) systems (Richey et al., 2016). Researchers identified other ways big data analytics supported operations, such as (a) material sourcing and inventory maintenance; (b) production costing, planning, process, and quality management; (c) human resource and logistics, planning and monitoring; and (d) responsive error correction and real-time crime prevention (Addo-Tenkorang & Helo, 2016; Braganza, Brooks, Nepelski, Ali, & Moro, 2017; Carillo, 2017; Grover & Kar, 2017; Hazen et al., 2014; Hazen et al., 2016; Kache & Seuring, 2017; Schoenherr & Speier Pero, 2015; Waller & Fawcett, 2013; Wang et al., 2016).

Customer relationships. Customer relationship management benefited from big data analytics, according to researchers, by (a) identifying customer preferences, (b) enabling

customer satisfaction, and (c) enhancing customer intimacy and loyalty (Addo-Tenkorang & Helo, 2016; Kache & Seuring, 2017; Raguseao, 2018; Schoenherr & Speier Pero, 2015; Tan, Zhan, Ji, Ye, & Chang, 2015; Waller & Fawcett, 2013). Pickard and Cokins (2015) suggested using big data analytics to target customer profitability, including projected customer revenue and cost of those expected sales, rather than using the traditional profitability model, which aggregates total revenue, total costs, and net profit.

Supplier relationships. Similarly, supplier relationships profited from big data analytics, because of (a) increased visibility and connectivity, (b) real-time transportation tracking, (c) enhanced inventory accountability, and (d) supply chain integration (Addo-Tenkorang & Helo, 2016; Braganza et al., 2017; Grover & Kar, 2017; Gunasekaran, Papadopoulos, Dubey, Wamba, Childe, Hazen, & Akter, 2017; Hazen et al., 2016; Kache & Seuring, 2017; Richey et al., 2016; Waller & Fawcett, 2013; Wang et al., 2016). Gunasekaran et al. (2017) underscored the most critical contributions of big data analytics to supply chain as connectivity and information sharing, which combined to strengthen the firm and supplier relationship, increasing commitment and sustainability. Waller and Fawcett (2013) reported multiple specific and detailed applications for big data and predictive analytics in the manufacturing supply chain, relating to forecasting, inventory management, transportation management, and human resources.

Decision-making. Big data analytics has impacted multiple levels of management decision-making, including (a) operational, involving ordinary daily transactions, (b) tactical, encompassing managerial process planning and short-term budgeting, and (c) strategic, concerning long term planning and capital budgeting (Corte-Real, Ruivo, Oliveira, & Popovic, 2019b; Townsend, Quoc, Kapoor, Hu, & Zhou, 2018). Waller and Fawcett (2013) stated that

data is the key to better decisions and higher profits, providing examples of various tactical and operational decisions that depend on quality data. Similarly, Carillo (2017) stated that the success or failure of business organizations relies on the effective use of data, to direct management action. Wamba et al. (2017) identified big data analytics as the success differentiator for manufacturers, retailers, and health care practitioners. Ghasemaghaei, Ebrahimi, and Hassanein (2018) declared better decision making as the ultimate objective of big data analytics, citing the critical need for (a) high-quality data, (b) effective big data analytical tools, and (c) training for analysts who use the tools, which together equips the organization for faster, smarter decision-making. At the operational level, company decisions applied to dynamic activities of real-time responsiveness, such as process control, quality monitoring, inventory stock levels, order fulfillment timing, and shipping concerns (Corte-Real et al., 2019b; Richey et al., 2016; Schoenherr & Speier Pero, 2015; Townsend et al., 2018). At the tactical level, company decisions applied to matters such as demand planning, sales projections, production budgeting, cost containment, and process procedures (Grover & Kar, 2017; Raguseao, 2018; Schoenherr & Speier Pero, 2015; Townsend et al., 2018; Wang et al., 2016). At the strategic level, company decisions focused on overarching issues, such as target profits, sustainability, innovation, competitive advantage, and customer relationships (Hazen et al., 2016; Gunasekaran et al., 2016; Schoenherr & Speier Pero, 2015; Townsend et al., 2018; Waller & Fawcett, 2013). Braganza et al. (2017) described a three-phase process for effective decisions, including (a) implement a cross-functional problem-solving approach to an operational challenge, (b) perform data analysis of relevant information, to address the challenge, and (c) execute a change in processes to increase profits, satisfy customers, increase efficiency, or otherwise satisfy organizational goals and objectives.

Visibility. The expanded scale of data availability necessitated new ways to present the information, to ensure a broader understanding of its implications (Raguseao, 2018). Big data analytics significantly expanded the ability to visualize company activities, revealing visible patterns for revenue, costs, and profits that affect the company as a whole, as well as minute details of operational activities that pertain to every function performed by the organization (Hazen et al., 2014; Schoenherr & Speier Pero, 2015; Wang et al., 2016). Kache and Seuring (2017) noted that this visibility provided a degree of transparency to the organization, instilling greater confidence in the organization by users of the information. Richey et al. (2016) reported the prevalence of visualization as a critical tool of big data analytics in supply chain operations, to monitor production and improve responsiveness. Likewise, Hazen et al. (2014) mentioned the worth of visualization for production, logistics, and inventory control.

Innovation. Addo-Tenkorang and Helo (2016) emphasized innovation as an important benefit of big data analytics, citing data insights about customer demand as the foundation for product development and creative solutions to meet customer needs. Other researchers confirmed this benefit and suggested utilizing predictive analytics to create revolutionary solutions to customer needs, creating new and improved products that bypass insignificant adaptive battles with competitors, which may only require minor changes to existing products (Hazen et al., 2016; Wang et al., 2016).

Value creation. Hazen et al. (2016) declared that combining big data with predictive analytics allows companies to build un-substitutable resources to accomplish company goals, accomplishing marked competitive advantage. Several other researchers agreed, citing the benefits of extracting insights from data to create valuable solutions to practical company challenges (Addo-Tenkorang & Helo, 2016; Braganza et al., 2017; Gupta & George, 2016; Tan

et al, 2015; Zeng & Glaister, 2018). Gupta and George (2016) cautioned that solutions created with big data predictive analytics only provided a lasting advantage if rivals cannot easily replicate the results.

Developing technology. As the use of big data analytics increased, new tools and infrastructure were identified, such as (a) auto-id technology, (b) cloud computing, (c) the internet of things (IoT) and (d) real-time data tracking (Addo-Tenkorang & Helo, 2016; Hauang, Zhong, & Tsui, 2015; Kache & Seuring, 2017; Townsend et al., 2018). Hauang et al. (2015) explained auto-id technology as smart devices that allow communication with network computer systems, using radio frequency identification (RFID) or optical-scan barcode. Cloud computing traditionally only supported operations as an information infrastructure tool but later expanded to facilitate big data analytics' computing capacity (Addo-Tenkorang & Helo, 2016). Kache and Seuring (2017) noted that merging big data, cloud computing, predictive analytics, and auto-id technology resulted in the advanced embedded technology of IoT, which the authors suggested as useful to activities such as production, logistics, and relationships with customers. Corte-Real, Ruivo, and Oliveira (2019a) stressed the usefulness of big data and IoT within the confines of strict data quality, leading to better products and service and very specific identification of product and process strengths and weaknesses. However, the authors cautioned that the infancy of IoT's developmental stage could weaken company results unless careful data integrity is maintained. Finally, real-time data tracking has emerged as a responsiveness tool for transportation, production, human resources, and SCM (Addo-Tenkorang & Helo, 2016; Kache & Seuring, 2017; Schoenherr & Speier Pero, 2015; Waller & Fawcett, 2013).

Cautionary observations. Researchers noted big data challenges and risks relating to (a) lack of employee analytical skills, (b) need for analysts to interpret data with business knowledge

perspective, (c) organizational resistance to change, (d) security concerns, and (e) cost of infrastructure (Gupta & George, 2016; Kache & Seuring, 2017; Raguseao, 2018; Schoenherr & Speier Pero, 2015; Sivarajah et al., 2017; Wamba et al., 2017). Tan et al. (2015) declared that big data analytics represented substantial untapped potential for firms, but Braganza et al. (2017) reported that most organizations have only one targeted big data initiative in place, indicating less big data utilization than one might assume. Zeng and Gaister (2018) further expressed a caution that effective big data analytics must (a) present information in ways that less technical employees understand, (b) relate data to company objectives, processes, and customer needs, and (c) apply uniquely human abilities of creativity, curiosity, and intuition to the data findings.

Disruption to accounting functions that dictated CPA adaptation. Historically, accountants utilized data analysis tools, such as statistics, data mining and queries (a) for internal accounting functions, (b) external audit duties, and (c) management support for decision making (Richins et al, 2017). Technological advances introduced expanded information availability, allowing real-time access to detailed transaction-level data, and facilitating significant improvements to operational processes, for increased competitive advantage (Hazen et al., 2014). Researchers recounted ways that technology advances and data profusion have disrupted normal accounting functions, threatening CPAs' ability to maintain their established management support and advisory roles in the organizations they serve (Cao et al., 2015; Nielsen, 2018; Richins et al., 2017). Schneider et al. (2015) stressed the applicability of data analytics to a broad range of accounting functions, including financial, managerial, fraud, tax, and audit, because big data's availability, challenges, and opportunities affect the underlying transactional source that is foundational to each of these activities.

Specific instances of accounting disruption were identified and categorized as (a) obsolescence of existing accounting methods caused by technology advances, (b) the expanding role of management accounting, and (c) challenges presented by the technological disruption.

Obsolescence of existing accounting methods. Expanded information availability enabled data analysis that has fundamentally changed organizational structures, accounting systems, and audit processes (Schneider et al., 2015). Many researchers noted big data's distinct superiority in quality and usefulness, compared to traditional data sources (Richins et al., 2017; Schneider et al., 2015; Warren, Moffitt, & Brynes, 2015; Yoon, Hoogduin, & Zhang, 2015). Specifically, Warren et al. (2015) attributed much of this big data benefit to the ability to capture and analyze unstructured data, such as audio files, video images, and textual exchanges, for use in financial and managerial accounting analysis, in addition to management decision support. Multiple authors stated that exponential improvements to management control systems and AISs occurred when this unstructured information is combined with the traditional structured numeric data (Vasarhelyi, Kogan, & Tuttle, 2015; Yoon et al, 2015).

Several researchers focused on the big data benefit of timely information availability to allow error corrections, process modifications, product adaptations, and course changes in a much shorter time range (Pickard & Cokins, 2015; Vasarhelyi et al., 2015; Yoon et al, 2015). For example, technology advances enabled accounting functions, such as inventory tracking and control using big data analytics, to transform systems into dynamic real-time specific-identification product tracking, from static traditional costing methods of last-in, first-out (LIFO) and first-in, first-out (Vasarhelyi et al., 2015). Further, predictive big data analytics tools highlighted information gleaned from transactional data, to project trends and forecast future events, overshadowing traditional budgeting techniques (Cao et al., 2015; Nielsen, 2018).

Also utilizing the expanded and varied structured and unstructured data, Yoon et al. (2015) stressed the effectiveness of big data analytics as supplementary information to corroborate audit findings, promoting client confidence in CPAs' reliability and trustworthiness, based on the addition of unstructured audit evidence. Cao et al. (2015), Richins et al. (2017) and Vasarhelyi et al. (2015) emphasized the impact big data analytics has on audit procedures, including evaluation of the entire population of transactions, rather than testing a small sample of transactions. However, Richins et al. (2017) cautioned that the larger transaction pool alone would not guarantee greater confidence in the validity of the underlying structured data, because (a) that particular advancement included the same transaction dataset as sampling methods would, and (b) strict statistical sampling had been shown as very accurate in assessing data validity. Although expanding audit transaction scope increased auditor awareness and thoroughness, it also caused auditor challenges relating to (a) increasing audit exception volume and (b) incorporating unstructured data findings into traditional audit procedures (Richins et al., 2017).

Technology advances and big data analytics have facilitated (a) better monitoring for controls, (b) advances in crime prevention and fraud detection, and (c) more effective continuous audit processes (Alles, 2015; Richens et al., 2015; Zhang, Yang, & Appelbaum, 2015). Adding unstructured data, including source documents, surveillance videos, audio recordings, and text captures, to management control systems provided significant advancement to monitoring for controls, fraud, operations, and audit (Cao et al., 2015). Alles (2015) noted the high demand for continuous audit as an internal control tool that safeguards assets and financial statement integrity. Zhang et al. (2015) identified continuous audit, combined with monitoring and big data analytics, as a progressive step toward real-time financial statement capability. Alawadhi et al.

(2015) reported the development of continuous audit and continuous monitoring systems as an internal audit function implemented by management, often with management advisory assistance from outside CPAs, data from which auditors could access during external audits. The authors stated an expectation that ongoing external auditor participation in the continuous audit system would increase and include interim period opinion determinations by the auditors, as continuous audit develops further (Alawadhi et al., 2015).

The last identified component of the potential obsolescence of existing accounting practices involved financial reporting. Appelbaum, Kogan, Vasarhelyi, and Yan (2017) warned that traditional historical financial statements are insufficient, compared to future-oriented projections obtained by predictive big data analytics, which illuminate patterns, trends, and preferences, which are useful for long-range decision making, product improvement, and product development. Also associated with reporting, Vasarhelyi et al. (2015) determined visual depictions of transactions more effective than traditional financial statements when conveying complex data and relationships about company performance and processes. Researchers detailed preference for visualization, undergirded by big data analytics, because of its aesthetic appeal, clarity, effectiveness, and understandability (Janvrin, Raschke, & Dilla, 2014; Nielsen, 2018).

Expanding role of management accountants. Accountants' principal service roles in organizations have remained constant in mission, yet variable in method (Schneider et al., 2015). The authors categorized management decision support functions as (a) inferring, which encompassed cost allocation and operational strategies; (b) predicting, which included budgeting, forecasting, and estimations; and (c) assuring, which incorporated compliance and audit functions. Because of the increased volume and variety of organizational data available, the methods used to fulfill these accounting roles have evolved and the emphasis on each accounting

role has shifted to meet the needs of the organizations they serve (Janvrin & Watson, 2017; Richins et al., 2017; Schneider, et. al., 2015). Further, Richins et al. (2017) observed that accountants have traditionally served as data analysts, but were limited to smaller quantities of structured data, whereas big data capabilities have (a) enabled much greater quantities of structured data and (b) added unstructured data to the analysis. These shifting roles enabled management accountants to function more constructively, to support management in creating value for business organizations, both operationally and strategically (Nielsen, 2018; Richins et al., 2017; Schneider et al., 2015). This review subsection highlighted several specific ways that big data analytics has affected specific components of management accountants' responsibilities.

Visualizations and real-time reporting were impactful management accounting changes that stemmed from big data access and analytics (Janvrin et al., 2014; Nielsen, 2018; Pickard & Cokins, 2015; Vasarhelyi et al., 2015). Janvrin et al. (2014) emphasized the effectiveness of visualization in conjunction with business intelligence because the visual depictions of processes and operational results allow management to understand the complex data indicators more completely and interactively than traditional financial statements. Likewise, Nielsen (2018) touted visualization as an effective and interesting tool to enhance internal reporting and communication to management, thereby informing managers and leading to targeted decisions for practical improvements to products and processes. Real-time reporting has also impacted the management accounting's role in business, through ongoing monitoring of controls and processes, enabling (a) timely adaptations for error corrections and product or process improvements, (b) crime prevention and fraud identification, and (c) better customer profitability analysis and customer responsiveness (Pickard & Cokins, 2015; Vasarhelyi et al., 2015).

Likewise, when combined with traditional structured data, the addition of unstructured data-enhanced management information (a) permitted better understanding of customer preferences and patterns, and (b) provided informed insight for decision making (Nielsen, 2018; Schneider et al., 2015; Waller & Fawcett, 2013). Big data analytics advancement facilitated more complete assessments of the companies' strengths, weaknesses, and core competencies, incorporating them into (a) newly developed tools to solve operational challenges and (b) normal management accounting tools such as the balanced scorecard and the strengths, weaknesses, opportunities, and threats analysis (Appelbaum et al., 2017; Nielsen, 2018; Warren et al., 2015).

Multiple researchers recognized quality interpretation of big data analytics findings, even when not directly related to financial calculations, as an emerging managerial accounting responsibility, because of the significant risk that analysis could be misapplied, if not for good judgment, knowledgeable business understanding, and analyst skepticism (Fay & Montague, 2015; McKinney, Yoos, & Snead, 2017; Zhang et al., 2015). Fay and Montague (2015) remarked that accounting professionals were required to apply sound judgment in everyday accounting work, attesting to the appropriateness of entrusting them with the analytics interpretation task. Other researchers concurred, encouraging accountants to become involved in big data analytics interpretation in all aspects of business, to utilize accountants' broad business knowledge base, proprietary insights, and reasoned decision matrices (McKinney et al., 2017, Richins et al., 2017, Schneider et al., 2015). McKinney et al. (2017) asserted the need to (a) question the validity and completeness of the data, (b) recognize big data's limitations and drawbacks, and (c) apply critically thinking skills, to ask challenging questions about the data. Zhang et al. (2015) stated that regardless of quantity or quality, analysts must decipher and apply data to practical business scenarios to benefit organizations.

Finally, management accountants' responsibilities have expanded due to the continual merging of management information systems (MIS) and AISs (Coyne, Coyne, & Walker, 2016; Spraakman, O'Grady, Askarany, & Akroyd, 2018). An organization's MIS often includes subsystems such as (a) ERP systems, (b) SCM systems, and (c) customer relationship management (CRM) systems (Richardson et al., 2018). These comprehensive systems encompass matters such as operational plans, production budgets, manufacturing processes, internal controls, customer relationships, vendor relationships, cash receipts and disbursements, and ongoing transactional records, including source documents, such as contracts, invoices, and delivery records (Coyne et al., 2016; Spraakman et al., 2018). Griffin and Wright (2015) noted the inevitability of an interrelationship between big data and traditional accounting and auditing functions, due to the commonality of underlying artifacts and data streams.

Challenges and risks presented by the disruption. Given the vast evidence of the positive impact that is possible through the implementation of big data analytics, some researchers warned accountants of the risk of not using the available data (Alles, 2015; Enget, Saucedo & Wright, 2017). These authors stated risk possibilities such as poor determinations, faulty conclusions, and unmet client needs. Enget et al. (2017) referred to the risk relating to non-action on big data analytics as an example of substandard work and poor judgment. Alles (2015) focused on the fact that when clients invest in infrastructure that enables big data analytics, and accountants refuse to adapt to the change by utilizing that data, they risk losing the client. Richins et al. (2017) expressed the potential risk that technology advancements and automation of accounting and auditing functions could result in non-accounting firms acquiring skills to perform audit and accounting services in direct competition to CPAs. The authors countered with the reassurance that CPAs provided comprehensive services that meet clients' audit or

accounting needs but also encompassed factors not easily replicated by other experts, including professional judgment, client trust, and business knowledge. However, leveraging these attributes for big data analytics required their usage to decipher and integrate unstructured data findings into the analysis (Richins et al., 2017).

Conversely, using big data analytics created risks as well, such as the increased auditor responsibility and associated legal liability, when auditors were given access to the entire transaction population, yet did not identify existing trouble, which surfaced at a later time (Cao et al., 2015; Enget et al., 2017; Schneider et al., 2015). Other researchers noted risks of big data analytics involving vulnerabilities such as (a) privacy or confidentiality; (b) intellectual or industrial property rights; and (c) trade secrets, relating to inside processes, practices, or knowledge bases (Schneider et al., 2015, Yoon et al., 2015; Zhang et al., 2015).

Another big data analytics challenge for the accounting profession was the impending technical expertise shortage, as the demand for big data analytics in accounting potentially exceeds the supply of technically trained CPAs (Alles, 2015; Cao et al., 2015; Nielsen, 2018; Richins et al., 2017). Cao et al. (2015) noted that practicing CPAs were untrained for using big data analytics, and rather than retraining the CPA for the task, presented the solution as a choice between (a) hiring technically trained accounting professionals to join existing accounting staff or (b) subcontracting the technical aspects of the data analytics to other organizations. Nielsen (2018) also acknowledged that most practicing accountants were not trained in technology-based analytics, such as business intelligence, data mining, and data management, but suggested that additional training to gain skills such as statistics, regression analysis, econometrics, visualization techniques, and data modeling, could prepare practicing CPAs to use big data analytics (Nielsen, 2018). Richins et al. (2017) discussed accounting firms' acute need for

qualified data technicians but stressed the fact that technological skill was not a replacement for the business acumen and reasoning skillset that traditional accountants have exemplified. Alles (2015) proposed the shortage in data analytics technical expertise to be a temporary one, which he expected would reconcile itself by focused technical training initiatives that facilitate a corresponding increase in supply, to match the demand. The author compared the shortage of expertise to similar demand challenges presented to ERP and SCM experts, as those technologies were emerging, which are no longer a concern, due to supply and demand market forces.

Another important challenge identified for big data analytics in accounting involved CPA reticence, observed as (a) CPAs' lack of preparedness to use big data analytics in accounting functions, and (b) accounting firms' slow adaptation to demand for big data analytics (Alles, 2015; Cao et al., 2015; Nielsen, 2018; Richins et al., 2017). Since 2015, researchers and professional organizations have described the transformational impact of big data on companies' organizational strategy, accounting processes, and audit functions (Alles, 2015; Cao et al., 2015; Schneider et al., 2015). Cao et al. (2015) declared the critical need for accountants to obtain training in big data analytics, suggesting that if accountants failed to obtain technological training, they should outsource the duties, rather than omit the service offerings. Alles (2015) warned (a) the disruption from data analytics threatened the sustainability of existing audit practices and (b) failure to follow clients' lead into analytics use could result in lack of favor and credibility with clients.

Despite these early warnings, Nielsen (2018) reported that management accountants were not advancing significantly in analytics skills development, such as IT, statistics, econometrics, and data modeling skills. The author presented survey results that indicated 29% of accountants were not using big data analytics at all, and another 37% of accountants were in infancy stages of

analytics utilization. Reasons for these lethargic participation figures were (a) 28% stated lack of management interest and prioritization, and (b) 29% named lack of knowledge about how to perform analytics (Nielsen, 2018).

Similarly, Richins et al. (2017) reported that accounting firms have been slow to adopt big data analytics for audit services, an example of change reticence that the authors identified as a pattern for the profession. Alles (2015) also recognized a significant degree of reluctance to change that accountants exhibited toward big data analytics, which they stated aligns with accountants' response to past technology developments, identifying the main impetus for change as pressure from clients to do so. Conversely, Janvrin and Watson (2017) dissented from this view of change resistance, portraying the accountants as a profession of adapters, open to technological changes, as evidenced by their involvement with broad accounting and MIS, such as ERP and SCM.

Notwithstanding the past actions of accountants, Richins et al. (2017) urged accounting professionals to prepare themselves to utilize big data analytics, to (a) supplement traditional historical accounting reporting with future-view accounting decision inputs, or (b) acknowledge the stark possibility that clients would replace them with other professionals who would provide these services. Appelbaum et al. (2017) concurred, stating that big data analytics facilitated a transition for accountants that expanded responsibilities, adding proactive, future-focused services to the normal reactive, past-centered reporting services that accountants provide. The determination of whether big data analytics posed a threat, or an opportunity, depended upon the accountant's response to changes they encountered (Richins et al., 2017).

Subsection summary. This subsection covered literature about technological operational changes that created challenges and opportunities for businesses, resulting in corresponding

changes for CPAs. The review first addressed the nature of the technology changes, followed by a discussion of the impact the enhanced information had on companies' competitive advantage. Finally, the review presented examples of disruption that these technology changes created for CPAs, as they performed multi-faceted support work for business organizations.

Potential uses of big data analytics in normal accounting functions.

This three-part subsection summarized research findings of the applications for big data analytics that technologically skilled accountants have implemented in their work. This piece of the literature review summarized uses of big data analytics in accounting for (a) financial functions, such as measurement and reporting; (b) managerial functions, such as oversight and systems support; and (c) audit functions, including external and internal auditing. Data analytics affected all primary accounting functions because the three accounting domains of financial, managerial and audit share the same underlying database, and accountants who have responsibilities in any of these domains encounter challenges that require interpretation and analysis of organizations' expanding data (Schneider et al., 2015).

***Financial: Measurement and reporting*.** Measurement and reporting changes in the financial accounting domain resulting from big data and analytics included development of visualization tools, which enhanced reporting options for organizations, allowing better understanding of the underlying transactions, and providing more interesting and useful insights for company planning (Vasarhelyi et al., 2015; Warren et al., 2015). Other advances in financial accounting measurement and reporting centered around the shift from exclusively past reporting to include real-time reporting data, for better understanding of financial outcomes and opportunities (Cockcroft & Russell, 2018; Neilsen, 2018). Similarly, predictive analytics tools facilitated improved measurement techniques for accounting estimates and future-centered

valuations (Richardson, Teeter, & Terrell, 2019; Schneider et al., 2015; Waller & Fawcett, 2013).

Visualization and unstructured data. Cockcroft and Russell (2018) explained visualization as a dynamic supplement to traditional financial reports, rather than a replacement for them. Richardson et al. (2019) explained how accountants used visualizations for either (a) depicting past analysis, such as the charting of information presented on traditional financial statements or (b) exploring the data for new insights, such as geographical data drill down, to assess product success in particular regions during certain operational periods. The authors further categorized visualizations based on the types of information being depicted, whether (a) quantitative, for which they suggested scatter plot, maps, line charts, and box plot presentations, or (b) qualitative, for which they recommending plot bar charts, treemaps, symbol maps, and word cloud presentations (Richardson et al., 2019). Finally, Warren et al. (2015) provided examples of using unstructured visual and audio data to supplement financial statement information and assist with measurement determinations, such as (a) videos of company real estate to convey the condition of properties, relating to impairment valuations, (b) monitoring and safeguarding assets in restricted access areas and (c) recorded customer service telephone conversations, and (d) textual replication of Securities and Exchange Commission filings and web pages.

Real-time reporting. Neilsen (2018) emphasized the pertinence of real time reporting to facilitate forward view for financial statements, overcoming limitations caused by traditional past-only financial reporting. Waller and Fawcett (2013) provided selected examples of real-time reporting in measurement and operations to (a) monitor inventory supply, (b) anticipate customer demands, (c) detect in-store theft, (d) assess inventory capacity and (e) provide transparency to

customers about inventory availability. Vasarhelyi et al. (2015) discussed the applicability of RFID and barcode to accounting measurement, for precise, current-value, perpetual inventory, rather than traditional inventory calculations, such as (a) first-in, first-out, (b) last-in, first-out, and (c) lower of cost or market. Relating to financial reporting, Pickard and Cokins (2015) suggested using expansive current data capability to analyze the ongoing profitability of individual customers, rather than grouping them all for analysis, to permit targeting goods and services toward most profitable customers.

Predictive analytics. Neilsen (2018) suggested that traditional reporting only addressed the issues of what had happened, which is descriptive analytics, whereas predictive analytics would use trending analysis to establish patterns, allowing analysts to forecast possible future events. Waller and Fawcett (2013) provided examples of predictive analytics applications in measurement to estimate inventory supply, delivery schedules, human resource requirements, transportation schedules, and more. Other researchers described instances of predictive analytics used in measurement, for (a) customer receivable collectability, (b) loan loss estimations, (c) goodwill impairment assessment, and (d) warranty and litigation liability contingencies (Richardson et al., 2019; Schneider et al., 2015). Cockcroft and Russell (2018) cautioned that the basis of reporting decision making must be supportable historical events, with the addition of predictive data analytics providing useful insights that support future planning and budgeting exercises. Similarly, McKinney et al. (2017) recognized accountants' critical role, which required them to deliver a measure of skepticism to big data analytics, to ensure the authenticity of the underlying information.

Managerial: Oversight and systems. Much of the impact of big data analytics in the managerial accounting domain affected tactical company operations, inventory control, and

general operational oversight (Hazen et al., 2016; Pickard & Cokins, 2015; Schneider et al., 2015; Vasarhelyi et al., 2015; Waller & Fawcett, 2013). Also, big data analytics provided decision support by enabling better internal reports, such as capital budgets, operations budgets, and long-range planning (Vasarhelyi et al., 2015; Waller & Fawcett, 2013; Warren et al., 2015). Finally, comprehensive MIS used big data to facilitate (a) enterprise management, supervising production resources and operational processes and (b) SCM, coordinating supplier and customer relationships (Addo-Tenkorang & Helo, 2016; Vasarhelyi et al., 2015).

Operational oversight. Schneider et al. (2015) noted managerial big data analytics applications to (a) maximize production efficiency, (b) identify trends and highlight opportunities, (c) monitor quality control, and (d) improve costing allocations. Janvrin et al. (2014) touted the necessity of data visualization, targeting decision-makers, whether internal or external users, to increase clarity and comprehension of the underlying data. Vasarhelyi et al. (2015) anticipated interactive visual representations of detailed financial events as more valuable to users than traditional accounting reports. Warren et al. (2015) presented uses of unstructured audio and visual data to augment traditional managerial oversight functions, such as (a) video productivity and attitude monitoring, for human resource oversight, (b) real-time production monitoring, to identify process bottlenecks and assess inventory quantity levels, and (c) customer communications monitoring, through website and social media feedback, complaints, and internet reviews, to assess customer satisfaction levels. Waller and Fawcett (2013) stressed the importance of big data analytics in customer relationship management, to support logistics monitoring and control, such as delivery schedules, traffic challenges, weather delays.

Budgeting and planning. Waller and Fawcett (2013) contended that effective big data analytics, in combination with a thorough understanding of organizational mission and

operational processes, led to better decision making (a) on the strategic level, such as capital budgeting, and (b) on the tactical level, such as break-even analysis. Warren et al. (2015) and Hazen et al. (2016) advocated incorporating the unstructured components of big data into balanced scorecard assessments, to isolate critical success factors and enhance competitive strategies. Vasarhelyi et al. (2015) concurred, noting accountants' ability to provide decision support for management, using structured and unstructured data relating to human resources, marketing, supply chain, and numerous other operational and strategic planning functions.

Systems. Vasarhelyi et al. (2015) discussed technological advancements that changed accounting functionality, progressing from manual accounting systems to computerized general ledgers, and evolving to include expansive data networks that manage enterprise resources and coordinate supply chain activities. The authors noted that accountants' support functions were accomplished through ERP management, such as human resource planning, process planning, and sales marketing. Spraakman et al. (2018) identified ERP systems as critical to optimal production performance and effective decision making. Appelbaum et al. (2017) described enterprise systems as coordinated data management tools that merge structured and unstructured data relating to company products, processes, and people, including employees, customers, and suppliers.

Addo-Tenkorang and Helo (2016) praised supply chain management systems for their ability to (a) improve process quality and efficiency, (b) match customer demand to production supply, (c) coordinate logistics, and (d) prevent crime. These supply chain activities were related to the accounting function by accountants' responsibility for product costing, inventory management, and asset safeguarding. Spraakman et al. (2018) noted a distinction between AISs in practice and education, observing (a) actual systems as decidedly more technically oriented

than those studied in most academic programs and (b) indicators of an effective merger of AIS with MIS. As technology progressed, many AISs integrated operational data management systems, providing a singular database to coordinate previously separate management systems, including resource planning, supply chain, and customer relationship management (Appelbaum et al., 2017; Richardson et al., 2018).

Audit: External and internal. Big data analytics' impact on the audit function and controls environment has been significant because the ability to analyze expanded data sets presented a disruption to the traditional methods used to assess the validity of financial measures (Richins et al., 2017; Schneider et al., 2015). Likewise, internal audit functions were impacted by data availability and the ability to identify potential instances of fraud or asset misappropriation (Addo-Tenkorang & Helo, 2016; Richardson et al., 2019; Schneider et al., 2015). Further, the inclusion of unstructured data enhanced the credibility and usability of the structured data for internal audit staff, managers, and external auditors (Richins et al., 2017; Vasarhelyi et al., 2015; Warren et al., 2015).

External audit. Big data analytics' impact on the audit function primarily related to the ability to analyze the complete transaction dataset, rather than a limited transaction sample (Cao et al., 2015; Richardson et al., 2019). Cao et al. (2015) listed additional big data analytics applications, such as (a) solvency risk assessment, (b) fraud risk assessment, (c) internal control testing, and (d) material misstatement risk evaluation. Alawadhi et al. (2015) concurred, presenting numerous applications for big data analytics in audit services, such as (a) exploratory and confirmatory analytical procedures, (b) targeted external account balance confirmation selection, (c) detail transaction scrutiny, e.g. related party transaction isolation, and (d) multivariate ratio analysis.

Additional researchers emphasized the confirmatory value of big data analytics, due to the availability of unstructured evidence, to corroborate audit findings through text mining and statistical analysis (Richins et al., 2017; Yoon et al., 2015; Vasarhelyi et al., 2015). Vasarhelyi et al. (2015) noted that developments in transaction record digitization have made manual methods of analysis increasingly difficult, requiring auditors to access company database systems in conjunction with their normal audit duties. Richardson et al. (2019) recognized this shift, noting the emergence of systems translator software, used to merge data from diverse transactional databases into a company data warehouse, which can be accessed by (a) managers, for oversight, and (b) external auditors, for auditing procedures.

Internal audit. Cao et al. (2015) stressed that internal audit functions replicated processes of external audits, making big data analytics applications for audit procedures suitable for preemptive internal audit as well. Further, internal audit functions included continuous data assurance procedures, used to monitor ongoing transactions for inconsistencies and outliers (Alawadhi et al., 2015; Zhang et al., 2015). Schneider et al. (2015) described big data analytics' usefulness to detect fraudulent transactions and identify transaction anomalies for further investigation. Perols, Bowen, and Zimmermann (2017) presented predictive big data analytics as a tool for fraud prevention and identification, using fraud prediction models for audit planning and forensic investigations.

Subsection summary. This subsection covered literature about practical uses of big data analytics in normal accounting functions. The review covered three primary functional accounting domains of financial, managerial, and audit, highlighting specific instances of big data analytics applications identified by researchers. The subsection provided selected examples

of accountants' ongoing use of big data and analytics to increase efficiency and effectiveness, and to add value to the organizations accountants serve.

Professional competency shift necessitated modern technology skills.

This four-part subsection summarized research findings of the changing CPA competency requirements, arising because of technology advancements. This piece of the literature review addresses (a) competency expectations of CPAs, (b) technical skills needed, (c) tools and technologies used in big data analytics, and (d) training needed to attain competency. A review of these issues highlighted the requisites needed for services adaptation, to equip CPA to include big data analytics in accounting services.

Professional competency expectations of CPAs. Mayer, Davis, and Schoorman (1995), in their model of trust enhancement, presented a three-part requisite for establishing trustworthiness in a given field, comprised of ability, benevolence, and integrity, which combined to facilitate quality professional judgment. Likewise, these three attributes were evident in the AICPA's Code of Professional Conduct (2014) by (a) ability's correlation to the due care principle, (b) benevolence's alignment with the public interest principle, and (c) integrity's specific inclusion in both documents. In the Model of Trust Enhancement, the term ability referred to an individual's level of competence and functional adeptness, which lends credibility in a chosen domain (Mayer et al., 1995). AICPA's Code of Professional Conduct's (2014) comparable directive of due care similarly included (a) abiding by professional standards; (b) increasing competency and quality; and (c) performing duties with excellence. The model's (Mayer et al., 1995) concept of benevolence, conveyed confidence in an individual's selfless interest in promoting the good of the constituency served, rather than that individual's self-interest. The corresponding AICPA code section (AICPA, 2014) referred to the public interest

principle in a compatible manner; both terms highlighted the caution presented by agency theory, to guard against the prioritization of the professional's self-interest. Both documents emphasized the critical mandate of high standards of integrity, to establish and maintain trust (AICPA, 2014; Mayer et al., 1995). The AICPA code (AICPA, 2014) applied to this study by relaying accountants professional duties (a) of due care, which included competence and quality, with continual improvements; (b) of public interest, which ensured an overarching motivation of public good, for all users of the information being analyzed, to thereby earn public trust; and (c) of independence, which incorporated professional skepticism, a critical element of data analysis. Duska, Duska, and Ragatz (2011) summarized professional obligations of accountants as (a) maintaining accounting competence, (b) prioritizing the interest of clients ahead of the accountants' interest, and (c) serving the broader public interest.

Pertuit (2019) discussed the disruption that CPAs encountered because of rapid technological advancements that directly affected accounting functions, simultaneously describing disruption as (a) an obstacle to the continuation of business as usual for accountants and (b) a force of innovation for the accounting profession. Krahel and Vasarhelyi (2014) noted a demand-side mandate for analytics in accounting, initiated by businesses, with accountants responding to calls for assistance from organizations they serve. Acquiring the technical skills that enabled accountants to provide those support services exemplified the competence obligation of CPAs' professional responsibilities, under the due care principle (AICPA, 2014). Alles (2015) emphasized this responsibility by stating that accountants must follow clients' lead to big data analytics to maintain their currency and credibility. Jenkins, Popova, and Sheldon (2018) discussed CPAs obligation to uphold the public trust by responsible actions, to protect the

interests of clients, the business community, and other affected stakeholders, all of which incorporate the CPA public trust mandate (AICPA, 2014).

Richins et al. (2017) suggested that the professional competency update that big data analytics initiated be addressed (a) for new CPA entrants, through accounting education adaptations, and (b) for existing CPA practitioners, through continuing education requirements. The AACSB (2014) stressed IT competency as a critical element of accounting education, including it as a required component of member university programs, for AACSB accounting program accreditation standards. The AICPA (2019b) established a pre-certification core competency framework, which detailed competencies expected of incoming accounting professionals, involving (a) technical accounting topics, including technology and information systems; (b) broad business topics, including strategic and operational management; and (c) professional topics, including ethics and collaboration. Sledgianowski et al. (2017) presented ways that accounting education could be adapted to accomplish this mandate, and broaden accounting graduates' knowledge and experience base, to prepare them for data analytics in their accounting work. Zhang, Dai, and Vasarhelyi (2018) noted inconsistencies in university accounting graduates' preparedness, which often required additional technical skills education, immediately after graduation, to enable accountants to meet employer expectations. Winstead and Wenger (2015) concurred, noting distinct differences between the goals of accounting educators and accounting practitioners about proficiencies accounting graduates should possess.

Types of technical skills needed. Carillo (2017) identified big data analytics as a multidisciplinary activity, requiring deep knowledge of business finance and IT functions, causing managers and accountants to require more understanding about IT systems. Rienzo and Chen (2018) specified spreadsheet, database, project management, and statistical analytics as

most critical skills for overall business oversight. Gupta and George (2016) added recommended skills of machine learning and data scrubbing, in conjunction with deep organizational knowledge. Schoenherr and Speier-Pero (2017) advocated a more statistical approach to big data analytics, with emphasis on predictive analytics, including forecasting and optimization skills.

Specific to accounting functions, Richins et al. (2017) encouraged (a) training in business modeling, (b) extracting, cleaning, and interpreting data for better understanding, (c) learning to use a combination of structured and unstructured data, and (d) gaining better understanding of programming languages, to allow accountants to interact with computer engineers. Neilsen (2018) asserted that management accountants need skills in visualizations, statistical analysis, business intelligence, data mining, programming, and data management. Dzuranin, Jones, and Olvera (2018) expanded on the technical skills requisites, to include a greater emphasis on (a) critical thinking skills and (b) communication of the findings as key skills that accountants need. McKinney et al. (2017) agreed and stressed the need for accountants to apply skeptical lenses to data analysis, to safeguard data quality.

For continuous audit, Alawadhi et al. (2015) recommended that accountants supplement audit experience and training with data analytics skills for (a) data extraction and data mining, (b) statistical regression and probabilities, and (c) ERP system manipulation and programming. Richardson et al. (2019) summarized the minimum necessary accountants' skillset, including (a) analytics mindset, (b) data scrubbing, (c) data quality evaluation, (d) descriptive analytics, (e) data manipulation, (f) statistical data analysis, and (g) data visualization. Tschakert et al. (2016) explained the analytics mindset as an inquisitive and exploratory attitude, applied to technologically oriented business challenges.

Tools used in emerging technology. Dzuranin et al. (2018) stated the usefulness of Excel in accounting analytics, but also advocated accountants' use of (a) visualization software, such as Tableau, Qlik Analytics, and Microsoft Business Intelligence, (b) audit software, such as ACL Analytics or IDEA Data Analysis, (c) statistics packages, such as SAS Analytics or SPSS Statistics, and (d) expanded programming languages, such as R Analytics and Visual Basic. Tschakert et al. (2016) also recommended Excel, ACL Analytics, and IDEA Data Analysis for audit and accounting data analytics, but also included Access as an essential tool. Several researchers noted the usefulness of analytics through visualization, using Tableau and Excel, for graphical presentations (Janvrin et al., 2014; Kokina, Pachamanova, & Corbett 2017; Hoelscher & Mortimer, 2018). Other researchers prioritized numerical functions in Excel, preferring pivot tables, filtering, and regression (Ragland & Ramachandran, 2014; Sledgianowski et al. (2017). Pertuit (2019) advocated using a cloud-based financial management system that allowed company customization using varied software solutions, connected by a common programming language, to allow financial and operational oversight.

Lunsford and Phillips (2018) categorized analytics tools into three groups, used for (a) storing and managing data, (b) systems-based analytics, and (c) visualizing and reporting. Schneider et al. (2015) noted many alternative MIS, including ERP, SCM, and relational databases, representing software tools that collect data for analytics. Appelbaum et al. (2017) discussed analytics applications for these systems using (a) descriptive analytics, such as simple models or visualization, (b) predictive analytics, such as probabilities or regression, and (c) prescriptive analytics, such as decision aids or Monte Carlo simulations. Spraakman et al. (2018) advocated Excel as a critical analytics tool, even for MIS, such as ERP and SCM. These software

programs and computer systems were presented as examples of applicable analytical tools, and do not represent specific recommendations of the researcher.

***Ways to obtain technological competencies*.** Carillo (2017) suggested three institutional opportunities for the needed training (a) university Master of Science degree in data analytics, (b) concentration in data analytics in a university Master of Business Administration degree, and (c) certificate of data analytics programs, offered through a university or an independent company, such as International Business Machines (IBM). Further, the author touted the computer information systems academic discipline as the best choice for university data analytics training, due to the program's (a) interdisciplinary nature and (b) experience blending business knowledge with technology applications. Conversely, Krahel and Vasarhelyi (2014) recommended skills upgrades through technology-based AIS courses that covered spreadsheet skills, statistical analysis, and ERP. The authors further advocated the development of a post-graduate certification in AIS, encompassing data analytics training, ERP consciousness, supply chain exposure, security training, and data management (Krahel & Vasarhelyi, 2014).

Tschakert et al. (2016) suggested diverse avenues to gain the skills needed for accounting big data analytics, including internal training, mentorships, conference training, online training courses, and software exploration. Likewise, Smith (2018) acknowledged multiple ways to gain technical competencies, but stressed accountants' obligation to obtain the capabilities, also proposing the analytics skillset for accountants to include cryptocurrency, artificial intelligence and blockchain technology. He advocated these identified technological advances as opportunities to expand and enhance (a) AIS functions such as management reporting, data quality, and internal control oversight and (b) the audit function of assurance, augmenting traditional procedures with real-time continuous audit capability (Smith, 2018).

Zhang et al. (2018) emphasized the effectiveness of online training courses in emerging technology topics for recent graduates that need additional technical skills, and for practicing accountants that wish to incorporate data analytics into their accounting service offerings. The authors noted the advantages of online technology training for accountants, such as (a) lower price, (b) targeted skills development, and (c) time and location flexibility. Some reputable educational providers offer courses in accounting and technology online, at little or no cost, facilitated by university or corporate organizations (Carillo, 2017; Zhang et al., 2018).

Subsection summary. This subsection covered literature about competency skills needed to use big data analytics in accounting work. The review provided a summary of CPAs' professional conduct requirements relating to trust enhancement. Further, the subsection described potential skills, tools, and training needed to become proficient to perform big data analytics in accounting services.

Potential themes and perceptions.

The researcher identified potential themes and perceptions from the literature, to guide exploration of the topic in the investigative stages of the study. The researcher addressed these emergent themes further through interviews with study participants, seeking participant insights and observations. Likewise, the investigator sought to understand participant feelings and viewpoints, in addition to the perceptions gained from the literature.

Summary of potential themes. Potential themes identified from the literature included the progression of impact that disrupted accountants' service offerings, including (a) technological changes that improved business operations and profitability, (b) ways the technology changes modified the techniques accountants use to perform their duties for organizations, and (c) steps accountants could take to prepare themselves to support data-driven business organizations.

Summarizing, the impetus behind the disruption appeared as a change in the format of the AIS database, which encompassed the foundation of all accounting functions (Appelbaum et al., 2017; Richardson et al., 2019; Schneider et al., 2015; Vasarhelyi et al., 2015).

The first potential theme involved significant technology changes to general business operations that improved efficiency and profitability (Braganza et al., 2017; Carillo, 2017; Hazen et al., 2016; Waller & Fawcett, 2013). The widespread impact of computerization of operations, in every sector of business, was apparent in academic and professional literature (Addo-Tenkorang & Helo, 2016; Braganza et al., 2017; Carillo, 2017; Gupta & George, 2017; Hazen et al., 2016; Kache & Seuring, 2017; Raguseao, 2018; Richey et al., 2016; Sivarajah et al., 2017; Waller & Fawcett, 2013; Wang et al., 2016). The literature indicated that these technological advancements created a strong advantage to companies that utilized them, through lower costs, better management, and increased productivity, and caused marked disadvantage to companies that did not utilize the advances (Addo-Tenkorang & Helo, 2016; Carillo, 2017; Gupta & George, 2017; Hazen et al., 2016; Richey et al., 2016; Waller & Fawcett, 2013; Wang et al., 2016).

The second potential theme related to modifications required to allow CPAs to perform duties for organizations in these data-intense business conditions (Alawadhi et al., 2015; Cao et al., 2015; Neilsen, 2018; Perols et al., 2017; Richardson et al., 2019; Schneider et al., 2015). The literature review identified an urgent need for accountants to adapt the way they perfomed accounting duties, allowing them to perform normal accounting services for organizations whose business operations had become increasingly digitized (Alawadhi et al., 2015; Cao et al., 2015; Cockcroft & Russell, 2018; Hazen et al., 2016; McKinney et al., 2017; Neilsen, 2018; Perols et al., 2017; Richardson et al., 2019; Vasarhelyi et al., 2015; Waller & Fawcett, 2013; Warren et al.,

2015). Accordingly, the literature signaled that CPAs faced an imminent disadvantage unless they adjusted accounting processes and procedures to allow use of the available data for ordinary accounting functions, such as decision support, reporting, planning and external audit (AICPA, 2019b; Alles, 2015; Krahel & Vasarhelyi, 2014; Pertuit, 2019; Richins et al., 2017).

The third potential theme centered around accountants' skill set expansion to accommodate data analytics services in accounting work (AICPA, 2019b; Cao et al., 2015; Dzuranin et al., 2018; McKinney et al., 2017; Neilsen, 2018; Richardson et al., 2019; Richins et al., 2017; Zhang et al., 2018). The literature review revealed a preparedness deficiency in practicing CPAs, which would require supplemental training before big data analytics could effectively be incorporated into accounting functions (Cao et al., 2015; Carillo, 2017; Dzuranin et al., 2018; Gupta & George, 2016; Neilsen, 2018; Richins et al., 2017; Rienzo & Chen, 2018; Tschakert et al., 2016). Options for obtaining the needed training were discussed in the literature, with an implication that accountants would obtain the skills, if they intended to continue to offer accounting services to technology-driven business organizations (Carillo, 2017; Krahel & Vasarhelyi, 2014; Smith, 2018; Tschakert et al., 2016; Zhang et al., 2018).

Summary of potential perceptions. Some perceptions about the disruption formed by the researcher, from compilation of the literature were (a) inadequacy of currently practicing accountants' technology-based skills, (b) complacency in accounting practitioners, (c) accountants' obligation to support organizations with their services, and (d) vulnerability to other experts if accountants do not adapt services for data-driven businesses (Alawadhi et al., 2015; Alles, 2015; Cao et al., 2015; Krahel & Vasarhelyi, 2014; Neilsen, 2018; Pertuit, 2019; Richins et al., 2017). These perceptions combined to present a professional situation in which the risk of accountant inaction may override their reticence, motivating accountants to circumvent

inadequacy and complacency constraints (Alles, 2015; Jenkins et al., 2018; Krahel & Vasarhelyi, 2014; Neilsen, 2018; Pertuit, 2019; Richins et al., 2017; Smith, 2018; Tschakert et al., 2016).

Summary of literature review.

This literature review included three main subsections, which aligned with and supported the study, including the following review topics (a) expanded information availability generated demand for big data analytics, (b) potential uses of big data analytics in normal accounting functions, and (c) professional competency shift necessitated enhanced technological skills. The first topic pertained to clients' big data analytics needs, and CPAs' responsibility to meet the needs of their clientele, from the perspective of big data analytics' impact on the broad business environment, with cognizance of the applicability of agency theory. The second topic discussed expansion of CPA services to incorporate big data analytics, from the perspective of big data analytics' impact on the CPA profession, an instance of adaptive leadership theory. The third topic addressed technically oriented accounting competency requirements, from the perspective of big data analytics' impact on the individual CPA practitioner, considering CPAs' professional responsibilities. Finally, the review included a summary of overarching themes and perceptions from the literature.

Transition and Summary of Section 1

Section 1 established the foundation of the study, by detailing the problem studied, including background, purpose, nature, and significance of the problem. Section 1 also explored theoretical origins for the study and presented the proposed research questions. An exhaustive literature review provided support from the topic's existing body of academic knowledge.

Section 2 shifted the research activities toward technical study procedures, as they relate to the researcher and the participants. Discussions in the section included research methodology

and population sampling for the study. Finally, Section 2 included measures for data collection, data analysis, and reliability assurance.

Section 2: The Project

This section included essential elements of the research project, beginning with the purpose statement, the role of the researcher, and the participant recruitment information. The next topics of this section comprised research methodologies and population sampling, followed by data collection and analysis processes. In conclusion, this section identified reliability and validity procedures.

Purpose Statement

The purpose of this qualitative case study was to add to the accounting body of knowledge by exploring the reasons for currently practicing CPAs' lack of preparedness to use big data analytics as part of their normal accounting functions. The investigator studied perceptions and attitudes of currently practicing CPAs in Louisiana about (a) their levels of readiness to implement data analytics in their ongoing accounting work functions, and (b) the impact that their preparedness or lack thereof might have on their competitiveness in the current and future business marketplace for CPAs.

Role of the Researcher

The researcher's role in this qualitative study was significant because the investigator serves as the primary instrument for data collection and processing in qualitative studies (Stake, 2010). At the time of the study, the researcher has held the CPA certification for 35 years and practiced in the public accounting field for more than 25 years, which provided an experience-related interpretive tool to the data analysis process, although no past or present work relationships existed between the researcher and participants. The researcher, as a member of the LCPA, was granted permission to petition CPA members for potential study participants, representing access that was allowed solely due to the researcher's membership in the

organization. Stake (2010) noted that the researcher's role in qualitative studies was participatory and subjective, unlike the researcher's role in quantitative studies, which was a structured and objective approach.

The investigator's primary responsibilities included developing detailed plans for the project and performing an exhaustive review of pertinent academic literature relating to the topic (Yin, 2014). Before these plans could be extended to include study participants, the researcher obtained approval to conduct the study from the institutional review board (Creswell, 2014). Next, the researcher planned to (a) recruit participants, (b) solicit informed consent from participants, (c) conduct participant interviews, using open questions, (d) transcribe interviews, (e) analyze and categorize transcript themes, and (f) interpret findings (Yin, 2014).

Participants

The participants of the study were Louisiana CPAs that were invited to participate through email contact from the Louisiana Society of Certified Public Accountants (LCPA). The researcher requested and obtained permission to compose an email that was sent to Louisiana CPAs on the researcher's behalf, which included a brief explanation of the subject matter of the study. The email also included a pre-interview screening survey, which (a) asked demographic and professional background questions and (b) requested prospective participants to furnish contact information, to be included in a pool of potential participants that agreed to grant the researcher a 15 to 30-minute personal interview participants. Survey participants were informed that a sample of volunteers would be selected from the volunteer interviewee pool. The researcher contacted the selected interviewee volunteers, by email or telephone, to schedule an acceptable personal interview time, during which participant-signed consent forms were

executed. The investigator maintained ongoing email or telephone communications with the selected volunteers, establishing a working relationship with study participants.

The researcher ensured ethical protection of participants by (a) performing the interview in a setting approved by the interviewee, (b) maintaining security over interview data at all times, (c) minimizing access to the data to only those trained in confidentiality requirements, (d) ensuring confidentiality by substitution of pseudonyms in place of participant identification, (e) storing multimedia and data files in password-protected format, and (f) destroying multimedia and data files after a three year required retention period. Through all stages of the study, every effort was made to ensure equitable participant selection procedures and to otherwise protect participants from harm associated with the study.

Research Method and Design

This study investigated challenges caused by technology advancements that confronted practicing CPAs as they performed their work for business organizations (Richins et al., 2017). The qualitative research method was the best approach for evolving research because it allowed a more holistic consideration of the topic studied, whereas quantitative methods relied on access to numerical measurements of historical records (Stake, 2010). Using the qualitative approach to study Louisiana CPAs' preparedness to include data analytics in their accounting work was appropriate because (a) it would have been difficult to quantify the level of preparedness of CPAs, and (b) the shift toward using accounting data analytics was a relatively new development, resulting in limited established academic theory (Barczak, 2015). Further, the topic was appropriate for an exploratory qualitative study because it was an emerging problem, so the concept of accounting data analytics may have been unfamiliar to study participants unless they had been directly involved in the use of these new analytical tools.

The research project utilized case study design for this qualitative study, because the methodology facilitated exploring participants' feelings, attitudes, opinions, and perceptions about the challenges they encounter, to enable a better understanding of the problem (Creswell & Poth, 2018). Case study design was most appropriate, to enable the investigator to study and understand the mindset of a group of CPAs in Louisiana who encountered imminent disruption to normal accounting services due to data profusion, which had the potential to either (a) threaten or (b) enable future success for the accounting profession (Janvrin & Watson, 2017).

Population and Sampling

This population for this study was CPAs practicing in the state of Louisiana, in public or private accounting positions. Board meeting minutes of the State Board of Certified Public Accountants of Louisiana (2019) listed almost 7,500 individuals as active Louisiana CPAs, as of the January renewal dates, for the 2018 and 2019 calendar years. The study excluded CPAs (a) not performing accounting services at all, (b) performing accounting services in other locations, but not in Louisiana, and (c) who were not between the ages of 18 and 65. This chosen population provided an investigator the opportunity to more fully understand how Louisiana CPAs responded to data-driven organizational changes related to accounting functions. Non-practicing CPAs would not have been confronted with emerging technological challenges, and therefore could not contribute to understanding the problem being studied. Similarly, practicing CPAs that did not perform services within Louisiana could not supply insight into how Louisiana accountants respond to emerging information system changes. Finally, the exclusion based on age range followed Liberty University's (2019) institutional review board's categorization for normal participants, from the Application for Use of Human Research Participants.

The sampling plan included convenience sampling of the target population, followed by random sampling to narrow the participant group to a manageable volume for a qualitative study. Convenience sampling is a non-statistical method, commonly used in qualitative research, involving participants that were easy to access and from whom data was readily available (Creswell & Poth, 2018). Although random sampling was typically used in quantitative research, this qualitative study used the methodology to randomized the interviewee selections (a) to obtain a broad cross-section of the subject group, and (b) to limit the quantity of interviews, which may otherwise have exceeded the investigator's practical capacity to administer (Creswell, 2014).

The convenience sample for this study originated from the LCPA, a professional association that represents Louisiana CPAs, with the membership of approximately 6,000 licensees (Society of Louisiana CPAs, 2019). Thus, the LCPA sample group represented a substantial subset of the entire study population. LCPA agreed to contact member CPAs to deliver the investigator's participant recruitment information via email. A short survey (a) requested limited demographic information, (b) verified study qualifications, and (c) solicited interview volunteers, to become part of a potential interview pool. All recruited interview volunteers were assigned a priority interview order, based on random number generation, with the first 12 prioritized interviewees serving as the initial study participants.

The maximum number of participants planned was 50, with the expectation of a participant sample group between 12 and 24 individuals. The sample size would have been expanded, and interviews continued, in sample priority order, until data saturation was achieved. Data saturation was defined by Mason (2010) as the point at which no greater understanding of the matter results from extending the investigation. Dworkin (2012) determined the optimal

sample size for qualitative studies as between five and fifty participants, and Mason (2010) reviewed more than 500 qualitative studies, finding an average sample size of 31 participants. Although these researchers' statements guided sample size estimation, the actual sample size for qualitative studies is contingent upon the data saturation point, rending determination of absolute sample size impossible to ascertain in advance (Sim, Sanders, Waterfield, & Kingstone, 2018).

Data Collection

The data collection process for this qualitative case study included three aspects of the project, including documentation of research instruments, data collection techniques, and data organization techniques. This subsection explained three instruments used in the study, including (a) the researcher, (b) the pre-interview screening survey, and (c) the participant interview. Next, data collection techniques were described, detailing the implementation of these instruments. Finally, the subsection designated data organization tools and techniques, including security measures.

Instruments.

Stake (2010) explained the function of the researcher in qualitative studies as an active participant in the study and the primary research instrument because the investigator collects critical data as they observe, perceive, and question the information collected through all other study instruments. Aside from the researcher, the first physical instrument used in the study was the pre-interview screening survey, included in Appendix A, enabling the identification of qualified participants for potential interviews. The screening survey included several yes or no questions, verifying participant eligibility including (a) Louisiana licensed CPA, (b) actively practicing as a CPA, (c) performing services within Louisiana, and (d) participant age of 18 to 65. The minimum age for Louisiana CPA licensees is 18, but this fact was also verified by the

screening survey, to verify this qualifying age criterion (State Board, 2019). Next, the survey sought permission for an interview and requested contact information. The survey document informed volunteers that they would be included in a volunteer interviewee pool and that interviewees would be randomly selected if the number of volunteers exceeds the needed number of participants.

A secondary physical instrument was the interview guide, a complete copy of which is presented in Appendix B. Creswell (2014) directed the construction of qualitative interview guides, consisting of open-ended questions (a) encouraging participant discourse and (b) directing the interviewee toward the information needed to answer research questions, thereby addressing the problem, which is CPAs' lack of preparedness to use big data analytics. The guide included three primary interview questions, each with a set of subsidiary questions, to clarify or probe further, which directly correlate to the study's three research questions, as follows:

1. "How do you feel about CPAs using big data analytics in accounting work?" Subsidiary questions were used to gain insight into interviewees' reasons for using big data analytics in their accounting work or not. This interview question sought information needed to answer the first research question regarding how Louisiana CPAs incorporated big data analytics into accounting.
2. "To what extent do you think using big data analytics in accounting work affects competitive advantage for CPAs?" Follow-up questions identified the interviewee's perceptions of ways big data analytics might strengthen or weaken CPAs' competitive advantage. This interview question was designed to inform the second research question about how incorporating big data analytics into accounting affected competitive advantage for Louisiana CPAs.

3. "How equipped do you feel to use big data analytics in accounting work?" Probing questions followed, about (a) perception of CPAs' aptitudes and attributes that might prepare them for big data analytics, (b) opinion about whether further education or training would be needed to implement big data analytics, and (c) interest in incorporating big data analytics into accounting work. This interview question informed the third research question about whether Louisiana CPAs were equipped to use big data analytics in accounting.

Data collection techniques.

Data collection techniques for this case study began with the administration of the screening survey, which facilitated participant qualification and recruitment. The screening survey's purpose was in no way quantitative, and only incidental data collection resulted from its question responses. The resulting volunteer pool was randomized by employing random number generation to assign a unique numeric identifier to each volunteer, which served as the volunteer's pseudonym and interview priority order. The initial twelve interviewees were those volunteers whose pseudonyms were the lowest numbers of the randomized volunteer pool. Subsequent interviewees were added, in sequential number order, until the researcher determined that data saturation has been accomplished, as assessed in the data analysis process. After selected, participants signed consent agreements before the commencement of the volunteer's interview (Creswell & Poth, 2018). The entire interview was recorded, and the investigator also created a field journal, including notations of observations, perceptions, and impressions during the meeting.

Data organization techniques.

As soon as the data was collected, the researcher became responsible for maintaining participants' confidentiality (Yin, 2014). After the pre-interview surveys had been collected, survey respondents' identifying information was compiled, and pseudonyms were assigned. A pseudonym cross-reference document was created, based on the random number identifier that was assigned to each respondent, and the document was maintained under password protection. Subsequently, participants were only referenced by their pseudonyms in the study instruments. During the interviews, care was taken not to refer to the interviewee by legal name, to protect their anonymity. After the interviews, the voice recordings were transcribed and saved in a password-protected document, identified by the pseudonym. Likewise, field notes were summarized using pseudonym identifiers and saved in password-protected files as well. Interview transcripts and field notes were then categorized by identifier, for ease of access and preparation for analysis.

Summary of data collection.

This subsection described the qualitative data collection process, including research instruments, data collection techniques, and data organization techniques. Three study instruments were presented, comprised of the researcher, a screening survey, and an interview guide. Data collection and organization techniques were outlined, describing (a) the process of utilizing these three instruments to collect data, and (b) the procedures for managing the information obtained from the collection efforts. These data collection processes were customary practice for all types of qualitative research and were thereby appropriate to this qualitative case study (Creswell, 2014; Creswell & Poth, 2018; Stake, 2010; Yin, 2014).

Data Analysis

Data analysis began with careful interview transcription and field note assimilation. The next step was coding, which involved classifying and sorting common themes that emerge from the interviews (Bogdan & Biklen, 1998; Stake, 2010). As the interview process continued, these themes were summarized and synthesized, to establish patterns of commonality and identify anomalies (Yin, 2014). Interpretation of the findings was a critical element of data analysis, which required the researcher to use personal experience and judgment to discern meaning from the data collected (Barczak, 2015; Creswell & Poth, 2018). Continual iterations of data analysis, throughout the interview process, enabled the researcher to identify the data saturation point. Saturation was accomplished when little or no added information emerged from further interviews, signaling that the qualitative study had an adequate sample size (Creswell, 2014; Mason, 2010).

For this research project, the investigator transcribed audio interview recordings into Microsoft Word documents, and reviewed the transcripts meticulously, clearly identifying themes by color-coded highlighting. Highlighted interview themes were summarized, with cross-reference notation of interview identification number and transcript page numbers. Although computerized programs for qualitative data analysis were available, the manual methodology was recommended for the initial stages of all qualitative analysis and qualitative researchers stated that manual transcript analysis may suffice to accomplish the full study's coding objectives for small studies (Bogdan & Biklen, 1998; Creswell & Poth, 2018; Saldana, 2013).

Next, the researcher (a) synthesized common interview themes, as consensus views and (b) flagged outlier themes, for potential discussion as anomalies or divergent opinions. After interviews had been conducted, transcribed, and coded, the researcher interpreted the findings,

applying the results to the chosen research questions and the practical business problem relating to CPAs' response to the emerging demand for data analytics in accounting.

Reliability and Validity

In qualitative studies, the terms reliability and validity represent the process used by the researcher to ensure a trustworthy and credible study (Bogdan & Biklen, 1998; Creswell & Poth, 2018). Qualitative methodology's focus on the research process differed from the objectives of quantitative studies, which typically used these two terms to indicate verifiability of the data and generalizability of the findings (Creswell & Poth, 2018). Creswell (2014) associated qualitative reliability with the researcher's level of consistency of approach and protocol for the study. Further, the author attributed qualitative validity to strategic procedures the researcher would implement to assure the accuracy of the findings.

Reliability.

Consistency in every stage of the research process was the key element to reliability in qualitative research (Creswell, 2014; Creswell & Poth, 2018). Yin (2014) advocated careful documentation of data collection and analysis processes, to increase reliability and provide other researchers with guidelines for performing similar studies. Similarly, Barczak (2015) stressed the importance of descriptive data collection and data analysis narratives, to lend credibility to and rationalize findings of the study.

For this research project, reliability was accomplished primarily by a thorough and consistent interview process, led by a semi-structured interview guide and careful transcription of interview recordings. Secondarily, reliability was enhanced by documentation of fieldwork protocol, including (a) participant qualification, (b) sample selection, ongoing until saturation is reached, (c) personal interviews, to be recorded and transcribed, (d) detailed interview

observation notes, (e) meticulous transcript coding, identifying themes (f) synthesis of common themes, (g) interpretation of findings, and (h) validation of findings (Yin, 2014).

Validity.

Creswell and Poth (2018) explained qualitative validity as a strong level of exactness, accomplished by careful expression of the perspectives of participants and the researcher. The authors noted that validity could be accomplished through structured processes and strategies, recommending at least two validation strategies be applied to each study, and noting no significant differences between the various qualitative design approaches regarding validation. For this study, the researcher chose two initial validation strategies, including saturation and triangulation, with optional member checking by interviewees, for additional corroboration.

Saturation testing was used to determine when an adequate sample size of interviews had been reached, indicated by the point in data collection when no new themes were emerging, and when additional interviews confirmed the same primary range of themes that were identified by previous interviews (Creswell, 2014; Fusch & Ness, 2015; Mason, 2010). Similarly, Fusch and Ness (2015) and Stake (2010) explained triangulation as the process of analyzing various sources of data, to ensure that agreement existed about prevailing themes from the different data sources. Fusch and Ness (2015) also emphasized the interconnectedness between saturation and triangulation. Finally, to extend the credibility of the study, participants were given the opportunity to review transcripts and notations from their interviews, a form of member checking, to verify their contribution to the study, and add clarification, if desired (Stake, 2010).

Summary of reliability and validity.

This subsection explained the disparate interpretations of the terms reliability and validity when used in qualitative versus quantitative studies. Next, this study's qualitative measures of

reliability protocol were discussed. Finally, the study included an explanation of strategies for accomplishing qualitative validity. Together, the reliability and validity processes provided the study with increased credibility and repeatability.

Transition and Summary of Section 2

Section 2 described the study procedures specific to the researcher and the participants. The section covered research methodology and population sampling. Next, the section detailed protocol for data collection and data analysis, including specific data collection instruments for the study. Finally, Section 2 described factors that influence reliability and validity in quantitative studies, with specific references to measures taken to ensure those credibility factors.

Section 3 finalized the research project, starting with an overview of the study. Next, the section included the findings of the study, including pertinent themes identified by the research, and the relationship between those themes. Other discussions in the section included (a) application to professional practice, (b) recommendations for action, and (c) recommendations for further study. Finally, Section 3 reflected, summarized, and concluded the project narrative.

Section 3: Application to Professional Practice and Implications for Change

Section 3 finalized the research project, including the investigative portion of the study. This section began with an overview of the study premise, followed by descriptions of the study findings, identifying emergent themes that arose during participant interviews. The researcher compared and associated these themes with the anticipated themes and perceptions identified in Section 2 and with the research questions, conceptual framework, and literature that undergird the study. Next, the investigator discussed the study's impact on professional practice, presenting four practical recommendations for action. The researcher included recommendations for further study of the topic, as well as reflections on the research project and the impact that it made on the researcher and the participants. Finally, the section summarized the entire project and provided conclusions formed from the study.

Overview of the Study

This research project considered the challenge and opportunity that data profusion created for practicing CPAs in Louisiana, as they carry out their normal accounting functions relating to managerial and financial accounting. The problem studied was the lack of preparedness of currently practicing CPAs in Louisiana to use big data analytics. To analyze this problem, the researcher developed three qualitative research questions about Louisiana CPAs' use of big data analytics in normal accounting functions, relating to (a) how they incorporate big data analytics as part of their work, (b) how using big data analytics affects competitive advantage for them, and (c) how equipped they feel to use big data analytics.

After conducting a detailed literature review about the study topic, the researcher designed a qualitative case study to investigate the CPA participants' observations and insights about the quandary. Using the perceptions of CPA participants may help to provide deeper

understanding of the problem and assist CPAs in overcoming obstacles surrounding the problem. Personal interviews were conducted with a group of CPAs practicing within the state of Louisiana, using a semi-scripted interview guide, which directed interview questions that answer the study's research questions. These interviews were transcribed and analyzed, to identify thematic commonalities and anomalies relating to the study. Finally, the investigator used personal experience and judgment to interpret the meaning of the themes that emerged in the findings.

Studying the research problem of Louisiana CPAs' unpreparedness to use data analytics in accounting revealed important concepts that highlighted the struggle that has confronted CPAs due to data profusion in the accounting and management information systems. Awareness of these challenges could serve as an impetus to help identify ways to overcome the obstacles that might otherwise prevent Louisiana CPAs and the collective CPA profession from incorporating data analytics in accounting.

Presentation of the Findings

Using a multiple case study, qualitative approach, this study explored the disruption to CPAs' accounting practice and methods due to the emergence of big data. The research investigated how Louisiana CPAs perceived and responded to the technology changes, with a focus on the CPAs' level of preparedness to use big data analytics. Study participants represented diverse fields of accounting practice and varied locales within the state of Louisiana. This participant diversity allowed the investigator to gather insights from Louisiana CPAs about the impact that technological changes had on them and the accounting profession. The field study for this research utilized three study instruments, comprised of (a) a pre-interview

screening survey, (b) personal interviews with CPAs, and (c) the researcher, whose observations, perceptions, and experience guided the data collection process.

A study recruitment email, which briefly described the study, was disseminated by the LCPA state society on behalf of the researcher and requested that the CPA complete a pre-interview screening survey. Of the 3,692 Louisiana CPAs contacted by LCPA as potential participants, 36 individuals completed the survey, and 26 of these qualified to participate, based on study criteria. Three of the 26 qualified participants declined interview permission, leaving only 23 interview volunteers. This response rate was surprisingly low, with less than 1% of the potential interview pool agreeing to interview.

Using the pre-interview screening survey, the researcher identified the eligible volunteer participants, and these CPAs were each assigned a random-number pseudonym, which forthwith served as that participant's identification number and priority order for interviews. The first-priority group of twelve participants was selected, based on these randomized identifiers, and eight of these volunteers were interviewed. The remaining four CPAs from this initial group were either (a) not available for interviews or (b) not actively practicing as a Louisiana CPA. Nine more CPA participants were selected from the randomized volunteer pool, only four of whom were available and were interviewed. This brought the interviewee total to 12 individuals. CPA participants signed consent agreements, acknowledging the structure and scope of the study (Creswell & Poth, 2018). Using pseudonyms, rather than participant names, ensured CPA anonymity (Yin, 2014). The demographics of the interviewed CPAs were quite diverse, as some were internal or private CPAs, and others were external or public CPAs. Some interviewees were in the early stages of their career, and others were in the middle to late stages. Some CPAs

worked in small cities; others worked in medium or large cities. Finally, the CPA group represented six separate regions of the state of Louisiana. Figure 2 depicts these demographics.

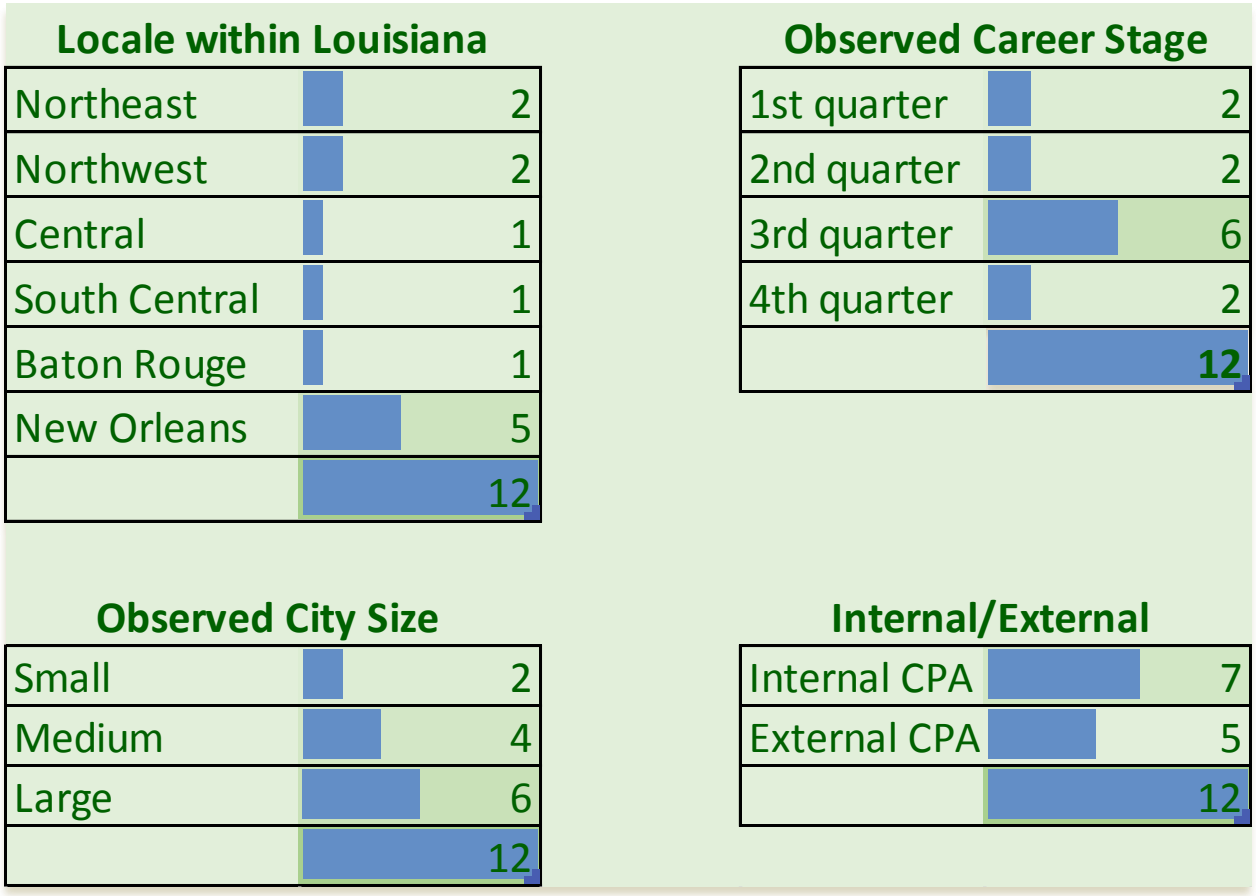

Figure 2. Demographics of Study Participants

Interviews commenced in semi-structured style, allowing the investigator to present broad queries that aligned with each of three research questions, followed by secondary questions for each broad question, to delve further into the discussion topic, addressing remaining issues pertinent to the study. Concurrently, the researcher made field notes of observations, attitudes, and perceptions from the interview. Each interview was recorded, using two separate audio recording devices, to ensure the integrity of the transcription efforts. A combination of (a) word processor voice dictation software and (b) manual transcription

provided greater accuracy for transcribing the interview recordings. The researcher provided a transcribed interview document to each interviewee as an exercise in member checking, with a request for notification of any needed corrections or desired additions (Stake, 2010). To further confidentiality, transcripts and field note compilations contained only pseudonym identifiers, rather than participant names (Yin, 2014).

Analysis of the transcribed interviews, through careful coding and synthesis, indicated a distinct set of common themes or patterns in the interviewees' perceptions. The coding process identified multiple instances of consensus views, sometimes representing divergent ideals from separate subgroups of the interviewee pool, with only an occasional outlier opinion emerging. The emergence of clearly repetitive themes and participant perceptions signaled achievement of data saturation and adequate sample size (Mason, 2010).

Validity measures included saturation, triangulation, and voluntary member checking. Saturation was achieved when analysis of multiple interview transcripts produced themes that had previously been identified in other interviews. Triangulation was accomplished by interviews from (a) varied practice fields, including public and private accounting and (b) various geographical regions throughout the state, with comparable themes arising regardless of practice area or geographical region. Member checking resulted in several participant responses, but no corrections or other changes were suggested to the transcripts.

Following coding and synthesis of the transcripts, the investigator reviewed the findings, applying judgment and experience to interpret the data collected, to (a) address the selected research questions and (b) apply these interpretations toward the practical business problem of CPAs' response to data analytics in accounting. Throughout the fieldwork, the researcher

contributed observations and questionings, based on professional judgment and personal experience, to guide the data collection process (Stake, 2010).

The study illuminated several themes, which were first compiled individually, and then collectively correlated to each of the study's research questions. Themes, trends, and related participant perceptions were explored in search of consensus opinions and anomalies. The investigator compiled a list of themes for the most noteworthy identified issues.

Theme 1: Plans to use big data analytics in accounting work.

CPAs expressed good reasons for wanting to incorporate big data analytics in accounting work. Many interviewees firmly declared that using data analytics was the way of the future for accounting, as one CPA stated, "CPAs need to know how to provide analytical information that can be derived from big data and therefore we have to know how to use it, in order to do that" (Participant 3939, personal communication, October 12, 2019). Participants repeatedly discussed an imminent threat if CPAs fail to adapt to allow them to use the data fully, noting that other technical professionals would threaten the CPA if they were able to do the analysis and CPAs were not. Study participants stated a unified consensus view of analysis as inherently an accounting role, noting that no other professional group could serve that function adequately. One CPA said, "I think it is absolutely part of what we are, and I would be just appalled if the profession didn't grasp it and take it on, because it is the future of the profession, in a lot of ways" (Participant 3939, personal communication, October 12, 2019). Another interviewee stated, "You could go into a situation and evaluate it and understand what it is. Lots of times you have IT people that come in and they have no idea what it is that you (CPAs) do" (Participant 7416, personal communication, October 18, 2019).

Most CPAs voiced a feeling of obligation to fulfill the needs of the businesses they served, as one participant expressed, "It (analytics) just makes what we can to provide to our clients, or if it is private accounting what is being provided to other people in the organization, more valuable" (Participant 8276, personal communication, October 18, 2019). Similarly, another CPA said, "All they (clients) have to do is ask or make me aware that they need something, and I will try to help in any way I can" (Participant 8596, personal communication, October 24, 2019).

Several interviewees expressed the expectation of benefits in operational efficiency, which would allow more accounting work to be done with less time and effort. For example, one interviewee stated the differentiation between using big data with digitized records versus traditional methods, with the comment, "It depends on if you are going to work on it for 12 hours or 24 hours. The only handicap is on yourself, if you do not want to adapt to the new ways of doing things" (Participant 5054, personal communication, September 20, 2019).

Theme 2: Hesitancy to implement big data analytics in accounting.

Interviewees discussed marked reservations about incorporating big data analytics in accounting, as well. The most universally expressed hesitancy was the CPAs' lack of training and experience in dealing with data. Only one of the twelve CPAs interviewed had any formalized training related to data extraction or manipulation, but most stated that they would need additional training to enable competent use of big data analytics software tools. Some comments from concerned interviewees included, "I don't feel equipped at all, because when I was in school, we didn't even have PCs" (Participant 3939, personal communication, October 12, 2019) and "There is a definite learning curve in utilizing the tools that have these big

datasets…it is a whole different mindset" (Participant 7416, personal communication, October 18, 2019).

Several CPAs also voiced concern about the risk of bad data from the expanded data sources. One participant stated, "There is data that might be available, but you know we are not necessarily a trusting group. I would rather rely on my own information" (Participant 7510, personal communication, October 17, 2019). Other consensus reservations related to (a) little or no client demand for big data analytics services at present, (b) concern that costs of providing the additional services might outweigh the benefits of it, and (c) general resistance to change. One CPA noted a significant holdback for data analytics in resistance to change and technology as, "the number one disadvantage… the whole attitude of, I am old. I can't learn anything new" (Participant 8596, personal communication, October 17, 2019).

Theme 3: Expectation of competitive advantage for CPAs that use analytics.

Study participants expressed a strong consensus opinion that adding data analytics capabilities to accounting would provide a distinct competitive advantage for CPAs and CPA firms. Most study participants stated a belief that the future belongs to those who adapt to the data-driven business environment, and that those CPAs and firms that do not would lose clients because of their refusal to adapt. Some CPAs mentioned the basic need to learn about data analytics to be able to meet client needs when requested, rather than the CPA being the initiator of big data analytics services to the business. Others noted that the operational efficiencies gained from big data analytics would become the competitive driver, in the form of reduced billable time charges to businesses, along with higher quality service. For example, relating to efficiencies gained in the audit function, one interviewee noted the possibility that CPAs could analyze, "A whole lot more data faster, which is good, because you would have the potential to

work on a lot more clients in the same amount of time. Instead of doing one audit, you could possibly pick up three" (Participant 5293, personal communication, October 11, 2019).

Another point of interest was the differing perspectives that interviewees held about whether the competitive pressure was directed toward them or not. Some CPAs expressed an expectation that all CPAs should understand data analytics, with comments such as, "If you don't you are going to fall behind. The competition is going to chew you up. You have got to be able to provide that service for your client, if they ask for it" (Participant 6788, personal communication, October 17, 2019). Others stated only a necessity that some CPAs in the firm or business be proficient in using data analytics tools, as stated by one participant, "We are going down that road with key personnel in the firm. I am not necessarily going to get that training myself. I like the idea of having it in my toolbox… to go promote to clients" (Participant 8405, personal communication, October 24, 2019).

Theme 4: Potential risks when incorporating analytics in accounting.

In addition to the expectation of competitive advantage, many CPAs also expressed concerns about potential competitive weakness caused by incorporating big data analytics due to the possibility that the costs of providing the service might exceed the benefits gained from it. One CPA expressed this risk as the fundamental holdback to data analytics in accounting implementation, "Expertise is going to cost you money, in terms of salaries or consulting fees. Do the costs outweigh the benefits?" (Participant 8656, personal communication, October 28, 2019). Another CPA stated, "The risk for a firm like ours, in a market like ours, is that we invest a considerable amount of money and the return isn't there" (Participant 8405, personal communication, October 24, 2019).

Similarly, several CPAs mentioned the fact that many clients would resist fee increases that might arise due to the addition of the expanded services, which could lead to competitive vulnerability. One interviewee suggested that clients might protest accounting fee hikes, "Like when I go to a law firm; I don't need a partner to work on this, because he is charging double" (Participant 2925, personal communication, September 20, 2019). Another participant stated that his clients would question increases in his billing that would arise from expanding capabilities and service offerings, predicting his clients' responses would be, "Just do what you need to do, to get me in compliance with the tax law, and get my financial statement done" (Participant 7510, personal communication, October 17, 2019).

Theme 5: Known state of unpreparedness, with aptitude for data analytics.

None of the 12 CPAs that were interviewed stated confidence that they were adequately equipped to use big data analytics in their work. Some were more comfortable than others with their ability, but most said they felt ill-prepared to do that type of work. Still, when questioned about whether the aptitudes and attributes of CPAs aligned with those needed for data analytics, most said the abilities needed by CPAs and data analysts were very closely aligned. Even interviewees who were not interested in performing data analytics in accounting expressed confidence that CPAs' aptitudes were adequate, as stated by one CPA who was decidedly against adding data analytics work to the accounting function stated, "I think a CPA could do it. With the training, education, and certifications that a CPA gets, they could be successful in data analytics" (Participant 6082, personal communication, October 14, 2019).

A robust majority of interviewees referred to CPAs' training and experience as an analytical strength that most other professionals do not share, enabling the acquisition of new capabilities that also required an analytical mindset, such as data analytics demands. For

example, one interviewee explained his approach to challenges presented in accounting work with the statement, "I oddly look at every task, tax return, or review (everything) as a scavenger hunt, where I am in there and trying to find this and this. And I will complete it and be victorious when it is complete" (Participant 5054, personal communication, September 20, 2019).

Theme 6: Interest, initiative, and training needs for accounting data analytics.

When asked what it would take for CPAs to become proficient in data analytics, the three requirements of interest, initiative, and training repeatedly emerged from study participants. Most of the CPAs interviewed expressed interest in pursuing the data analytics skills, but some noted that they were not interested in changing the way they practice accounting. When asked about their interest level in adding data analytics to accounting functions, one CPA stated, "It is not what I would really want to do, but I feel like it is the way of the future, so we have to be able to do some of it" (Participant 8276, personal communication, October 18, 2019).

Aside from CPAs' interest in data analytics, much initiative is required to obtain the skillset, because existing CPAs are often extremely busy and would have to find time to learn the new skills. Also, many of the existing CPAs were educated before big data analytics was needed, and the prospect of adding significant new technological capabilities to their skillset might be daunting. Predictably, most respondents stated that even if interest and initiative were present, there remained a need for intensive training, and many noted a depth mandate much greater than typical continuing education courses. A few of the specific skills and tools that were mentioned by CPAs who were actively trying to obtain the data analytics capabilities were (a) Power BI, (b) advanced Excel, (c) Tableau visualization, and (d) SQL database and queries. The consensus view of interviewees was that CPAs could and would rise to the challenge to embrace data analytics because they viewed analysis as a big part of what CPAs do, and the fact that the data

that must be analyzed was in a different format than it had been in the past would not stop the CPAs' determination to analyze.

Relationship of themes and patterns to research questions.

Research question 1. How do Louisiana CPAs incorporate big data analytics as part of their normal accounting functions?

The overwhelming majority of CPA participants stated a need for the profession to learn how to use big data analytics in accounting work but were divided about how soon the capability should be added to the CPA skillset. Of the CPAs interviewed, about half said they were already using at least some data analytics, but all of these expressed an immediate need for additional training to enable full participation with analytics in their work. Of the other CPAs interviewed, all but two said they planned to use data analytics in accounting work in the future but were not doing so yet. A strong consensus of the CPAs voiced reasons they felt compelled to learn about accounting data analytics, relating to meeting clients' needs, CPA efficiencies, and professional territorial issues. Similarly, the majority of interviewees also expressed legitimate reservations that were temporarily holding them back, such as risk of bad data, inadequate training, low client demand, cost/benefit concerns, and general resistance to change. Additionally, three separate instances of outlier opinion were expressed as (a) the accounting data analytics push might be all hype, and therefore not require change to accommodate it, (b) engaging in data analytics might dilute CPAs' existing strengths, and (c) adding data analytics might carry risk of an independence compromise.

Research question 2. To what extent does using big data analytics as part of their normal accounting functions affect competitive advantage for Louisiana CPAs?

CPAs interviewed held a solid consensus view that CPAs who incorporated big data analytics in their accounting work would gain significant competitive advantage. Yet, when asked if they felt personal competitive pressure to obtain data analytics skills, only half of interviewees stated any pressure to act immediately. Some reasons noted for the apparent misalignment were (a) interviewees near retirement age, (b) clients demand for the services was weak, or (c) the expectation that others in the firm would obtain the training needed to provide the service to clients. Conversely, many CPAs worried that (a) costs of obtaining big data analytics proficiency might not be justified by the benefits obtained by the skills and (b) clients might be skeptical of CPA firms' new service offerings, especially if they perceived them as a reason for increases in traditional accounting service fees. Less prevalent concerns about risks to competitive advantage were also expressed, relating to data security and dilution of primary CPA services.

Research question 3. To what extent are Louisiana CPAs equipped to use big data analytics as part of their normal accounting functions?

Most of the CPAs interviewed did not feel at all equipped to use big data analytics in their work. Yet, they were confident that most CPAs could learn the skills needed to do the analytics work, due to the analytical mindset of typical CPAs, and the fact that becoming a CPA is an indicator of both intelligence and tenacity. Study participants referenced three requisites for CPAs to become proficient in data analytics, including interest, initiative, and training. Several interviewees stated that any of the three, without the other two, could predispose a CPA to failure in the endeavor. Overall, the collective participant group was very optimistic about CPAs' ability to obtain the necessary capabilities for data analytics in accounting. Further, whereas a few CPAs indicated no interest in expanding accounting services to include data analytics, many

interviewees expressed an opinion of data analytics in accounting as just a normal progression of the accounting function, much like the evolution of manual to computerized accounting systems had been to CPAs of the past.

Relationship of themes and patterns to conceptual framework.

Considering the themes and patterns relating to the conceptual framework of the study required analysis of the findings as they relate to the underlying concepts of agency theory, adaptive leadership theory, and accountants' competency.

Agency theory. Agency theory highlighted individuals' propensity to prioritize their interests, to the potential detriment of others' (Jensen & Meckling, 1976). Applying the theory to the Louisiana CPAs' situation required consideration of what actions would most benefit the organizations that CPAs serve, with secondary consideration of the benefits that CPAs would personally gain from those actions. The researcher assessed the findings of the fieldwork from the agency theory perspective and noted a keen sense of responsibility in the CPAs' responses, which compelled them to take action to meet client needs. Many participants expressed a connection between that responsibility to meet clients' needs and plans to expand their knowledge base and service offerings to include data analytics capabilities, in conjunction with their existing accounting services. For example, one CPA said, "As a small CPA firm, we do whatever we need to do. If a client wants me to wash his car, I will wash his car. All they need to do is make me aware that they need something" (Participant 8596, personal communication, October 24, 2019).

Adaptive leadership theory. Adaptive leadership was closely aligned to change management, relating to required adjustments to shifts in conditions, such as the evolving technology-driven business environment in which CPAs function (Heifetz et al., 2009). As it

related to the field study, adaptive leadership was exemplified by participants' expressions of competitive pressure brought on by technology changes that push them to understand and use data in new formats and in copious quantities. One CPA interviewee stated, "I think the notion that we may be analyzing data that isn't necessarily traditional general ledger transactions, like performance indicators, other non-financial information and effects of financial trends, scares some people" (Participant 8405, personal communication, October 24, 2019). The interviewee followed that observation with an expression of confidence, saying, "I think in general, the profession is properly disposed to move into data analytics" (Participant 8405, personal communication, October 24, 2019).

Also related to adaptive leadership and the competitive challenge, CPAs expressed competitive challenge to the profession as a whole by the onset of big data and the need to analyze it. An interviewee noted, "If we don't … other professionals are going to step in and fill the gap, because the need is there. There is no other profession that is going to be able to fulfill the need as well as CPAs" (Participant 3939, personal communication, October 12, 2019).

Accountants' competency. Accountants' competency referred to CPAs' mandate to maintain technical proficiency, including knowledge and skills, as a precursor to providing quality service to clients and upholding their obligation to themselves, their clients, and the profession (AICPA, 2019a). Participants of the study repeatedly voiced a need for additional training, to enable use of data analytics tools. Some CPAs expressed interest in learning database and program query languages, such as SQL, to prepare them to personally extract and manipulate the underlying data for analysis. One interview said, "The data is there. I just have to know how to extract it, and then make it work for me… to come to an end conclusion – whatever management is looking for, or I am looking for" (Participant 2925, personal communication,

September 20, 2019). Other CPAs stated interest in being able to understand the data analytics process, so they could collaborate with others who were directly involved in extraction of the data for analysis. For example, one CPA said she wanted to obtain knowledge about using data analytics to enable constructive oversight over subordinate CPAs, "So that I could feel comfortable that they know what they are doing, and that they are pulling out the information that answers the question" (Participant 3939, personal communication, October 12, 2019).

Regardless of the planned levels of involvement with data analytics, most CPA interviewees agreed to the necessity of acquiring expanded knowledge to understand the data and the tools used to analyze it. All interviewees perceived data analysis as inherently within the accounting domain, enhanced by CPAs' broad knowledge of business processes, and thus not a function that could be easily shifted to other professionals. One participant observed, "It is part of the (CPA) job description. This is just what it has evolved into. We have to figure out how to extract information and then figure out how to make sure that what we have is useful" (Participant 6788, personal communication, October 17, 2019).

Alignment of themes and patterns with anticipated themes and perceptions.

Prior to commencement of the field study, the investigator developed anticipated themes and potential perceptions, based on the conceptual framework and the literature review. This subsection compared those expected themes to the outcomes that emerged after completion of the investigative component of the study, adding participants' perspectives to the foundational work already compiled. Although most of these researcher expectations were corroborated by participants' opinions and insights, interviewees did not agree with some initial researcher perceptions.

Themes 1 & 2. The first anticipated theme related to technological changes to the overall business environment, which the conceptual framework and literature review indicated as distinct benefits to businesses' efficiency and profitability (Braganza et al., 2017; Carillo, 2017; Gupta & George, 2017; Kache & Seuring, 2017; Raguseao, 2018; Sivarajah et al., 2017). Participants agreed with this as a critical facet of modern business operations, and perceived this change as a positive development, from the organization's perspective. Further, the technological shift in business operations was cited by many interviewees as the primary reason they considered expanding their knowledge base to include some level of data analytics. After the interviews were completed, the findings shifted this theme slightly, to encompass two themes, including (a) CPAs' plans to use big data in accounting work, and (b) CPAs' hesitancy to implement big data analytics in accounting. The prevalence of participant hesitancy was strong enough during the interviews to warrant acknowledgment of it as a secondary theme relating to the possibility of adoption of data analytics in accounting work.

Themes 3 & 4. The second anticipated theme emphasized the ways that technological changes required accountants to modify the methods they used to perform accounting duties (Alawadhi et al., 2015; Cao et al., 2015; Cockcroft & Russell, 2018; McKinney et al., 2017; Neilsen, 2018; Perols et al., 2017; Richardson et al., 2019; Vasarhelyi et al., 2015; Warren et al., 2015). Perceptions of participants indicated a consensus opinion that CPAs would need to adapt to enable them to use data analytics in accounting, as noted in finalized theme three. The difference between the expectation and the final theme was in the urgency of timing of the CPAs' required change. Most participants indicated that they saw the necessity for big data analytic capability as a near-future competitive pressure, rather than an immediate pressure. Some interviewees also expressed potential risks surrounding the CPA service adaptations,

which was termed theme four, most notably concerning the cost versus benefit risk of obtaining the analytics capabilities.

Themes 5 & 6. The third anticipated theme highlighted preparatory steps that accountants could take, to enable them to support businesses in this increasingly data-driven environment (Cao et al., 2015; Carillo, 2017; Dzuranin et al., 2018; Krahel & Vasarhelyi, 2014; McKinney et al., 2017; Neilsen, 2018; Richins et al., 2017; Richardson et al., 2019; Smith, 2018; Tschakert et al., 2016; Zhang et al., 2018). As stated in finalized theme five, most interviewees concurred with a data analytics training need, expressing confidence in CPAs' capability to learn the necessary skills, should they desire to do so. A sixth theme emerged from participants, emphasizing the fact that in addition to the need for training, to accomplish the feat of adding the analytics capability, CPA interest and initiative were also necessary.

Perceptions. In addition to the anticipated themes, the investigator declared preliminary perceptions regarding CPAs' use of data analytics, based on the review of pertinent literature. These perceptions related to CPAs' perceived (a) inadequacy of skills, (b) complacency, (c) duty, and (d) vulnerability to other experts (Alawadhi et al., 2015; Alles, 2015; Cao et al., 2015; Krahel & Vasarhelyi, 2014; Neilsen, 2018; Pertuit, 2019; Richins et al., 2017; Smith, 2018; Tschakert et al., 2016). During the interview process, participants confirmed that both inadequacies of skills and a sense of duty to businesses served were forces driving change in the CPA profession. However, the level of complacency expressed by interviewees was markedly lower than anticipated, as most CPAs seemed aware of the need for adaptation, and willing to advance toward data analytics, in a cautious but determined manner. Finally, the researcher perception of CPA vulnerability to other experts was not shared by most participants, as they expressed strong conviction that no other professional group could offer management the same

level of broad-based analytical prowess, regardless of that expert group's technological advantage.

Summary of the findings.

The fieldwork for this research study identified six themes that clarify issues relating to the lack of preparedness of currently practicing CPAs in Louisiana to use big data analytics. Six themes emerged from the participant interviews. The first theme highlighted most CPAs' plans to use big data analytic in accounting work, followed by theme two, which related a distinct element of hesitancy to implement big data analytics in accounting. The third theme related to a strong expectation of competitive advantage for CPAs that use data analytics, alongside the fourth them, which noted potential risks when incorporating analytics in accounting. The fifth theme acknowledged a definite state of unpreparedness, but a consciousness of CPA aptitude for data analytics, whereas the sixth theme identified three distinct factors of interest, initiative, and training as requisites for accounting data analytics. These themes were discussed individually and then linked to the conceptual framework and research questions that were inherent to this study. This linkage provided better understanding of the problem and the underlying reasons for the lack of preparedness in Louisiana CPAs to use big data analytics as part of their normal accounting functions. Finally, this subsection compared the anticipated themes and perceptions to the finalized themes, to illuminate the contributions made by the participants' opinions and insights. The addition of the interviewees' views contributed a significant level of depth of understanding to the study.

Figure 3 visually depicted the relationships of each of the identified themes with one of the study's three research questions, relating to CPAs perspective about (a) using big data analytics, (b) facing competitive challenges, or (c) being equipped for big data analytics. The

graphic also exemplified each theme's association with one of the three concepts or theories that established the study's conceptual framework, comprised of (a) agency theory, (b) adaptive leadership theory, and (c) accountants' competency.

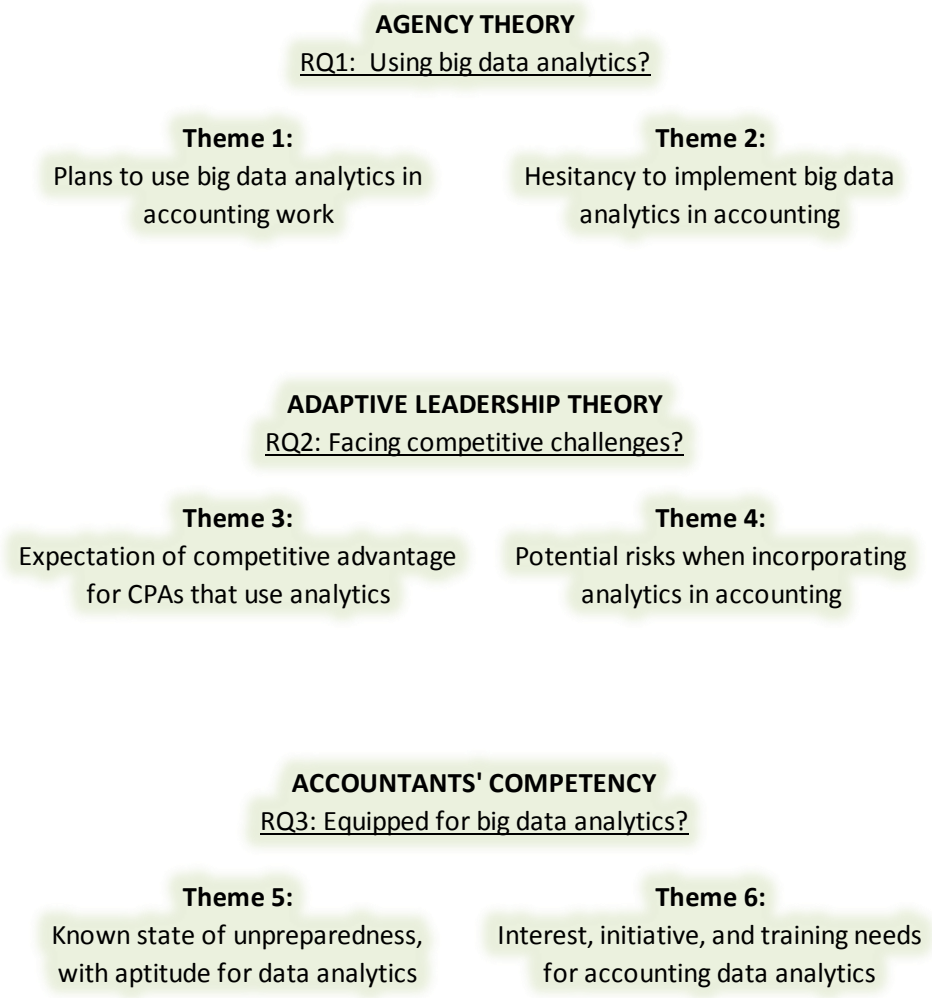

Figure 3. Association of Themes to Research Questions and Conceptual Framework

Applications to Professional Practice

This research project examined the state of preparedness of CPAs to use data analytics in accounting by considering the technology changes that have occurred in most business operations and then assessing how those changes affected the services CPAs provided to organizations. The focus of this work was on the currently practicing CPA population, with minimal consideration given to the topic of how these challenges affected past or future CPA professionals. The findings of the study provided impact to general business practice, as well as the specific field of accounting, and were evaluated reflecting the investigator's biblical worldview.

Relevance to business practice.

Data proliferation challenges have become extremely significant to business in general, as well as to the accounting profession because technology advances forced changes in the methods by which business transactions are conducted and documented (Pickard & Cokins, 2015; Nielsen, 2018). The incessant advancement of data volume mandated that business managers find ways to manage the available big data, extracting and converting it into usable information (Addo-Tenkorang & Helo, 2016; Kache & Seuring, 2017). Secondarily, new systems permitted gathering of pertinent but unstructured data, such as videos, documents, contracts, and social media records, which presented a new level of challenge to managers and accountants (Richey et al., 2016). Participants attested that these shifts were important to this study because they perceived CPAs as (a) accountable for the integrity of data included in company databases, and (b) uniquely positioned as advisors that assist management with record-keeping disruptions, such as those presented by the advancement of the information age.

Relationship to the biblical framework.

The biblical mandates pertaining to this study centered around upright and honorable behavior and were exemplified by choosing to do what is right and pleasing in God's sight (Deuteronomy 6:18). This premise permeated the theoretical underpinnings of this study, which were (a) agency theory, (b) adaptive leadership theory, and (c) accountants' competency. Agency theory alerted CPAs to the danger of putting selfish desires ahead of clients' best interests (Torvend, 2016). Adaptive leadership stressed the necessity for CPAs to use innovative and creative ways to serve others in business organizations (Van Duzer, 2010). Accountants' competency related to CPAs' responsibility to deliver excellence and due care in every job they undertake (Keller & Alsdorf, 2012).

Participants repeatedly expressed a strong feeling of (a) CPAs' obligation to do what was best for the businesses they serve, and (b) the CPAs' requirement to adapt to the changing business environment, which included prolific data availability, to continue to serve their organizations in the traditional management support function. This heartfelt expression by interviewees encompassed the essence of the theoretical concepts that supported this study, because it intimated the priority of clients' needs, and the necessity for adaptation of methods, to continue to deliver service excellence.

Applicability to the field of accounting.

This study directly applied to the field of accounting because the topic of CPAs unpreparedness to use data analytics in accounting affected the core services that accountants provided to business organizations. CPAs duties included many responsibilities, such as management decision support, general record keeping, financial statement preparation, budgeting, costing, tax compliance, internal controls, and auditing. Most of these functions relied

on digital storage of the underlying data that supported accountants' reports and calculations. As that volume increased, the complexity of managing, extracting, and using that data increased as well (Richins et al., 2017).

Even as the demands of the workplace pressured existing CPAs to become more technologically adept, accounting accreditation organizations and professional accounting associations have continued to ensure that future CPAs become equipped for the technology-driven business environment through adjustments to university accounting curriculum (AACSB, 2014). As of this writing, the AICPA has proposed changes to the CPA exam to measure prospective CPAs' technological skills and competencies, and the National Association of State Boards of Accountancy has considered licensure changes to include requirements for licensee data analytics and technology expertise (Tysiac, 2019).

Recommendations for Action

The investigator conducted a thorough review of professional and academic literature relating to using data analytics in accounting, followed by a qualitative field study which gathered the opinions and perceptions of practicing CPAs throughout the state of Louisiana. The findings of the literature review and the qualitative fieldwork led the researcher to formulate a set of action recommendations. These recommendations identified a potential progression toward solving the problem of Louisiana CPAs' lack of preparedness to use big data analytics. Although not all CPAs may choose to follow the path of data analytics in accounting, these recommendations provided practical guidance about how to proceed, for CPAs who desired to expand their service offerings to include data analytics in their accounting work.

Action 1: Explore opportunities for use of data analytics in accounting.

CPAs can learn about using data analytic tools in accounting, through professional and academic sources. Professional organizations that represent CPAs and Certified Global Management Accountants (CGMAs), such as the AICPA and state CPA societies, provide informational articles, books, videos, and training courses, to assist CPAs in understanding the challenges and opportunities that increased data volume presents to the CPA profession. Accounting education organizations, such as the AAA, publish theoretical and practical academic guidance relating to data analytics applications in accounting as well. CPAs should take continuing education courses that (a) describe the disruption to normal accounting functions caused by data proliferation and (b) introduce tips and tools for becoming more familiar with data access and manipulation. CPAs should talk to peer CPAs about ways to incorporate analytics in accounting. CPAs should attend conference sessions about trends in accounting practice.

Action 2: Project impact of data analytics on business entities CPA serves.

Internal accountants should investigate company data systems to determine data availability, analysis of which could improve (a) decision making, (b) productivity, and (c) profitability. Similarly, external accounting advisors and consultants should ask clients if they have access to data that they need help analyzing to obtain these same objectives. External auditors should review client data sources and search for ways to utilize data capabilities, integrating data analytics, and other technology tools into audit procedures, targeting efficiency and effectiveness improvements.

Action 3: Acquire adequate knowledge of analytics to oversee others' use of it.

The study identified openness to learning as an essential attribute of a CPA seeking to understand data analytics. Many interviewees mentioned that an initiative to learn was the most critical element to a CPA's ability to shift their analytical competency from the more limited traditional formats to the broader big data paradigm. At a minimum, CPAs who serve data-intensive organizations should become familiar with data analytics to the extent necessary to know (a) what data is being collected, (b) who in the organization can access the data, and (c) what tools are available that would be useful to analyze the data. This familiarity could help the CPA identify ways to use the data effectively, to maximize company productivity and profitability. Secondarily, this degree of awareness would allow a CPA to oversee or support other individuals that were performing accounting big data analytics for the business.

Action 4: Obtain training to enable personal use of data analytics in accounting.

Currently practicing CPAs that wish to utilize the available data to assist the companies they serve should seriously consider obtaining some form of data analytics training. Technology oriented training would supplement CPAs' knowledge base of traditional accounting education courses and practical experience. Because technological changes are moving at a very fast pace, the tools needed to perform the data analysis are constantly evolving as well (Carillo, 2017). CPAs would need to be aware of this evolution, to ensure that the training obtained was applicable to contemporary data formats and operating systems, as of the time of training. At the time of the investigator's conversations with Louisiana CPAs, there was a preponderance of interest in analytical tools such as (a) Microsoft's Power BI, software for business analytics, (b) Microsoft's SQL Server, database and analytics tools, (c) Microsoft's Excel, with data analysis tools, and (d) Tableau's software, for analysis and visualization. Many other vendors offer data

analysis software, and this list should not be viewed as an endorsement of the products mentioned, but a mere compilation of the tools most often referenced by this study's participants.

Identification of those impacted by the study.

The study stands to impact a significant portion of practicing CPAs, due to the prevalence of data-oriented developments and increased data availability in most business operations. Digitization affected many internal accounting functions, such as financial reporting, operational budgeting, capital budgeting, costing, systems oversight, internal controls, and general management decision support (Janvrin & Watson, 2017). External accounting was greatly affected by the increased data availability as well, particularly in the audit and management consulting service areas (Cao, Chychyla, & Stewart, 2015). Likewise, these same impact factors affected the organizations that these CPAs served, identifying opportunities for enhanced efficiencies, increased profitability, and better management decisions. The findings of this study were most applicable to Louisiana CPAs because the study directly focused on that subgroup of the profession. However, because CPAs in other locales faced similar challenges and opportunities, most, if not all, of the study findings could be universally applied to CPAs outside of Louisiana as well.

The findings of the study also impacted educators, including continuing education providers and university accounting programs. New entrants to the accounting profession are becoming more prepared by adjustment to the accounting curriculum, to include more exposure to analytics (AACSB, 2014). Participant CPAs expected to obtain planned analytics training from a combination of continuing professional education and university classes. Participants in this study stressed a strong need for practical, hands-on training in the accounting analytics area, rather than just theoretical or overview-level coverage of the topic. Many interviewees expressed

a desire for training that would provide simulations using analytics software tools and real data sets, knowledge from which could be applied to similar data extractions from the organizations they serve.

Ways to disseminate study findings.

Plans to disseminate the findings of the study included publication of the entire dissertation in Liberty University's Scholars Crossing repository and the publicly available ProQuest Dissertations collection. In addition, the investigator planned to (a) submit the study for potential conference presentation of the findings in one or more academic venues, and (b) submit findings of the study to one or more academic journal articles, describing the study process and outcomes. Finally, the researcher anticipated publication of a synopsis of the study findings in a periodical professional magazine that reaches Louisiana CPAs, through the state society of CPAs.

Recommendations for Further Study

During the research process, the investigator identified other issues that might warrant further research relating to the topic of this study. Each recommendation for potential study was briefly described. Following up this study with these interrelated research topics could reveal nuances about the topic that lend a clearer understanding of the matters broached in this research report.

Recommendation 1: Broader demographic.

A broader demographic, encompassing a larger sample size, might illuminate insights into CPA perceptions of the entire profession, which could reveal additional patterns or themes that increase understanding of the problem or reveal potential solutions. This larger qualitative or

mixed-method study might be accomplished on a US-wide basis, through cooperation with the AICPA or NASBA.

Recommendation 2: Quantitative study.

A quantitative study of Louisiana businesses could be undertaken, to ascertain the level of need for big data analytics that companies are experiencing, correlating the demand to factors such as company size, industry, and data application type. Questions could be included to reveal the likelihood of business managers' choosing CPAs as their preferred data analytics service providers.

Recommendation 3: Separate studies for internal and external accounting.

Another option for a complementary study involved separating the internal and external accounting functions, for purposes of studying the impact that data analytics might have on the CPAs in those capacities. A follow-up study that focused exclusively on private CPAs, as they perform internal accounting functions, might reveal data analytics applications specific to supply chain management, internal accounting, and management decision support. Alternatively, a follow-up study that focuses exclusively on public CPAs, as they perform services for external accounting functions, might highlight data analytics applications relating to auditing, tax preparation, and management consulting.

Recommendation 4: Ways to obtain data analytics competency.

A study that presents alternative ways to obtain competencies for data analytics in accounting would be a useful endeavor to help the profession. The project could focus on available university training, continuing education options, self-study, and avenues for experiential learning.

Recommendation 5: Various other study avenues.

Other potential study topics might include (a) change management strategies in the accounting profession, (b) expansion of CPAs' role as broad business advisors, (c) potential supply chain data integrity vulnerabilities, and (d) audit information technology oversight requirements.

Reflections

This sub-section reviewed the researcher's background and research experience, including potential biases and preconceived ideas that might have influenced the study process and outcomes. The researcher also discussed the effects that the study had on CPA participants and the CPA community, as well as effects the study had on the researcher, which resulted in changes in thinking about the subject matter of the study. Finally, the investigator reflected upon the applicability of biblical principles to the study findings.

Experience with the research process.

The researcher worked as a full-time CPA in public practice for 25 years, from 1983 until 2008, and transitioned to a full-time accounting faculty position in Fall of 2008, maintaining a part-time CPA practice until March 2017. Prior to entering academia, the researcher had no significant experience with academic writing. However, the researcher gained some experience with academic research since that career transition. Nevertheless, that experience was insignificant compared to the depth and rigor involved in this study, which required determination, extensive time commitment, and immense personal initiative to complete. Intense interest in the study topic was a critically important factor that the researcher credited for the feat, facilitating doctoral persistence throughout the process.

Personal biases and preconceived ideas.

The researcher's past experiences in accounting public practice and accounting academia could have impacted the research process, through personal bias and preconceived ideas. To combat this possibility, the researcher utilized a semi-structured interview guide, to ensure participant's contribution to each research question, and to prevent researcher leading during the interviews. The goal of the interview process was to assess the feelings of the Louisiana CPA community regarding big data analytics in accounting work, relating to factors of necessity, preparedness, ability, and interest. The researcher approached the investigative stage without predetermined expected outcomes, knowing that the opinions and perceptions from interviewees might be vastly divergent.

Effects of the researcher on participants or situation.

The study impacted some participants by raising their awareness of the increased data availability and the competitive pressure that might arise from other CPAs' use of the data in accounting services. Secondarily, the research affected participants by consideration of preparatory training in data analytics tools to posture the CPA for future demand for accounting analytics services. Further, the study informed the CPA profession, collectively, of pertinent information and issues surrounding the potential evolution of accounting analysis to include big data analytics.

Changes in thinking as a result of the study.

Understanding participants' views of the study topic broadened the researcher's perspective as well. First, the investigator was surprised that so few Louisiana CPAs were willing to engage in the conversation about data analytics in accounting. The researcher had assumed that most CPAs would wish to express their opinion about the matter, which did not

align with the response rate for the study. This change in thinking caused the researcher to consider undertaking another study in the future, perhaps in quantitative format, to try to reach the large group of Louisiana CPAs that were unresponsive to this qualitative study's recruitment efforts, to capture the opinions of the larger CPA subject pool.

Secondly, most CPAs who were interviewed exhibited a high degree of flexibility and adaptability, which was an unexpected condition, from the researcher's initial perspective. The reason for CPA participants' unpreparedness to implement data analytics in accounting seemed to originate more from a lack of client demand than it did from (a) resistance to change or (b) inability to adapt, as might have been expected. Most CPAs expressed eagerness to do whatever was needed to better serve organizations, including analysis of big data.

Biblical principles reflection.

Refreshingly, CPA participants responded with a sense of honor and obligation to serve organizations, in whatever way they could. These CPAs consistently saw themselves as problem-solvers and support professionals, reminding the researcher of the servant-heart referenced in scripture as, "Whoever wishes to become great among you shall be your servant; and whoever wishes to be first among you shall be slave of all. For even the Son of Man did not come to be served, but to serve" (NASB, Mark 10:43b – 45a). The researcher found inspiration in the level of interviewees' commitment to the profession and the organizations they served.

Summary and Study Conclusions

Through this study, the researcher explored the challenge confronting practicing Louisiana CPAs, which arose because of technological advances that enabled increased access to underlying data transactions that were maintained in organizations' accounting information

systems. Accountants' duties, though varied in purpose, regularly involved accessing these information systems, as a basis to perform accounting functions for the organization.

Summary of the study.

The problem studied was Louisiana accountants' lack of preparedness to use big data analytics in normal accounting functions, leading to competitive disadvantage in their profession. Three research questions were utilized to address the problem, relating to whether currently practicing Louisiana CPAs' (a) use data analytics, (b) encounter competitive pressure surrounding data analytics, and (c) feel equipped to use data analytics in accounting work.

The researcher used a comprehensive literature review to confirm patterns of (a) information volume increases, which created demand for data analytics, (b) some ways that CPAs could use data analytics for accounting activities, and (c) CPAs' responsibility to adapt to incorporate the technological advances into their accounting services. To investigate the problem, the researcher utilized a qualitative case study methodology, applied to a study population comprised of CPAs practicing within the state of Louisiana, which allowed collection of participants' perceptions and opinions about the changes that CPAs were experiencing. Personal interviews with participants, centered around the chosen research questions, were performed, recorded, and transcribed. These transcriptions were classified, sorted, and compiled, in a search for recurring themes and patterns, termed coding. The researcher then interpreted the findings, using personal knowledge, experience, and judgment, to ascertain the meaning of the findings.

The findings that emerged from the investigative stage of the research process were aligned to the study's three research questions. Concerning the first research question, CPA participants' firm intentions to use big data analytics in accounting to assist clients and to

increase practice efficiencies emerged as a strong theme. A related but secondary theme included CPAs' hesitancy toward implementation of data analytics, resulting from cautionary inhibitions, like data integrity concerns and lack of training.

Next, a primary theme arose relating to the second research question, about interviewees' perception of competitive advantage for CPAs that use analytics. The subordinate theme related to risks of utilizing the advanced technology tools, such as cost-benefit considerations and CPA expertise dilution, which some CPAs thought could result from offering the added peripheral services.

The last pair of findings tied to the third research question and was associated with the level of CPAs' preparedness to incorporate analytics services into accounting activities, the theme for which was a consensus opinion that perceived CPAs as unprepared to do the work, yet capable of learning the needed skills. Secondary but related to this theme was the three-fold requirement of interest, initiative, and training, identified as critical for accomplishing analytics training, according to the interviewee perspectives.

After aligning these field study findings to the research questions and conceptual framework, the investigator compared the emergent themes to those that had been identified through the literature review, before commencement of fieldwork. Next, the researcher considered the findings' relevance to business practice, the biblical framework, and the field of accounting. The study was finalized by the researcher's recommendations for action, recommendations for further study, and reflections on the research process.

Prior to this study, academic literature and professional publications were reviewed, in search of guidance to practicing CPAs about the challenge with data proliferation within management and accounting information systems presented to accountants. That review

identified a distinct shortage of coverage on the subject, particularly as it related to practicing CPAs, because most research on the topic focused on adaptations to university curriculum, to better prepare accounting students for the digitization of accounting data. This study bridged that gap in part, lending practical perspective from existing accounting practitioners.

Identification of pertinent issues relating to this research problem, which was the lack of preparedness to incorporate data analytics in their accounting work, illuminated the challenges that CPAs must overcome to continue to serve organizations as the broad-based business advisors that they are, and to use management and accounting information systems to perform ongoing accounting functions that (a) provide data analysis and interpretation in many areas of business, (b) enable accurate financial reporting, (c) facilitate internal control structures, and (d) support management decision making.

Study conclusions.

The researcher formed several conclusions from the implementation of the study, involving the Louisiana CPAs' level of preparedness for big data analytics in accounting. These conclusions related to Louisiana CPAs' (a) low participation response to the study topic, suggesting CPA population apathy, (b) commitment to continue to serve organizations, amidst changing circumstances, and (c) unpreparedness, with low urgency to become prepared for analytics in accounting.

Relating to the lack of Louisiana CPA participation in the study, the researcher had expected responsiveness to be much stronger, regardless of whether LCPA members felt the potential shift was a positive or negative change for CPAs, and regardless of whether each CPA felt personally prepared to provide data analytics services in their accounting work. The response rate led the researcher to conclude that the LCPA recruitment pool may have been influenced by

either (a) lack of interest or (b) lack of understanding of the topic under study, both of which might be indicative of apathy. Because this study was inherently designed as an intimate, qualitative research project, it required only a small group of participants to express opinions and share perspectives, to enable better understanding of the research problem, in an exploratory manner, so no apparent harm was done to the study by the low response rate.

The researcher concluded that CPAs do face competitive pressure to incorporate data analytics in accounting work, and they are committed to continually meet the needs of their clients and employers, but also that most CPAs feel that pressure on a prospective basis, rather than as a current competitive challenge. This seems to result from low organizational demand or need for analytics services from the CPAs at present. CPAs repeatedly stated a strong commitment to providing analytical services to organizations, regardless of the changing format in which the data might be presented. Participants acknowledged the need to obtain skills in analytics, to face future competitive challenges that they could foresee from the evolving management and accounting information systems. Likewise, many interviewees expressed confidence that competitive advantage would be gained by early adoption of data analytics in accounting functions.

Based on the study participants' input, the researcher concluded that Louisiana CPAs were not adequately prepared for data analytics in accounting, but they were also not feverishly seeking to rectify the deficiency. Most CPAs interviewed knew that data availability was increasing but did not seem overly concerned about their unpreparedness to utilize that information. Many interviewees expressed determination to acquire data analytics capabilities, but only limited urgency to become proficient in analytics quickly, due to little or no current demand to incorporate analytics capabilities from the organizations they served.

In closing, this research project allowed the investigator to study the potential disruption that CPAs have encountered due to technological advances that affected the underlying data systems with which accountants performed their professional duties. The project highlighted CPA perspectives of the impact of the technology changes, CPAs' preparedness to encompass data analytics, and pathways to become more prepared for data analytics in accounting. Through the research process, the project increased awareness of the challenges confronting participant CPAs individually and the accounting profession collectively.

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Appendix A: Screening Survey

Answer questions 1-5 with yes/no answers. Answer # 6 with your contact information, if willing.

1. Are you a CPA, licensed to practice by the State Board of Louisiana CPAs?

   Yes ____ No ____

2. During 2019, have you actively practiced as a CPA, in public or private accounting?

   Yes ____ No ____

3. During 2019, have you performed services as a CPA, within the state of Louisiana?

   Yes ____ No ____

4. Are you between 18 and 65 years old?

   Yes ____ No ____

5. Are you willing to participate in a 15-30 minute interview, to provide input for the doctoral dissertation topic: "CPAs as Data Analysts: How Louisiana Accountants Respond to Data-Driven Business Paradigms"?

   Yes ____ No ____

6. If your answer to question 5 is **Yes**, thank you! Please provide your contact information, to add your name to the potential interviewee pool.

   Name: _____

   Email address: _____

   Telephone number: _____

   LCPA Regional Chapter, if known: _____

Notice: *This is to advise interview volunteers that agreeing to be interviewed does not guarantee that you would be contacted, because the volunteer pool could potentially exceed the researcher's interview capacity. In case of such capacity excess, a randomized selection of CPAs from the interviewee pool will be contacted to participate in the personal interview component of the study.*

Appendix B: Interview Guide

Greetings! Thank you for agreeing to give me an interview related to my dissertation. I know your time is valuable, and I appreciate your willingness to use it this way today. I am exploring three research questions relating to data analytics in accounting, so I will be asking you a few questions relating to each of those questions.

Before we begin, I would like to define what I mean when I say big data and big data analytics.

Big data: quantities of information that are so cumbersome or so intricate that standard analysis procedures cannot process them

Big data analytics: a process involving inspection, cleaning, transformation, and modeling of big data, to collect useful information for decision making

- The first question pertains to CPAs as support professionals, serving organizations in various capacities, in the broad business environment:

RQ1. How do you feel about CPAs using big data analytics in accounting work?

RQ1a. Why should CPAs use big data analytics in accounting work?

RQ1b. Why should CPAs avoid using big data analytics in accounting work?

RQ1c. In what ways, if any, are you (personally) incorporating big data analytics in accounting work you do?

- I understand. Thank you. Now, the second question relates to the CPA profession, and the competition between individual CPAs and or firms.

RQ2. To what extent do you think using big data analytics in accounting work affects competitive advantage for CPAs?

RQ2a. In what ways do you feel that using big data analytics in accounting work <u>strengthens</u> competitive advantage for individual CPAs and/or firms?

RQ2b. In what ways do you think that using big data analytics in accounting work weakens competitive advantage for individual CPAs and/or firms?

RQ2c. How much competitive pressure do you feel to use big data analytics (personally) in your accounting work, to stay competitive?

- Again, thank you. The third question considers individual CPAs, who were traditionally trained for accounting work, but maybe not specifically trained for big data analytics.

RQ3. How equipped do you feel to use big data analytics in accounting work?

RQ3a. To what degree do you consider your aptitudes (abilities/skills/experience) and attributes (characteristics/traits/qualities) to be adequate to use big data analytics in accounting work, if you so desire?

RQ3b. What additional education and/or training, if any, (beyond that required for all CPAs) would be needed, to enable you to use big data analytics in your accounting work?

RQ3c. What level of interest do you have in using big data analytics (personally) as part of your accounting work, either now, in the future, or both?

- This is valuable information. I really appreciate your participation in this interview. Your responses are valuable input for my study. Thank you so much!