2021

Exploring the Customization of Lean Six Sigma for Adoption in Public Organizations

Jeffrey Allen Farrell
Walden University

Walden University

College of Management and Technology

This is to certify that the doctoral dissertation by

Jeffrey A. Farrell

has been found to be complete and satisfactory in all respects,
and that any and all revisions required by
the review committee have been made.

Review Committee
Dr. Sheryl Kristensen, Committee Chairperson, Management Faculty
Dr. Salvatore Sinatra, Committee Member, Management Faculty
Dr. Raghu Korrapati, University Reviewer, Management Faculty

Chief Academic Officer and Provost
Sue Subocz, Ph.D.

Walden University
2021

Abstract

Exploring the Customization of Lean Six Sigma for Adoption in Public Organizations

by

Jeffrey A. Farrell

MPhil, Walden University, 2019

MA, Shorter University, 2009

BA, Wright State University, 1987

Dissertation Submitted in Partial Fulfillment

of the Requirements for the Degree of

Doctor of Philosophy

Management

Walden University

November 2021

Abstract

Lean Six Sigma is a hybrid process improvement strategy employed to increase quality, speed, and efficiency in business processes. However, over 60% of organizations that attempt to adopt Lean Six Sigma fail, leading to a loss of resources and reluctance to engage in future improvement efforts. The purpose of this qualitative exploratory multiple case study was to understand how leaders customize Lean Six Sigma for organizational factors found in public agencies in the United States. This study was framed first by a definition of Lean Six Sigma that distinguished four separate elements and then the contingency theory of organizations. Semistructured interviews with 7 participants representing 6 organizations, Lean Six Sigma program documents, and field notes were used to collect data about how leaders customize Lean Six Sigma for organizational factors in their organizations. Analysis of textual data revealed that leadership engagement is critical for adoption and sustainment, the define, measure, analyze, improve, and control improvement methodology is too time consuming and complex, and improvement specialists work and manage the program in addition to their normal duties. Results of this research may contribute to positive social change by providing public agency leadership with a better understanding of capabilities, capacities, and complexities of Lean Six Sigma that can be better aligned within the organization, thus resulting in more efficient and effective public agencies supporting the communities they serve.

Exploring the Customization of Lean Six Sigma for Adoption in Public Organizations

by

Jeffrey A. Farrell

MPhil, Walden University, 2019

MA, Shorter University, 2009

BA, Wright State University, 1987

Dissertation Submitted in Partial Fulfillment

of the Requirements for the Degree of

Doctor of Philosophy

Management

Walden University

November 2021

Dedication

I dedicate this dissertation to the one person who provided me with the support, inspiration, advice, motivation, and love needed to complete this protracted academic journey. My wife, Dr. Tanya Brinkley was the inspiration for my taking on this endeavor and staying with it through a year-long deployment, a new job, and all the other things life throws at us. She is the ultimate dissertation coach, mentor, companion, and partner.

I also must dedicate this effort to those people in my life who shaped and supported me through my life. I was lucky to have a great childhood and education. My parents, Gregory, and Linda had much to do with that along with my siblings, Theresa, Shawn, and Julie.

I must close this with mentioning one who is no longer with us. Ramsey, our Blue Tick Beagle, was a part of our family for ten years, two master's degrees, a PhD, and most of a second one. He was a great study-buddy and always knew when it was time to take a break.

Acknowledgments

Due to the length of time it has taken me to complete this dissertation, I have had to opportunity to work with several great committee members. Dr. James Bowman started this journey with me as my Chair and pointed down the right path. Dr. Richard Schuttler took over and was largely responsible for improving my writing. Dr. Sheryl Kristensen stepped-in to see me reach the finish line. The stalwart of my committee was Dr. Sal Sinatra. Thank you all for your advice, wisdom, and coaching. I hope I did not disappoint.

I must thank those in my life who provided support, encouragement, and the space needed to complete this project. Thanks to my Georgia Youth Challenge team, especially Colonel Wallace Steinbrecher and Brigadier General (Retired) Thomas Blackstock. It always helps to have bosses who care about what you do and provide the time and support to accomplish it.

I also must acknowledge my friends and extended family who supported this work. My brother-in-law Todd and Missy, Uncle Steve and Greg, and my Georgia National Guard friends and colleagues.

Table of Contents

List of Tables

List of Figures

Chapter 1: Introduction to the Study

Lean Six Sigma is a hybrid process improvement strategy designed to increase quality, speed, and efficiency in business processes, and reduce costs by organizations. It can be a successful improvement strategy for organizations, yet many leaders and managers fail to implement it fully and abandon their efforts (Lameijer et al., 2017). Public institutions can benefit from improvements that Lean Six Sigma can offer, but face barriers to adoption unique to the sector. Exploring implementation by organizations that customize strategies to fit their specific contexts and variables could be used to advise others in terms of successful adoption.

Taxpayers increasingly ask public agencies to deliver higher quality services with decreased revenues. Government agency employees adopting Lean Six Sigma may improve efficiency and effectiveness of services they provide their communities. Poor implementation or failure to adopt Lean Six Sigma to contingencies of organizations, however, may cause disruption and degraded services (Furterer & Elshennawy, 2005). Implementing the Lean Six Sigma strategy to align within the contexts of the agency may reduce the rate of implementation failure and benefit society.

Chapter 1 is an introduction to this study. It consists of the background, problem, purpose, research questions, and conceptual framework. In this chapter, I also address the nature, definitions, assumptions, and limitations of this dissertation. I conclude with a description of the significance of the study and an introduction to Chapter 2.

Background of the Study

Organizational leaders have several options for implementing continuous improvement (CI) in government agencies. One of the most widely used models for CI is Lean Six Sigma (Tsironis & Psychogios, 2016). Lean Six Sigma is a quality improvement methodology developed to increase customer satisfaction, speed, and quality of processes, as well as decrease costs (Laureani & Antony, 2017). It is a product of the integration of the waste reducing Lean manufacturing, a philosophy designed to improve organizational performance, and data-driven structured methodology of Six Sigma.

Lean Six Sigma was first acknowledged in 2000 when the George Group merged Lean with the more structured methodology of Six Sigma. The establishment of Lean Six Sigma provides companies a hybrid approach to reduce defects and waste in processes, thus improving performance. This integrated approach allows managers the choice to emphasize Lean-based tools to reduce waste or Six Sigma statistics-based tools to reduce variations in processes. Both philosophies allow for the team-based approach to process improvement.

Lean Six Sigma has a parallel-meso structure. A parallel-meso structure exists outside an organization's normal hierarchy and links both the micro- (individual) and meso- (group) levels within that organization. The Lean Six Sigma parallel-meso structure includes trained improvement specialists, employment of structured project management processes to identify and solve problems, and use of project performance metrics (Schroeder et al., 2008). These fundamental elements comprise the suggested

organization of a Lean Six Sigma program in an organization. They make Lean Six Sigma unique compared to other quality improvement methodologies and may contribute to its success (Zu et al., 2008). Several corporations have successfully adopted Lean Six Sigma based on the parallel-meso model. General Electric, Motorola, and other sizable manufacturing and service companies use Lean Six Sigma, and many consultants recommend it. These larger corporations have successfully implemented the Lean Six Sigma methodology because they have the resources to implement it.

Consultants and experts often advise organizational leaders to adopt Lean Six Sigma using the four-element framework. The four elements are (a) a parallel-meso structure, (b) use of improvement specialists, (c) structured method, and (d) focus on metrics (Pyzdek & Keller, 2014). For some agencies, this approach is not practical or possible (Kumar et al., 2014). Implementing this structured approach can require expenditures in resources that can stress smaller firms. Due to their size, structure, culture, and limited resources, some small-medium enterprises (SMEs) have modified elements of Lean Six Sigma to fit their organizational contexts (McAdam et al., 2014). Some SMEs have implemented Lean Six Sigma with part-time improvement specialists and just-in-time training, with some success, but the programs are less robust than those found in larger manufacturing companies (Kumar et al., 2011).

Public agencies share some difficulties that SMEs have concerning the implementation of CI strategies. Limited resources, rigid hierarchical structure, lack of customer focus, and political influence are often barriers to achieving quality improvement (Fryer et al., 2007). These barriers restrain the ability of government

institutions to adopt Lean Six Sigma in the form recommended by many consultants. These limitations force some managers to modify the framework and structure of Lean Six Sigma within their organization in order to seek efficiency based on specific organizational contexts. In a time of increased scrutiny and limited budgets, agency leaders seek to gain efficiencies and improve the effectiveness of their services. Implementing Lean Six Sigma cost-effectively and efficiently can provide the tools to improve organizations.

The adoption of Lean Six Sigma in the public sector is relatively new compared to its application in other sectors. The impact of contextual factors on the adoption of Lean Six Sigma in public agencies is not well-documented in the literature. There is also little research exploring how public agencies customize Lean Six Sigma to fit those contexts. This study is needed to address gaps identified in previous research.

Problem Statement

Organizational leaders find that failure to achieve results with the adoption of improvement initiatives such as Lean Six Sigma can cost them already limited resources (McLean et al., 2015). Two of every three continuous improvement initiatives fail according to Albliwi et al. (2014) and Jadhav et al. (2014) found that 70% of Lean implementation efforts fail in manufacturing organizations. The general problem is that the failure to successfully implement a strategy such as Lean Six Sigma can cost agency resources and make subsequent change efforts challenging to implement.

Many organizational consultants promote a one-size-fits-all model of Lean Six Sigma that incorporates the identified four key elements. Not all agencies, however, find

that possible due to various organizational contingencies. The specific management problem is that there appears to be a limited understanding by public agency leaders of how they may customize Lean Six Sigma for different organizational and environmental contexts during implementation. Previous research is limited regarding the effects of organizational factors on Lean Six Sigma implementation in the manufacturing, service, healthcare, and education sectors.

Purpose of the Study

The purpose of this qualitative exploratory multiple-case study is to understand how leaders customize Lean Six Sigma for organizational factors found in public agencies in the United States. Leaders must consider organizational and environmental factors such as limited resources, rigid structure, organizational culture, and nature of the work in making decisions about how to implement and adopt Lean Six Sigma in their organizations. Designing and implementing Lean Six Sigma may be affected by leaders' decisions. I collected data using open-ended questions during semistructured interviews with leaders and Lean Six Sigma practitioners from various municipal, state, and federal agencies to gain an in-depth understanding of the influence of organizational factors on the customization of Lean Six Sigma for their organizations. In multiple case studies, each government agency with its leaders and practitioners is considered a separate case study. I requested additional data in the form of organizational documents for triangulation purposes. Additional documents consisted of policy memoranda, reports, and briefings about the implementation and customization of Lean Six Sigma. Data collected were from semistructured interviews, organizational documents, and field notes.

I merged all data to identify themes to gain a better understanding of how and why leaders make decisions to customize Lean Six Sigma in those government agencies considering the adoption and customization of quality improvement strategies to best fit their organization.

Research Question

RQ1: How do leaders customize Lean Six Sigma for organizational factors found in public agencies in the United States?

Conceptual Framework

The conceptual framework for this study is the contingency theory of organizations. Schroeder et al. (2008) said the four elements of Six Sigma are the parallel-meso structure, improvement specialists, structured improvement project method, and a focus on metrics. Donaldson (2001) said effectiveness results from leaders finding the best fit among organizational contingencies and variables in their organization. This conceptual framework allowed me to explore links between organizational factors and decisions leaders make to customize key elements of Lean Six Sigma for the best fit in their organizations.

Schroeder et al. (2008) said the parallel-meso structure, which is outside an organization's traditional hierarchy and is designed to allow the management of the improvement of the organization, allows Lean Six Sigma to cross organizational boundaries within companies. The work of those within the parallel-meso structure connects executive leadership with those on the shop floor while working on improvement projects, achieving multilevel integration within the organization. Trained

Lean Six Sigma improvement specialists are typically identified using a belt hierarchy based on their extent of training and experience. Black and green belts use the Lean Six Sigma five-step structured process known as define, measure, analyze, improve, and control (DMAIC) to manage projects. The final key element is management's focus on performance metrics. Managers use metrics to measure Lean Six Sigma progress in terms of financial measures, customer-oriented performance metrics, and measurable improvement goals.

The contingency theory of organizations was used to explain how organizations achieve effectiveness through the best fit to adapt to the variables of a given situation or environment. Donaldson (2001) said effectiveness involves attaining the best fit between organizational contingencies such as the operating environment, size, and organizational sector (e.g., manufacturing, service, healthcare, education) and organizational structure, processes, and culture. Contingencies are situational characteristics that agencies have limited command over (Sousa & Voss, 2008). Managerial actions taken in reaction to contingencies are response and performance variable factors that are measures used to evaluate fit to contingencies. Some leaders may make modifications to their organizations to fit Lean Six Sigma within their firms or may find it necessary to modify Lean Six Sigma to suit their organization.

McAdam et al. (2014) said enterprises could implement a modified version of Lean Six Sigma to achieve process improvement results. The concept of Lean Six Sigma and contingency theory of organizations are the conceptual basis for this study. Further

exploration of the contingency theory of organizations, Lean Six Sigma, and their effect on the adoption of Lean Six Sigma in public agencies appears in Chapter 2.

Nature of the Study

For this study, I employed a qualitative research method. Maxwell (2013) said qualitative research was appropriate to understand meanings of events for participants and the influence various conditions have on their actions. Qualitative research also allows researcher to understand processes that lead to events or actions taking place. The qualitative research method was appropriate for studying the influence organizational factors and contexts have on leaders in terms of deciding how to customize Lean Six Sigma for their public agencies.

A quantitative research method is suitable to determine causes for events or relationships among variables for a particular phenomenon (Merriam & Tisdell, 2016). Quantitative researchers focus on results of a process or event and use quantitative methods to enumerate and generalize those results. I chose not to use a quantitative method because it would not allow me to explore the influence that organizational contexts have on the decisions of public agency leaders in customizing Lean Six Sigma. I seek to understand decisions and factors that lead to the customization of Lean Six Sigma, not the results of those decisions.

Researchers use the case study design to answer how and why questions (Yin, 2018). It is used to investigate a contemporary phenomenon in depth to try and understand conditions relevant to the case under study (Yin, 2018). Thus, the case study design is the appropriate research design for this study. The design allowed me to study

the phenomenon of Lean Six Sigma customization within its natural setting using the organizational contingency theory in more than one organization. This is important because analytic conclusions from multiple cases are stronger than a single case.

Definitions

Belt Hierarchy: A hierarchy of trained process improvement specialists in Lean Six Sigma practice that typically consists of five levels in ascending order of expertise: yellow belt (YB), green belt (GB), black belt (BB), master black belt (MBB), and Six Sigma champion (Antony & Karaminas, 2016).

Continuous Improvement (CI): A comprehensive and systematic strategy that involves identifying opportunities for improvement by continually reviewing processes to incorporate sustainable small-step improvements via active participation of people who are key to the fulfillment of strategic goals (Milner & Savage, 2016).

Critical success factor (CSF): Precise functional areas where satisfactory results can ensure effective and positive performance and the attainment of organizational goals (Rockart, 1979).

Improvement Specialists: Technical specialists trained to a high level in terms of application of process improvement techniques (Pyzdek & Keller, 2014).

Lean Manufacturing: A philosophy designed to improve organizational performance, competitive advantage, and shareholder profit by making customer satisfaction the core of its processes and eliminating waste and nonvalue-added activities in business processes (Anthony & Antony, 2016).

Lean Six Sigma: A hybrid business strategy and methodology that involves focusing on the reduction of variation and defects by following the DMAIC structure to achieve enhanced customer satisfaction and improved financial results (Snee, 2010; Yadav & Desai, 2016).

Six Sigma: An organized methodology designed to reduce variation in organizational processes by using a parallel-meso structure that includes improvement specialists, a structured method, and performance metrics to achieve strategic objectives (Schroeder et al., 2008, p 540).

Total Quality Management (TQM): A management philosophy that involves integrating the entire organization toward the CI of products, services, and processes to meet or exceed customer expectations (Baird et al., 2011).

Assumptions

To ensure relevance and value of the research, expectations outside the control of the researcher must be expected. I had three assumptions. The first assumption was that leaders choose to modify Lean Six Sigma due to organizational contingencies and hope to achieve success with the revised program. The second assumption was that I would find public agency leaders with Lean Six Sigma experience willing to participate in my research. The final assumption was that participants were open and honest in this study.

Scope and Delimitations

This study is limited to public agencies in the United States where leaders have implemented a project-based process improvement methodology as part of a CI strategy. Public agencies include those at the local, state, and federal levels of government. Private

or for-profit businesses, or those using something other than Lean Six Sigma, are outside the scope of this dissertation. I used this qualitative exploratory multiple case study to analyze how public agencies customize Lean Six Sigma for different organizational contextual factors.

Research is scarce involving implementation and adoption of Lean Six Sigma in government institutions. Most research involving Lean Six Sigma implementation happens in nongovernment organizations. New inquiries by researchers in Lean Six Sigma adoption involve SMEs. SMEs and public agencies are different enough from typical and large manufacturing corporations to warrant investigation. This study involves the unique structure, methods, and processes of Lean Six Sigma. Other quality management methodologies and strategies were not directly relevant.

Limitations

Qualitative research and case study design have inherent limitations. Qualitative research takes place in the real world, and the primary data collection instrument is the researcher (Maxwell, 2013). Searching for the why and how of a phenomenon involves collecting and analyzing text, not quantifiable numbers from an experiment or survey. To address limitations of a qualitative case study design, the researcher must understand the nature of those limitations and develop a plan to address them. This review of qualitative research limitations is divided into three areas: credibility, dependability, and transferability.

Credibility, or construct validity, involves how findings capture the reality of what is studied. Bias cannot be eliminated from qualitative inquiries because of the role

the researcher plays in the collection and analysis of data (Merriam & Tisdell, 2016). I have experience with Lean Six Sigma and continually remained aware of preconceived views on the subject. Another aspect of credibility is conducting investigations that demonstrate study conclusions match the reality of the investigated topic. Some methods employed included triangulation, member checking, and developing rich detailed case descriptions. I used interviews with subject matter experts, program managers, and leaders involved with Lean Six Sigma, as well as a thorough review of supporting documents.

The scholar conducts research that has consistency and repeatability. The key to a dependable and reliable qualitative investigation is to develop and maintain a sound protocol (Yin, 2018). Concerning transferability, the case study methodology does not involve statistical sampling; therefore, cases are not a sample of a broader set, but rather unique subjects (Maxwell, 2013). Conclusions of this multiple case study cannot be generalized to other entities. Results can be used to explore processes and decisions made to modify Lean Six Sigma strategies because of organizational contingencies.

Significance of the Study

The purpose of this qualitative exploratory multiple case study was to understand how public agency leaders and managers customize Lean Six Sigma for different organizational factors found in public agencies in the United States. Organizational leaders adopt strategies such as Lean Six Sigma to maximize efficiency, support customers, and improve competitiveness and resiliency in the market. Although the investigation into Lean Six Sigma adoption is not new, there is limited work involving

government institutions. Also limited is exploration of how organizational contextual factors influence the modification of the four key elements of Lean Six Sigma during adoption. Improving the efficiency and quality of service in government agencies may lead to positive social change for communities they support through the efficient application of limited resources and expectations for efficient services.

Significance to Practice

Failure to successfully implement a strategy such as Lean Six Sigma can lead to depletion of limited organizational resources, such as staffing, time, and funding, and can make subsequent process improvement efforts challenging to implement. Some leaders, especially those in the public sector, may believe that Lean Six Sigma is too complicated and resource-intensive to adopt because of its use in large manufacturing companies with resources to devote. Demonstrating that customizing Lean Six Sigma to fit organizations could result in an acceptable model that can benefit practitioners contemplating its use in their agencies. This case study has limited transferability but may add to quality in public institutions by providing insight into how public agency managers customize Lean Six Sigma to develop more effective and efficient processes.

Significance to Theory

There are a limited number of studies regarding the customization of Lean Six Sigma to fit within specific organizational contexts. This lack of research presented an opportunity for further investigation into this area. Additionally, Lean Six Sigma research is only now beginning to expand into nonmanufacturing organizations and the public sector. Expanding research on Lean Six Sigma modification in government agencies may

narrow add to the understanding of Lean Six Sigma implementation in organizations other than large manufacturing-based companies.

Significance to Social Change

This investigation may contribute to positive social change by adding to research on the adoption of Lean Six Sigma in government institutions. Employees of government agencies serve the citizenry, offering services that are vital to communities. Lean Six Sigma provides benefits to businesses through cost savings, increased efficiency, and increased customer satisfaction. Communities throughout the United States seek to reduce taxes and call for better quality services and agencies need to provide quality service efficiently.

Leaders seek to increase the efficiency of the services provided to their customers using Lean Six Sigma to meet the expectations of the citizens they serve. Lean Six Sigma is often perceived as resource-intensive and challenging to implement for organizations that have constrained resources, sophisticated human resources policies, and rigid organizational structures (Fryer et al., 2007). Although there are successful examples of Lean Six Sigma adoption in large firms such as General Electric, there are smaller firms and public agencies that experience difficulties because they have limited resources to apply to the implementation. This research could benefit the citizens supported by agencies that adopt Lean Six Sigma through the improvement of their services to those citizens.

Summary

Chapter 1 contains the basis for this research. The purpose of this qualitative exploratory multiple case study was to understand how leaders customize Lean Six Sigma for organizational factors such as size, sector, and culture found in public agencies in the United States. Analyzing how public institutions customize Lean Six Sigma to fit within organizational contextual factors may provide leaders with a better understanding of how to implement the methodology. Via an exploration of literature, I identified a gap in previous research related to this subject. Providing a better understanding to government agency leaders of how to modify Lean Six Sigma may help them to implement this quality improvement strategy in agencies that need to improve quality and efficiency. This chapter includes a discussion of background information as well as purpose and research question. The chapter also includes a description of the methodology and study design.

Chapter 2 includes the literature review. Subjects explored include the organizational contingency theory, quality management, Lean Six Sigma, and project-based quality process improvement programs. There is also a review of organizational elements necessary for the implementation of Lean Six Sigma, contextual factors that may influence Lean Six Sigma adoption, and the gap in the literature.

Chapter 2: Literature Review

The gap in the literature that I identified in this literature review is limited understanding, as exhibited in previous research, of how public agency leaders may customize Lean Six Sigma for different organizational and environmental contingencies during implementation. Lean Six Sigma is a process improvement strategy designed to improve efficiency and quality of processes while reducing costs. It is effective for manufacturing organizations and is widely adopted within nonmanufacturing settings as well. Consultants promote Lean Six Sigma as a one-size-fits-all program modeled on a parallel-meso structure incorporating improvement specialists from executive leadership level to the shop floor of an organization (Zhang et al., 2012). This model can work if organizations can afford additional personnel, time, and training.

Recent studies have identified how SMEs modify Lean Six Sigma to fit their specific organizations. Although Lean Six Sigma is considered beneficial for quality improvement, many organizations' implementation efforts fail, and they expend valuable resources in their efforts (Lameijer et al., 2017). My purpose for this research was to understand how leaders customize Lean Six Sigma for organizational factors found in public agencies in the United States.

Chapter 2 consists of the literature search strategy, a description of the conceptual framework for the study, a review of literature, and descriptions of the gap in literature. The topics that I addressed in the literature review include the history and development of quality improvement methodologies, elements of Lean Six Sigma, and possible alternatives. I examined literature regarding organizational and contextual factors for the

implementation of Lean Six Sigma. During analysis of the literature, I observed a gap in literature justifying this research strategy.

Literature Search Strategy

My purpose in this qualitative exploratory multiple case study was to understand better how leaders customize Lean Six Sigma for organizational factors found in public agencies in the United States. To understand this issue, I reviewed recent peer-reviewed articles, professional publications, and books related to Lean Six Sigma and its implementation and adoption. Results from this qualitative exploratory multiple case study may contribute to the body of knowledge by bridging a gap in the literature and provide insights for leaders regarding the adoption of Lean Six Sigma in public agencies.

I conducted the literature review using Google Scholar, EBSCOHost, ProQuest, ABI/INFORM, Business Source Complete, Emerald Insight, and SAGE Journals. The search strategy involved examining reference lists from reviewed articles and dissertations relevant to the research topic.

I conducted a review of literature using these keywords and keyword combinations: *Lean*, *Six Sigma*, *Lean Six Sigma*, *Lean Six Sigma implementation*, *Lean Six Sigma adoption*, *Lean Six Sigma in government*, *small-medium enterprises (SMEs)*, *public sector*, *continuous improvement*, *critical success factors*, *parallel-meso*, and *contingency theory*. The search was iterative, starting with a broad topic, then expanding to include keyword combinations to narrow the scope. Examinations of reference lists from articles I selected for review yielded additional articles and books. I checked Google Scholar and peer-reviewed journals monthly for new articles (see Table 1).

Table 1

Literature Search Strategy

Source	Count
Peer-reviewed articles	110
Non-peer-reviewed articles	8
Books	6
Dissertations	12
Total	136

Conceptual Framework

Lean Six Sigma and the contingency theory of organizations comprised the conceptual frameworks for this research. Schroeder et al. (2008) said Six Sigma was composed of four elements: (a) a parallel-meso structure, (b) improvement specialists, (c) structured method, and (d) management focus on metrics. Donaldson (2001) said performance outcomes of an organizational unit are the result of the fit between the unit's external context and internal arrangements. Six Sigma and the contingency theory view shaped this approach to research in exploring the customization of Lean Six Sigma for adoption in public agencies in the United States.

Schroeder et al. (2008) said the parallel-meso structure allows Lean Six Sigma to span management levels within companies. By managing the improvement of the organization, the parallel-meso structure is outside an organization's typical hierarchy. This serves to allow for the management of Lean Six Sigma improvement projects and

overall process improvements within organizations. The parallel-meso structure is composed of program leaders, trained improvement specialists, and management champions supporting the process improvement effort. The work of improvement specialists within the parallel-meso structure connects senior leadership with employees who work at the process level of the organization. Improvement specialist's work on projects achieve multilevel integration within the organization.

Lean Six Sigma-trained improvement specialists are typically identified using a belt hierarchy based on the extent of training and experience (Pyzdek & Keller, 2014). The BB is a Lean Six Sigma-trained improvement specialist who typically leads process improvement teams in a full-time capacity. BBs are often supported during improvement projects by trained part-time specialists such as GBs. Large organizations may also employ MBBs to manage the Lean Six Sigma program, conduct training, and mentor BBs and GBs.

Improvement specialists use the Lean Six Sigma five-step structured process known as DMAIC to manage projects. Dahlgaard and Dahlgaard-Park (2006) said the DMAIC process gives the BB a structured means to manage process improvement. Black belts apply specific Lean Six Sigma tools during each phase of the DMAIC process to identify a problem, measure processes, devise and test solutions, and then implement the change. The DMAIC structured process and its variations give the BB a proven and reliable method to lead a team during the development of quality process improvements (Kuvvetli & Firuzan, 2017).

The fourth key element of Lean Six Sigma is management's focus on performance metrics. Managers use metrics at multiple levels of the organization to measure progress. Financial measures, customer-oriented performance metrics, and measurable improvement goals comprise Lean Six Sigma performance metrics (Swink & Jacobs, 2012). Lean Six Sigma improvement efforts are measured in terms of financial costs and benefits of the project. Customer metrics include process speed, reduction of defects, and meeting customer requirements. Establishing a goal-oriented improvement program using specific metrics supports the disciplined approach that Lean Six Sigma brings to an organization.

The foundation for the contingency theory is the contingency approach found in science (Donaldson, 2001). A fundamental principle of the scientific contingency approach is that the effect of one variable on another depends on a third variable (Donaldson, 2001). Stated otherwise, the effect of X on Y depends on W. Organizational contingency theory studies involve three types of variables: (a) contextual, or contingency, (b) response, and (c) performance variables. Contextual variables are situational characteristics that are usually exogenous to the manager or organization who have limited opportunity to control. Response variables are the managerial response to current or anticipated contingency variables. Performance variables are dependent measures that represent aspects of effectiveness that management uses to evaluate the alignment between contextual and response variables.

The contingency theory explains organizational effectiveness that results from the fit between characteristics of the organization (contingency variables), the factors in

which the organization is situated, and the responses to those variables from management (Donaldson, 2001). Contingencies are situational characteristics over which the agency has limited control (Sousa & Voss, 2008). Managerial actions taken in reaction to contingency factors are response and performance variables. Metrics are used to evaluate the organization's alignment with contingencies as a result of performance variables. Some leaders may make modifications to structures or strategies to fit Lean Six Sigma within their organization or may find it necessary to customize Lean Six Sigma to suit their contingencies.

Donaldson (2001) distinguished between the contingency perspective of management and more universalistic theories of organization management that prescribe one best way to implement change. Motorola and General Electric demonstrated successful implementations of Six Sigma and Lean Six Sigma. Due to this success of increasing efficiency and cost savings, other organizations attempted to emulate their implementation models. But, because of differences in various organizational contingency variables, other organizations saw implementation failure rates exceed 60% (Jadhav et al., 2014).

Sousa and Voss (2001) said organizations' strategic context influences the adoption of QM.. Sousa and Voss proposed that internal and external contexts influenced the adoption of QM in organizations, thus leading to additional studies that examined the contingency theory in terms of the adoption of QM practices in businesses.

Hofer (1975) said internal and external variables and environmental and organizational characteristics influence strategy in organizations. Organizational

contingencies examined by Hofer included company size, industry type, duration of the strategy implementation, and the quality improvement culture of the organization. Researchers in the adoption of Lean Six Sigma and other QM practices discovered that enterprises could implement a modified version of QM practices, including Lean Six Sigma. Modifications can include employment of only part-time improvement specialists, limited scope projects, and just-in-time training.

Literature Review

I organized the literature review into six sections. The first explains the makeup and origins of Lean, Six Sigma, and Lean Six Sigma. In the next sections, I describe the four elements of Lean Six Sigma and how they may be customized. I survey alternative options for elements of Lean Six Sigma. Next, I review organizational and public sector contextual factors that may influence customization. The literature review closes with an examination of Lean Six Sigma implementation frameworks.

History and Development of Lean, Six Sigma, and Lean Six Sigma

One of the QM strategies organizations employ to implement CI is Lean Six Sigma. Lean Six Sigma is a hybrid quality improvement methodology formed to increase customer satisfaction, speed and quality of work processes, and decrease costs (Laureani & Antony, 2017). It is a product of the integration of lean management philosophy and the data-driven structured methodology of Six Sigma (Maleyeff, 2014). Combining the two methodologies allows leaders to take advantage of benefits each possesses while minimizing their faults.

Lean

Lean evolved from conditions in post-World War II Japan. Manufacturers needed to increase production in a resource-limited environment to improve their postwar economy. Lean is an improvement philosophy developed by Taiichi Ohno and implemented by Toyota. Lean was initially known as the Toyota Production System (TPS) in Japan. When TPS appeared in the United States in the 1990s, it was relabeled as Lean or Lean production.

Womack et al. (1990) defined Lean as a change philosophy that incorporates the concept of dynamic change backed by a set of principles and practices designed to create an environment of CI. Lean is designed to maximize value to customers by removing nonvalue-added activities and waste. Waste, or muda, is central to the Lean philosophy (Albliwi et al., 2015). Lean involves using processes and tools designed to identify and reduce waste, especially those identified by customers. By using workers involved in processes under review, Lean identifies as a bottom-up method for improvement. To identify waste, employees use a Lean tool such as value stream mapping to illustrate processes and identify areas of waste (Womack et al., 1990). Improvement teams then use other tools such as Kanban or 5S to develop options to eliminate the designated waste. Cause-and-effect analysis, another Lean tool, can then be used to weigh options for improvement and illustrate their effectiveness.

Maleyeff (2014) said Lean is a holistic philosophy that necessitates altering organizational culture to implement its practices, making Lean difficult for some organizations to adopt. Shifts in corporate culture can be difficult for many organizations

to embrace (Kotter, 2007). Lean has been successful in large manufacturing organizations but has been less successful in companies with low volume and high variety work processes. Also, many Lean tools are not adequate for examining more complex manufacturing processes or statistically analyzing results (Pepper & Spedding, 2010). Lean focuses on process improvement, with less emphasis on statistics (Drohomeretski et al., 2014).

Six Sigma. Six Sigma was developed by Bill Smith and managers at Motorola in the United States in the 1980s. Six Sigma's creation was based on foundations of Shewhart's Statistical Process Control (SPC) and Deming's (1994) Plan-Do-Check-Act (PDCA) cycle. Shewhart used SPC to bring processes under control by identifying and limiting variation. Deming's PDCA is the basis of process improvement methodology to include the DMAIC process improvement project structured method. Motorola's development and application of Six Sigma contributed to the company winning the Malcolm Baldrige National Quality Award (MBNQA) in 1988 and saving $5.4 billion in nonmanufacturing processes in 5 years (Dahlgaard & Dahlgaard-Park, 2006). Pepper and Spedding (2010) said after it was implemented at General Electric by Jack Welch in 1995, Six Sigma became more widely recognized by industry leaders.

Maleyeff (2014) said Six Sigma is a data-driven statistical methodology that has evolved into a comprehensive management system that is highly structured and formalized. Six Sigma's purpose is to identify and reduce variation and eliminate defects in processes (Maleyeff, 2014). Improvements are developed by teams using DMAIC. Practitioners use specific tools during each phase of the process improvement project.

Many of these tools, such as analysis of variance (ANOVA) and Gage R&R are statistical. Other tools used by practitioners, such as suppliers, inputs, process, outputs, and customers (SIPOC) mapping are used to define the process. Six Sigma is popular with large manufacturing and service companies such as Motorola, General Electric, and Honeywell. It requires extensive training for practitioners and organizational resources in order to adopt, making it difficult for smaller organizations with fewer assets to implement (Anthony & Antony, 2016).

Lean Six Sigma

Lean and Six Sigma evolved from earlier forms of QM practices to provide businesses a way to reduce waste and improve quality (Maleyeff et al., 2012). The evolution of QM then led to the combination of these two methodologies to form Lean Six Sigma, taking advantage of the best both have to offer (Snee, 2010). Lean Six Sigma was first recognized in 2000 when the George Group integrated Lean management with the more structured and statistical-based methodology of Six Sigma (Maleyeff, 2014). The creation of Lean Six Sigma provided organizations with a hybrid approach to reduce defects and waste in processes, thus improving performance. This fused approach allowed organizations to take advantage of the best of both and minimize the faults of each.

Yadav and Desai (2016) conducted a review of Lean Six Sigma literature. They proposed a basic definition of Lean Six Sigma that combined the concept of a business improvement methodology with the philosophy of maximizing shareholder value by improving quality. Faster processes, increased customer satisfaction, and reduced process

costs defined quality. Lean Six Sigma achieved this by combining Lean tools with the philosophy of reducing waste with the statistical tools, structured specialist-led improvement teams, and the DMAIC process of Six Sigma, to provide an effective process improvement methodology. Albliwi et al. (2015) suggested that combining Lean and Six Sigma tools, the DMAIC framework, and specialist-lead teams allowed organizations to use just one improvement methodology and not two. Combining the two strategies also provides for a mitigation of the weaknesses in both, taking advantage of their strengths. Next, I explored the elements that make-up Lean Six Sigma.

Elements of Lean Six Sigma

In their research on why the approach to practicing Six Sigma was seen as more successful than previous quality management philosophies, Schroeder et al. (2008) formulated a nascent definition of Six Sigma that can be applied to Lean Six Sigma. They defined Six Sigma as having four elements: (a) parallel-meso structure, (b) improvement specialists, (c) structured method, and (d) performance metrics. These four elements are designed to reduce variation in organizational processes to achieve strategic objectives. Zu et al. (2008) explored three elements of Six Sigma and their effectiveness in quality management and inferred that Lean Six Sigma is grounded in the Plan, Do, Check, Act (PDCA) cycle created by Deming. They also concurred with the Schroeder et al. description of the four elements of Lean Six Sigma's success. Zu et al. (2008) emphasized three critical aspects of Lean Six Sigma as its role structure (parallel-meso structure), structured improvement procedure, and focus on metrics. Swink and Jacobs' (2012) research compared financial performance to the adoption of Quality Management

and emphasized the same three elements for Six Sigma success. In their paper on how adopting Lean Six Sigma improves return on assets (ROA), Swink and Jacobs (2012) concluded that improvement specialists, structured methods, and performance metrics are the success factors for adoption. Swink and Jacobs (2012) also identified the parallel-meso structure as unique to QM.

Zhang et al. (2011) corroborated these three elements, but added two further concepts of customer orientation and leadership engagement. Shah et al. (2008), in research comparing Lean, Six Sigma and Lean Six Sigma implementation, also included customer focus and leadership support and engagement as part of their critical elements. These additional two elements tie Lean Six Sigma closely with the QM philosophy of Total Quality Management (TQM) (Shah et al., 2008). Additionally, both Lean and Six Sigma have a common underlying philosophy and set of practices that lead to conventional implementation processes and eventually to the combined Lean Six Sigma approach.

Past research proposed that the key elements that define Lean Six Sigma are (a) a parallel-meso framework, (b) a structured method, (c) use of improvement specialists, and (d) a focus on metrics. The addition of the TQM-based elements of customer orientation and leadership support devised a proposed structure of Lean Six Sigma for implementation in organizations. The four key elements of Lean Six Sigma combined with the philosophical underpinning of TQM facilitated a model for Lean Six Sigma that was used to establish the improvement methodology in organizations.

Parallel-Meso Structure

The parallel-meso framework is characterized as an informal hierarchal structure that parallels the established organizational hierarchy but does not replace it (Schroeder et al., 2008). This structure is composed of improvement specialists at different levels of the organization, including program champions, project sponsors, improvement specialists (BB and GBs), and project team members. The framework of Lean Six Sigma specialists, serving at varying levels of the organization, tie the quality improvement process together from the executive suite to the shop floor. Swink and Jacobs (2012), in a financial analysis of firms that adopted Six Sigma, characterized the parallel-meso structure as a centralized office within the company that oversees a dispersed training and project execution hierarchy. Swink and Jacobs (2012) found that companies that implemented Six Sigma established an executive team that set criteria and guided project selection. The parallel-meso structure also served to unite a variety of part-time and full-time improvement specialists who follow a structured method (DMAIC) for project execution.

Improvement Specialists

Often referred to in terms of a belt hierarchy in Lean Six Sigma, are employees explicitly trained to serve in their Lean Six Sigma role (Hoerl et al., 2001). Each specialist receives training specific to their level. The instruction focuses on the philosophy of Lean Six Sigma, the DMAIC project framework, and the tools needed to identify defects, variation, and waste, and to make necessary improvements. The belt hierarchy is similar to the colored belts in karate. The belt hierarchy found in Lean Six Sigma, in ascending order according to the amount of training and level of responsibility,

are the GB, BB, and MBB. Organizations can create other levels of belts for those who receive lesser amounts of training such as a White or YB.

The BB is typically a full-time improvement specialist trained to lead improvement teams (Hilton & Sohal, 2012). The BB is expected to know and understand the DMAIC process and when, where, and how to employ Lean Six Sigma tools. Green belts are part-time specialists who are trained and serve in the role as an assistant to a BB, or lead projects of smaller scope than that of a BB. The MBB is an experienced, full-time improvement specialist whose role is to train and advise belts and may manage the Lean Six Sigma program for an organization. White or yellow belts are team members who receive orientation training on Lean Six Sigma methods to be more effective team members.

Zu et al. (2008) identified additional roles in the Lean Six Sigma framework as project champions and sponsors. Champions are managers trained in the philosophy and basics of Lean Six Sigma and provide guidance and management to the organization's program. Project sponsors are often process owners and are expected to provide support, advice, and resources to the improvement team. Together, the champion, sponsors, MBBs, BBs, and GBs comprise the improvement specialists for the parallel-meso structure of an organization and manage and perform quality process improvement for a company.

Structured Method

The structured approach described by Schroeder et al. (2008), refers to the DMAIC framework for improvement projects. Each of the steps has a specific purpose in

moving the project to completion. There are Lean Six Sigma tools identified for use in each step to identify and define a problem and develop solutions. The DMAIC structured method is the platform for employing the Lean Six Sigma tools and principles in a structured process for problem-solving and process improvement.

Performance Metrics

Lean Six Sigma performance metrics allow organizational leaders to evaluate quality improvement efforts against the strategic direction of the organization and measure how those improvement efforts support organizational objectives (Zhang et al., 2009). Financial metrics for improvement projects can measure cost savings, return on investment, or other financial elements related to improvement. Also, improved performance can result in lower operational costs, increased earnings, or savings for the customer. Quality performance metrics are useful if they can relate to the goals of the organization.

The four elements of Lean Six Sigma provide the basis for the structure of the program and how it is expected to look and function in organizations. Consultants and practitioners advise leaders to adopt this model of Lean Six Sigma (Lameijer et al., 2017; Taylor & Taylor, 2014; Wu et al., 2011). They argue that due to its success, companies should implement this universal model of process improvement, making the necessary changes to their business. The contingency theory of organizations would suggest that this universalist idea of Lean Six Sigma may not work for all organizations due to their specific environments and contingencies. The choice that leaders must make is modifying

their organization to fit the universal model of Lean Six Sigma or customizing Lean Six Sigma to fit their organization.

I recognized and defined the four central elements of Lean Six Sigma. Organizations adopting the universal model of Lean Six Sigma employ a parallel-meso structure that consists of improvement specialists to manage quality improvement. These specialists manage projects using a structured method, and managers track progress using pre-defined performance metrics. Some organizations may seek to modify these elements to meet the specific contexts of their organization or operating environment.

Alternatives to the Elements of Lean Six Sigma

The four elements of Lean Six Sigma can be demonstrated universally based on the model established by early adaptors. Those organizations were typically large manufacturing concerns that demonstrated early success and are the examples of best in practice to be modeled by others (Hilton & Sohal, 2012). The four elements are the pattern those other enterprises emulated, and consultants advised clients to institute. Researchers (McAdam et al., 2014; Nonthaleerak & Hendry, 2008; Zhang et al., 2014; Zwetsloot et al., 2018) assessed that the three elements of parallel-meso structure, improvement specialists, and structured method have been modified due to organizational contingencies during implementation. The researchers produced examples of alternative means of implementing Lean Six Sigma in small-medium enterprises by illustrating alternative examples of some of the critical elements in small-medium enterprises adopting Lean Six Sigma. This research exemplified alternatives to the best practice of employing full-time BBs in small-medium enterprises, establishing a parallel-meso

structure, and the use of a structured method to problem-solving. The examples reinforce the contingency perspective of customizing Lean Six Sigma to meet organizational contingencies.

Alternatives to Parallel-Meso Structure

Schroeder et al. (2008) concluded that the parallel-meso structure is a well-defined process that assists leadership engagement. The parallel-meso structure envisioned by Schroeder et al. operated in parallel to the standard organizational leadership structure and was comprised of both Lean Six Sigma specific positions and operational managers and staff. A quality management office headed by a Lean Six Sigma champion or MBB oversees the quality management or continuous improvement operations. It assists leadership in project selection, project management, resourcing, training, and reporting progress of continuous improvement efforts. Black belts manage projects, and mentor and train other belts for the organization (George, 2003). Project sponsors work with improvement specialists to support projects with personnel, information, and other resources to aid project completion. This framework ties the Lean Six Sigma improvement specialists and the efforts of employee team members with the management hierarchy of the organization (Swink & Jacobs, 2012).

Findings in studies of SMEs and public-sector organizations summarized alternatives to the previously defined parallel-meso structure for Lean Six Sigma. Antony et al. (2005), in research into the influence academics and practitioners had on Lean Six Sigma adoption in small-medium enterprises, hypothesized that small-medium enterprises often adopted Lean Six Sigma in a less organized manner than larger

organizations did. They determined that, due to resource limitations, many enterprises do not employ a central quality management office and 35% do not establish a Champion. McAdam et al. (2014) case study findings agreed with Antony et al. (2005). McAdam et al. (2014) concluded that most small-medium enterprises studied had no parallel quality management structure due to limits in resources. Neither research team addressed success with alternative Lean Six Sigma structures in small-medium enterprises.

Alternatives to Improvement Specialists

Lean Six Sigma is built upon an infrastructure of improvement specialists often referred to by a colored belt system, or a belt hierarchy. The belt color (black, green, yellow, white) distinguishes training and level of responsibility within the hierarchy. These belts are considered a significant factor in the success of Lean Six Sigma over other quality improvement methodologies (Lloréns-Montes & Molina, 2006). The BB is most prominent of the improvement specialists because this position links leadership with the employees of the organization.

Best practice guidance for implementing Lean Six Sigma is that approximately 1% of the workforce should be identified, trained, and working as BBs (George, 2003; Kumar et al., 2008; Pyzdek & Keller, 2014). Senior management identifies and selects their best-talented individuals for assignment and training as BB (Antony, 2014). Alternatively, Kumar et al. (2011) found that several small-medium enterprises use only one or two BBs and employed no MBBs in their program. This practice is contrary to the large manufacturing best practice concept espoused by George (2003) and Pyzdek and Keller (2014).

Several researchers explain that BBs should serve in a full-time capacity and that this is a critical factor for success (Antony & Karaminas, 2016; George, 2003; McLean et al., 2015; Pyzdek & Keller, 2014). Once selected, the BBs would be freed from their regular duties while leading projects on process improvement (Hoerl et al., 2001). Black belts can manage two to three projects with a value of $500,000 to $1,000,000 per year and train and mentor GBs (Pyzdek & Keller, 2014). After two to three years, the full-time BB would be reassigned back to management duties and ready for further advancement in the company (Hoerl et al., 2001).

While it is common practice for large organizations to have BBs staffed at about 1% of the workforce, researched small-medium enterprises employed only a few per organization. McAdam et al. (2014) concluded in their multiple case study that some small-medium enterprises employed BBs in a part-time status or used GBs exclusively. Nonthaleerak and Hendry (2008), as well as Antony et al. (2005), also examined organizations that did not employ full-time improvement specialists in their Lean Six Sigma programs. Both research teams summarized that to make part-time improvement specialist work, they had to manage smaller, less complex projects. Antony et al. (2005) supported this conclusion and identified 55% of surveyed organizations used only part-time GBs for improvement projects. In addition to working smaller improvement projects, part-time improvement specialists were more successful when taking less time to complete their projects then full-time project leaders do (Laux et al., 2015).

Alternatives to the Structured Method

The structured approach is the standard problem-solving process used by improvement specialists in Lean Six Sigma. It provides a uniform guide for identifying a problem and developing a solution. This structured approach is the oft-mentioned DMAIC process, a more detailed version of Deming's PDCA continuous improvement process (Dahlgaard & Dahlgaard-Park, 2006). The DMAIC process provides a guide for the improvement specialist and identifies appropriate tools for its different phases. It is a common element of the Lean Six Sigma methodology, and the BB and GB training focuses on this and the tools used during the phases of the improvement process. Some organizations found the DMAIC process too time-consuming and detailed while others sought alternatives to the deliberate DMAIC methodology (McAdam et al., 2014). One common alternative for DMAIC is Design for Six Sigma (DFSS), which is used for process or product design instead of improvement. The process is similar to DMAIC but has an altered final two steps. The DFSS process is define, measure, analyze, design, and verify (DMADV). The DMADV can be as complicated as the DMAIC and is used to achieve a different result (Dahlgaard & Dahlgaard-Park, 2006).

More Lean-based continuous improvement processes employed in lieu of DMAIC are the Kaizen and the A3 processes. Both are used for less complex problems and do not require the resources and time that a DMAIC project requires (Suárez-Barraza & Miguel-Dávila, 2014; Viagi et al., 2016). Kaizen uses the PDCA process to guide improvement specialists. The A3 method, named for the international paper size used for the project tracking document, also employs the PDCA steps to identify and solve problems (Suárez-

Barraza & Miguel-Dávila, 2014). Each is an example of alternate processes that may be used to accommodate the need for fewer resources and shorter timelines to accomplish continuous improvement without employing the more complex and time consuming DMAIC project structure.

Alternatives to Performance Metrics

There are no identified alternatives to Lean Six Sigma performance metrics. Managers may attempt to conduct quality improvement within their organization without the aid of metrics. Doing so would limit the benefit from knowing where they started, how far they have gone, how much money was saved, and whether any goals were achieved. An alternative would be to not use performance metrics to measure Lean Six Sigma program performance.

Organizational Contextual Factors

Lean Six Sigma is a universal solution for quality improvement in organizations (George, 2003; Pyzdek & Keler, 2014). A contingency perspective allows for customization of Lean Six Sigma based on the relationship between its essential elements and contextual factors of the organization (Zhang et al., 2011). The most common contextual element recognized was organization size. Taylor and Taylor (2014) discerned that quality initiatives were first implemented in large manufacturing businesses. However, they inferred that smaller companies may be better equipped to adopt Lean Six Sigma due to their ability to adapt more quickly. Others argued that larger organizations could implement Lean Six Sigma with less effort because of available resources (Jayaram et al., 2010; Netland, 2015; Sila, 2007). Larger companies also have the structure and

human resource systems to absorb the parallel-meso structure that Lean Six Sigma consultants recommend creating.

Organizational sector, or industry type, is another context that may impact the adoption of Lean Six Sigma. Jayaram et al. (2010) and Netland (2015) deduced from their survey research that the manufacturing sector is believed more suitable for the statistical and waste reduction tools found in Lean Six Sigma. A related subset within the manufacturing sector is the nature of production. The nature of production describes the type of processes used by a company to produce their product such as batch work, process, and customized production (Silvestro, 2001). This categorization of work allows for further distinction in researching the effect of industry type-focused study of manufacturing and quality improvement. Lean Six Sigma's migration to other industries such as service, education, health services, non-profit, and government has found this to be less accurate (Zhang et al., 2012).

The culture of an organization also plays an essential part in the fit between elements of Lean Six Sigma and the organization. McAdam et al. (2016), Netland (2015), and Zhang et al. (2012) concluded that culture is related to change, quality, and work practices. Organizational culture can also influence implementation of Lean Six Sigma in an organization. Organizations with a culture that embraces aspects of quality such as customer focus, continuous improvement, and fact-based decision making, are more likely to adopt improvement methodologies such as Lean Six Sigma.

Another facet of organizational culture, as it relates to quality improvement, refers to the quality maturity or experience with quality improvement within the company.

Several researchers of quality maturity (Jayaram et al., 2010; McAdam et al., 2016; Netland, 2015; Sila, 2007) hypothesized that a mature quality environment, or previous experience with quality improvement, is a factor supporting adoption of current continuous improvement methods. This quality maturity exemplifies an existing quality culture in the business as well as experience with, and willingness to adopt, a new methodology. Several organizational contingencies have been shown to influence the implementation and adoption of Lean Six Sigma. Previously studied contingencies included company size, organizational sector, corporate culture as it relates to quality, and previous experience with quality improvement. In addition to these factors, public organizations have additional contingency factors that may also affect their adoption of Lean Six Sigma.

Public Sector and Lean Six Sigma

CSFs for Public Agencies

Identifying the differences between public and private sector organizations and the barriers those difference may pose to Lean Six Sigma implementation is important for understanding the difficulties public agency leaders face. Research in quality improvement in organizations has identified several CSFs important to implementation and adoption. Fryer et al. (2007) proposed a list of CSFs that was headed by (a) management commitment and support, (b) project linkage to the organization's strategy, (c) customer focus, (d) selection of the right people, and (e) training. Management commitment and support is considered the leading CSF for organizational change by numerous researchers across all sectors of organizations.

Maleyeff's (2014) qualitative research on sustaining Lean Six Sigma in the public sector, formulated four CSFs found in successful Lean Six Sigma programs in public agencies. The first CSF was that agencies deployed a sound, consistent, robust methodology. Second, leaders built trust with their employees by removing fear. Next, agency leaders initiated long-term cultural change focused on continuous improvement and keep up momentum to see the change. Lastly, agency leaders communicated their vision to all stakeholders. Although not clearly stated, the ideal of management commitment and support is echoed in all four of Maleyeff's CSF's. Researchers have concluded that CSFs are good indicators of success for adoption of change initiatives such as Lean Six Sigma. Identifying and understanding CSFs for Lean Six Sigma implementation can assist public agency leaders in their effort to adopt the quality improvement methodology.

Differences Between Public and Private Sector Organizations

Public sector organizations, by their nature, operate with some unique organizational contingencies not shared by other organizations. The most commonly identified difference from private organizations is organizational culture. The various cultural factors that make governmental entities different are a lack of a profit motive, a fragmented authority structure, operations in a political system, and often, resistance to change (Fan et al., 2017). In addition to these factors, governmental organizations experience higher than average leadership turnover, can have poorly defined processes, do not use quality metrics, and lack previous experience with quality improvement. These differences between public and private sector organizations provide unique challenges to

public agency leaders who want to implement a quality improvement methodology such as Lean Six Sigma.

The organizational contingencies that separate public agencies from private organizations can pose barriers to Lean Six Sigma implementation that private company managers do not have to contemplate. Fryer et al. (2007) in their examination of continuous improvement in the public sector concluded that public organization employees are not incentivized by earning a profit or operating with income generated by tax revenues or fees; and the lack of a profit motive can limit the enthusiasm for being more innovative. This source for funding can also restrain the resources necessary to conduct improvement projects. Lack of resources can limit essential training for improvement specialists, another CSF vital for implementation. Further, boards, authorities, and elected officials often govern public agencies. All often cause a fragmented supervisory chain when multiple leadership authorities provide conflicting or ambiguous guidance limiting enthusiasm for change (Antony et al., 2017a). Operating in a political system means that leadership continuity is tenuous, making long-term strategic changes difficult. All these factors are contrary to the previously identified leading CSF of leadership and management commitment and support.

Kumar and Bauer (2010) examined cases where the service processes were difficult to quantify, and customers and customer feedback were ill-defined. They concluded that defining work processes and customer needs can be demanding, thus making it a challenge to identify quality improvement goals and objectives. Yet, public service organizations can benefit from the adoption of a quality improvement philosophy

to provide more efficient and effective services to their constituents. In contrast, Fletcher (2018) investigated continuous improvement in the public sector, finding that implementation can be successful, but often at a slower pace than in the private sector. He determined that if the agency already possessed a quality culture with a focus on their customers, often the citizens, that Lean Six Sigma implementations were successful. He also found that having a full-time quality manager or improvement specialist on staff was a success factor.

Examples of Lean Six Sigma Implementation in Public sector Organizations

Furterer and Elshennawy (2005) said their experience leading a municipal financial department in a Lean Six Sigma project improved the delivery of financial services. They credited leadership support and the willingness of the employees to adapt to the change, echoing Maleyeff's (2014) findings. The authors did not address any results beyond the projects they worked and therefore, had no idea if Lean Six Sigma was sustained by the municipality for further improvements.

In a multiple case study of United Kingdom policing services adoption of Lean Six Sigma, Antony et al. (2017a) reported that elements of the organizational culture were directly related to success and ease of the implementation effort. The cases examined did not have a data-driven culture, causing some project leaders difficulty. Related to this lack of a data-driven culture was the fact that few in the organizations knew much about Lean Six Sigma or the tools associated with the methodology. The authors discovered that these factors made adapting to a Lean Six Sigma supportive culture slow, thus negatively impacting implementation. They recommended that public

sector leaders understand the CSFs important to Lean Six Sigma implementation and ready their organizations prior to beginning the effort. Dahlgaard and Dahlgaard-Park (2006) also identified that a supportive organizational culture was necessary for the successful implementation of CI supporting Antony et al. findings.

In another example of Lean Six Sigma's use in a public agency, the National Aeronautics and Space Administration's (NASA) Johnson Space Center (JSC) adopted Lean Six Sigma to improve mission success and to improve cost quality and scheduling. Meza and Jeong (2013) analyzed several Lean Six Sigma projects with the intention of devising a project performance model. This model would allow management to better judge the effectiveness of Lean Six Sigma projects in JSC. Meza and Jeong examined numerous CSFs and formulated the six they would use to structure their model. They concluded that their project performance model was effective at determining project effectiveness, and management employed it for future project evaluations.

A case study of Lean Six Sigma implementation in higher education institutions (HEIs) by Sunder M. and Mahalingam (2018) analyzed two projects within an HIE. One project used the DMAIC project structure to improve library services. The second also employed the Lean Six Sigma DMAIC process to find cost savings and process improvements in the document scanning services for faculty and students. The researchers reported four factors they believed led to the success of the projects. The first factor was top management support that also included management at all levels of the organization. They also discovered that implementing Lean Six Sigma is a complex phenomenon. The researchers concluded that involving an expert contributed to

successful change. Lastly, they validated a need to involve stakeholders throughout the organization as necessary to successful adoption.

Another case study, Kregel and Coners (2018) investigated the implementation of Lean Six Sigma in a German municipality. Their finding complemented several of the previous studies on Lean Six Sigma implementation in the public sector. Kregel and Coners outlined the factors of: (a) top management support, (b) an organizational culture accepting of change, (c) access to data, and (d) project selection that supported the strategic goals of the organization as essential to implementation in their case agency. Top management support and organizational culture complemented findings by Sunder M. and Mahalingam (2018) and Antony et al. (2017b). Kreger and Coners' work also supported research by Fletcher (2018) that discovered implementation can take longer and be more difficult in public agencies then in private sector organizations.

Previous research in Lean Six Sigma implementation into public sector organizations has illustrated the differences in contingency factors between public and private organizations. Research has also identified CSFs that may indicate success when adopting Lean Six Sigma. Leaders who understand the effects of customizing Lean Six Sigma by finding the fit between unique organizational contextual factors and the elements of Lean Six Sigma can benefit the communities their agencies serve. CSFs, organizational factors, as well as the implementation process, can influence how Lean Six Sigma is adopted in organizations. Relatedly, governmental organizations have some unique contextual factors that can influence how Lean Six Sigma is implemented. These factors make implementing Lean Six Sigma more challenging for government leaders.

Management can benefit by understanding the elements of Lean Six Sigma and the organizational contingency factors that influence implementation decisions.

Implementing Lean Six Sigma

Implementing Lean Six Sigma is an intricate, complex undertaking. Many businesses will hire a consultant to assist and guide in the effort (Pyzdek & Keller, 2014). Yadav et al. (2018) claimed others will emulate the efforts of another organization or follow a specific framework or model. Some practitioners and researchers have developed models for Lean Six Sigma implementation and adoption**.** These models are intended to provide practitioners a guide for implementing Lean Six Sigma.

Frameworks

Examples of practitioner-developed frameworks include Pyzdek and Keller's developed for Six Sigma, and George's framework specific to the implementation of Lean Six Sigma. Pyzdek and Keller emphasized that successful deployments involve focusing on a set of activities, processes, and systems within the company. These include leadership, infrastructure, stakeholder, and process feedback mechanisms, as well as strategic project selection (see Table 2). George (2003) promoted a structured approach that emphasizes action over strategy. His four-phase deployment plan begins with an assessment of the organization's readiness for Lean Six Sigma, then moves to engagement, mobilization, performance, and control (see Table 2). George also discussed common barriers to implementation such as a lack of leadership engagement and limited resources, as well as methods to overcome those barriers. The two frameworks previously compared were developed by practitioners.

The next examples were formulated by researchers; some having been put to the test in organizations. Kumar et al. (2011) constructed a framework for Six Sigma implementation for small-medium enterprises using a mixed-methods study that included a multiple case study with 10 small-medium enterprises. Their research yielded a five-phase, 12-step framework that can also be applied to larger organizations. The Kumar et al. (2011) framework began with an assessment of the company's readiness for Six Sigma and concluded with steps to ensure sustainment (see Table 2). The Kumar et al., framework was the subject of a confirmation study by Timans et al. (2016). The objective of the Timans et al. (2016) work was to strengthen the foundations of the previous Kumar et al. research and to identify and propose revisions to the original framework. Their research supported much in the initial framework and devised some recommended changes to implement. The updated framework has three phases with 13 steps (see Table 2).

The three phases and 13 steps of the Timans et al. research incorporated their proposed changes to the original 12-step framework developed by Kumar et al. (2011). The first change was to reduce the number of phases from four to three. Timans et al. justified this change by incorporating the readiness test found in the original Phase 0 (Prepare) into their Phase A (Recognize and Prepare). Next, they combined steps involving the pilot project with the initial training of improvement specialist, and they joined the development of leadership commitment with the identification of core business processes. Timans et al. added steps to incorporate a communication plan and a commencement ceremony along with the widening of the scope of the improvement

project to suppliers and customers. Lastly, the Timans et al. work rearranged some steps among the phases to arrive at their final framework. Timans et al. strengthened the justification for Kumar's framework and contributed to its validation. The research also created modifications and additions that resulted in the new framework backed by a thorough mixed methods study. Both Kumar et al. and Timans et al. produced research developed, tested, and validated frameworks to guide practitioners with their implementation process.

Jones et al. (2010) formulated an implementation framework for Six Sigma based on Deming's PDCA cycle (see Table 2). Their framework emphasized the importance of executive commitment, the role of the BB, and the DMAIC or DMADV process, as key to project success. Jones et al. (2010) designed their framework around eight constructs for Six Sigma implementation. These constructs were created based on a review of the literature and supported variations in implementing Six Sigma. Implementation variations can, per the authors, be affected by methods and/or psychological or contextual variables. The Jones et al. framework was not operationalized for their study unlike the two previous frameworks for Six Sigma implementation which were operationalized. In contrast to the two previous frameworks, the Jones et al framework used Deming's PDCA cycle as a conceptual base for their eight constructs. The previous two frameworks were designed on the concept of critical success factors.

Table 2

Summary of Six Sigma and Lean Six Sigma Implementation Frameworks

Authors	Practitioner or Researcher	Foundation	Structure
Pyzdek and Keller (2014)	Practitioners	Key is to focus on small number of activities and systems.	**Identify** Leader and Core Team Members **Hire** Consultant **Identify and Train** BBs **Train** Leadership **Select** Projects **Validation** **Identify and Train** Second Wave **Inculcate** Processes & Policies
George (2003)	Practitioners	Focus on Execution	**Readiness** - Identify factors and organizational preparedness for change **Engagement** - Develop Excitement **Mobilization** - Infrastructure and Training **Performance & Control** - Deployment Plans and Processes
Kumar, et al., (2011)	Researchers	Developed for small-medium enterprises 5 Phase 12 Steps	**Phase 0** - Assess Readiness **Phase 1** (Prepare) - Recognize need for change Develop management & leadership commitment, Education & training **Phase 2** (Initialize) - Identify and train 1st wave Identify core business procedures Select pilot project **Phase 3** (Institutionalize) - Communicate initial success Organization-wide training Establish evaluation methods
Jones, et al., (2010)	Researchers	Centered on Deming's Plan, Do, Check, Act (PDCA) Cycle Eight Constructs that Emphasize Leadership Commitment, BBs, and the DMAIC Process	1. Black belt Roles 2. DMAIC vs. DMADV 3. Plan - Address the first steps to start a project 4. Do - Measure the process (Measure Phase) 5. Check - Measure Performance of Improvement (Analyze Phase) 6. Act - Set and Implement Change (Improve & Control) 7. Financial Responsibilities - Measure the reported benefits 8. Executive Support - Measure management commitment

Implementation Analysis

Researchers have examined the implementation and adoption of Lean Six Sigma using theoretical concepts modeled on CSFs, individual and organizational learning, competency-based theory, and the diffusion of innovations. Researchers analyzed Six Sigma implementation employing the concept of CSFs. CSFs are those few areas where satisfactory results can achieve positive results for an organization (Rockart, 1979).

Antony and Banuelas (2002) sought to identify the key ingredients for the implementation of a Six Sigma program. Antony and Banuelas concluded that management commitment is the leading CSF, with culture change, infrastructure (parallel-meso model), and training as the top four CSFs. The second study by Chakraborty and Tan (2012) specifically focused on service organizations and discovered that strong management support is the leading CSF for implementation. Both research teams concluded that management support and commitment is the leading CSF for Lean Six Sigma implementation. Chakraborty and Tan's empirical-based case study confirmed what Antony and Banuelas discovered in their survey-based research a decade earlier.

In addition to the notion of CSFs, other organizational theories were used as a basis to examine the implementation of Lean Six Sigma in organizations. Absorptive capacity is the theoretical concept used by McAdam et al. (2014). The researchers explored the adoption of Six Sigma and Lean Six Sigma as the acquisition of new knowledge in organizations. They formed four research questions based on the four dimensions of absorptive capacity: acquisition (recognize the value and acquire new knowledge), assimilation (understand and learn from acquiring new knowledge),

transformation (develop and refine the routines between new and existing knowledge), and exploitation (apply new knowledge to achieve organizational objectives). The authors, using absorptive capacity as a theoretical framework, proposed that the application of Lean Six Sigma in small-medium enterprises is influenced by a series of recursive or iterative routines. These routines formed the key constructs of knowledge sources, acquisition, assimilation, and transformation in the use of Lean Six Sigma knowledge in small-medium enterprises.

In a subsequent study, Hilton and Sohal (2012) designed a model based on certain CSFs and competency-based theory for Lean Six Sigma deployment. Hilton and Sohal theorized that successful implementation is based on the relationship among the competence of the organization, the deployment facilitator, and the project leaders (BBs). They explained that organizational competence is related to various CSFs such as top management support, customer and supplier relationship, workforce management, and quality information. Organizational competence is also shaped by three Lean Six Sigma specific practices of role structure, structured improvement procedure, and metrics focus (Hilton & Sohal, 2012). Project leader competence included technical expertise in Six Sigma tools and processes, as well as soft skills such as effective communication, team building, and coaching. The program facilitator needs to have these skills for project leaders and sufficient leadership skills and experience to manage the deployment (Hilton & Sohal, 2012).

Both studies analyzed Lean Six Sigma implementation according to the elements of their theoretical frameworks. McAdam et al. based their research on the theoretical

concepts of absorptive capacity and Hilton and Sohal employed competency-based theory. McAdam et al. theorized on how new knowledge was acquired and integrated into the organization to facilitate the adoption of Lean Six Sigma. They devised their findings using an empirical-based multiple case study. Hilton and Sohal conducted a conceptual study that focused on the relationship among key actors and their competence levels to evaluate the adoption of Lean Six Sigma.

In further analysis of Lean Six Sigma implementation, Amar and Davis (2008) reviewed four frameworks for implementing Six Sigma or Lean Six Sigma employing two perspectives based on CSFs and Rogers' (2003) diffusion of innovation theory. Their study sought to identify those CSFs considered essential to the deployment and implementation of a program while integrating Rogers' diffusion of innovation theory to address the adoption of new ideas by individuals and organizations. Analysis of the individual, local, industry, and national culture into which the innovation is being introduced as a significant aspect of the theory. Rogers' leading conclusion was that innovations should be appropriately altered when they are transferred from one cultural setting to another (Amar & Davis, 2008).

Amar and Davis' review of the four frameworks revealed that none took into consideration the factors of culture found in Rogers' diffusion of innovations theory. They also determined that identifying CSFs did not constitute a functionally effective framework for implementation. Amar and Davis concluded that a suitable study of the innovation and the setting into which it will be adopted is necessary to determine how to customize it for the intended situation. Amar and Davis' incorporation of Rogers' theory

on the diffusion of innovations provides an explanation of how culture can be explained as a contingency to consider for customizing Lean Six Sigma for adoption.

Incorporating theory into their research of Lean Six Sigma, Lameijer et al. (2017) appraised Lean Six Sigma deployment models using Organizational Development (OD) theory. OD is the evolution of an organization in its form, quality, or state. The authors theorized that deployment and maturity models for Lean Six Sigma should integrate effective mechanisms of OD such as the teleological (learning) model or the theory of trade-offs (dualities). They explained that implementation processes differ, and that models often do not allow for adjustments to modify for contingencies. Lastly, deployment models do not consider the distinctive and unpredictable nature of implementation processes. Lameijer and his associates concluded that, while conducting a deployment within an organization, practitioners need to rely on their anticipation and inventiveness with an unpredictable, difficult deployment process.

Several examples of implementation frameworks exist, some practitioner-developed on the job, others academician-developed via research. There are also examples of research that analyzed the frameworks for the implementation of quality improvement programs. Analysis of CSFs is prevalent in the research, while other researchers employ various theoretical concepts, such as new knowledge acquisition, to explain implementation results. Lameijer et al. used organizational theory to examine implementation, while Amar and Davis (2008) applied the diffusion of innovations theory for their analysis. Each contributed to the body of knowledge in their field. Many (Dubey et al., 2015; Hilton & Sohal, 2012; Lande et al., 2016; Näslund, 2013) confirmed

that leadership support and involvement are critical to success, and many addressed the complex and dynamic nature of Lean Six Sigma adoption. The evaluated research demonstrated that companies pursuing quality management practices without a clear understanding for the need of customization will likely not meet their performance improvement expectations. Adapting Lean Six Sigma to fit specific organizational contingencies may make the best use of quality improvement tools and place the organization in an advantageous competitive position.

The previous section examined the implementation and adoption of Lean Six Sigma by organizations. Five frameworks were compared that provided a range of processes, steps, and phases that varied in complexity. These frameworks were designed to guide leaders through the process of implementing Lean Six Sigma into their organizations. There was also a discussion of the theory-based analysis of frameworks. That research examined implementation frameworks against various theories such as absorptive capacity, individual and organizational competency, diffusion of innovations, and CSFs.

Gap in the Literature

The purpose of this qualitative exploratory multiple-case study was to understand how leaders customize Lean Six Sigma for organizational factors found in public agencies in the United States. Most qualitative scholarly articles in this literature review consisted of data that focus on the description of the elements of Lean Six Sigma, how they are typically enacted in organizations, and the factors that may lead to their

modification. Very little data exist on how the elements of Lean Six Sigma may be customized in public agencies due their organizational contingencies.

A review of associated literature in this current study revealed a gap in the literature that leads to the use of an organizational contingency theory framework where organizational effectiveness is the result of the fit between the characteristics of the organization and the contingencies in which they are situated. This framework has been researched and tested by scholars and practitioners in the study of quality management adoption in small-medium enterprises throughout the world. For example, quality management adoption and strategic alignment within United Kingdom SMEs was found to vary based on the environments in which each existed. Dora et al. (2016) compared food industry contingency factors such as quality assurance requirements, shelf-life, and volatile supply and demand with individual company factors such as plant size and processing layouts that influenced how Lean was implemented in each. Those contingency factors influenced how Lean was adopted in each food processor.

Summary and Conclusion

The purpose of this qualitative exploratory multiple case study was to better understand how leaders customize Lean Six Sigma for organizational factors found in public agencies in the United States. In this chapter, I reviewed the elements that compose Lean Six Sigma and how they may be modified for implementation in organizations, having reiterated the problems that organizations experience based on their specific contingencies. The absence of literature regarding the customization of Lean Six Sigma for public agencies is outlined along with a summary of current research on factors

that influence Lean Six Sigma adoption in various organizations. I summarized how the definition of Six Sigma defines four key elements of the improvement strategy. I examined relevant research that demonstrates employing a contingency theory framework can explain why managers customize Lean Six Sigma for their organizations. These studies provided evidence that a contingency approach may explain why leaders customize elements of Lean Six Sigma for implementation in public agencies due to their unique contingency factors. My review of the literature identified a gap in the research regarding the modification of Lean Six Sigma to meet organizational contingency factors. Research in Lean Six Sigma implementation and adoption and how public agencies may customize the improvement methodology is sparse.

This qualitative exploratory multiple-case study was used to explore how public agencies customize Lean Six Sigma. Developing a better understanding of how agencies customize elements of Lean Six Sigma for successful adoption may provide leaders knowledge to improve their organizations. Chapter 3 includes a description of the design and methodology.

Chapter 3: Research Method

The purpose of this qualitative exploratory multiple case study was to understand how leaders customize Lean Six Sigma for organizational factors found in public agencies in the United States. Lean Six Sigma is a quality process improvement philosophy to improve efficiency, reduce waste, and lower costs of processes in organizations. Managers may customize some or all these four elements of Lean Six Sigma to fit their environment: parallel-meso structure, improvement specialists, structured method, and performance metrics.

I included in this chapter a description of research and explanation of methods used to collect and analyze data. I provided my reasoning for the specific design choice along with a description of the methodology. That methodology includes the selection of participants, design of the data collection instrument, procedures used to collect data, and my data analysis plan. I also expressed my plan to address issues of trustworthiness, as well as internal and external validity and dependability in this chapter.

Research Design and Rationale

The research question influences the focus and design of the research plan (Maxwell, 2013). The research question links the goals and conceptual framework of the study. The nature of the research question leads to the choice of design and data to be collected (Yin, 2018). The central research question I used to guide this study was: How do leaders customize Lean Six Sigma for organizational factors found in public agencies in the United States?

The rationale for this study is the conflict between implementing the universalist, or best practice, model of Lean Six Sigma based on the definition by Schroder et al. (2008) or the contingency theory-based idea of customizing Lean Six Sigma to best align with an organization's contingencies. Some managers use elements of Lean Six Sigma to model their program for process improvement. Other organizational leaders modify those elements to fit their circumstances to develop a program that meets their goals for improvement.

I chose the qualitative research method. This method enabled me to study the issue in depth, yielding a greater understanding of how public organizations customize Lean Six Sigma. There are four identified characteristics of qualitative research that I incorporated into my study. First, I focused on process, understanding, and meaning while trying to make sense of the situation in its natural setting. Second, as the researcher, I am the primary instrument for data collection and analysis. Next, the qualitative research process is inductive, so I gathered data to develop concepts, hypotheses, and theories. Lastly, qualitative research is characterized by detailed descriptions using words instead of numbers to describe what was learned.

Researchers use quantitative research methods to determine causes, measure facts and characteristics, and predict similar events in the future (Merriam & Tisdell, 2016). I did not choose a quantitative method because I wanted to explore how managers of public organizations modify Lean Six Sigma in depth. The quantitative tradition does not allow for the depth of understanding that I seek within this current research. Researchers using quantitative designs observe and analyze effects of variables and relationships

using statistics to understand the issue under study. Quantitative researchers can study a more substantial population within a limited range of inquiry, and results are more generalizable than those of a qualitative study (Maxwell, 2013). A qualitative method permits me to explore organizations to gain a greater understanding of how and why leaders decide to make modifications. Exploring a few organizations in great detail, I should be able to develop detailed descriptions that yield an understanding of Lean Six Sigma customization.

Concerning study design, I facilitated a detailed and in-depth exploration of the case in question by applying a qualitative multiple case study design. The case study is designed to provide an in-depth description and analysis of a contemporary phenomenon in its real-world setting. Case studies are designed for answering how and why questions in order to understand cases sufficiently (Yin, 2018). Multiple case studies involve several distinct cases, providing researchers the opportunity to strengthen the precision, validity, and stability of findings (Miles et al., 2014).

Other qualitative research designs were not useful to focus on different facets of the problem. An ethnographic study focuses on the culture of a group, and phenomenological research concerns the lived experiences of people (Patton, 2002). Grounded theory research involves building theories grounded in data (Goulding, 2005). The focus of this study is a process in a defined setting, and a qualitative case study design is the most logical choice for a research method.

Role of the Researcher

Stake (2006) said the human researcher is the chief mechanism in qualitative research. This human factor is the strength and fundamental weakness of qualitative inquiry and analysis (Patton, 2002). A strength of using qualitative research is responsive adaptive data collection, as well as immediate interpretation and analysis of data. Quality of results depends on skills, training, insights, and capabilities of the researcher. I have a professional relationship with the general subject of the study-as a certified Lean Six Sigma BB. I earned this accreditation through a government organization. This knowledge and training provide me with insights into problems and intricacies of Lean Six Sigma.

The weakness of qualitative research is that the researcher can also bring their shortcomings and biases to the process. Alleviating bias was completed through theoretical orientation and a robust protocol that includes member-checking and data triangulation. My individual bias was identified through self-examination. My experience with Lean Six Sigma does not extend to program management or leadership, and I had no professional relationship with any participants, thus avoiding any conflicts of interest. I addressed any preconceived ideas and biases.

Methodology

During the design of the multiple case study, I considered participant selection, instrumentation, data collection methods, and analysis. Each is a crucial element of the study's design. A clear description of these elements enables readers and other

researchers to replicate this research. A well-designed qualitative multiple case study can help protect against challenges to trustworthiness.

Participant Selection Logic

The population for this multiple case study was participants from federal, state, or municipal agencies that currently use Lean, Six Sigma, or Lean Six Sigma as a standalone program or part of an overall continuous improvement program. Location and organization size was not a consideration for selection. All agencies were located within the United States. Public agency size was not a factor considered in previous research and not a consideration in this study.

The sampling strategy for case selection was a purposeful strategy involving literal replication. The goal of literal replication is to identify and study cases that predict similar results for a more in-depth study of the phenomenon (Yin, 2018). Chosen cases possessed similar attributes based on selection criteria. This purposeful sampling strategy allowed me to explore cases that provided the most information regarding the phenomenon.

For inclusion in this study, I sought federal, state, or local government agencies with an active Lean, Six Sigma, or Lean Six Sigma program employed as a standalone program or as part of an overall CI program. The agency also needed to have a program manager and trained improvement specialists (GB, BB, MBB). Additionally, the agency should have either currently active projects or a history of completed Lean Six Sigma projects.

I applied a two-tier sampling logic for this multiple case study that used criteria for the selection of cases as well as additional criteria to identify documents, people, and activities within cases to examine. I reviewed Lean Six Sigma program documents requested from participants and agency managers that described implementation, adoption, and ongoing operations of improvement programs. I conducted telephone interviews with leaders, managers, and improvement specialists involved with the implementation and current operations of programs. Interviews were recorded using a digital recorder.

To recruit participants for the study, I posted a request for participation on LinkedIn and Walden University's participant pool. I contacted respondents via email and telephone to discuss the status of their program to determine the suitability of the agency for participation. If the organization met selection criteria, I emailed an invitation to participate in the study. I also identified additional cases through network or snowball sampling. Network sampling involves the identification of other cases through referrals from previously selected participants (Merriam & Tisdell, 2016). If referred participants met the selection criteria, they were added to the case study.

Several authors recommended a sample size large enough to ensure information redundancy or saturation. The level of information redundancy depends on amount of certainty required based on complexity of the theoretical interests involved in the research. Patton (2002) said data saturation involves the minimum amount of data collected that reasonably addresses the phenomenon based on the purpose and research.

The following questions help define saturation:

- What do I want to know, and why?
- What is useful?
- What will have credibility?
- What are the available time and resources?

For a multiple case study, two cases are the minimum, and the maximum is based on information replication and time and resources available to the researcher (Yin, 2018). For this study, I expected to examine between two and 10 cases to meet requirements for data saturation. At least two cases are necessary for the multiple case study, and 10 should provide enough data to reasonably address the phenomenon. I also estimated that more than 10 cases would exceed time and resources to collect and analyze data effectively.

Instrumentation

The primary source of data was a researcher-developed semistructured interview guide (see Appendix A). In addition to conducting interviews, I collected data from organizational Lean Six Sigma program documents and researcher field notes. Organizational documents included policies, procedures, and descriptions of the Lean Six Sigma program. My field notes included notes from interviews and reviews of organizational Lean Six Sigma program documents. Multiple sources of information allowed for inter- and cross-case analysis and triangulation for analysis and credibility.

The conceptual framework for this study was the contingency theory of organizations and the four elements of the definition of Six Sigma. The four elements of

Lean Six Sigma are: (a) parallel-meso structure, (b) improvement specialists, (c) structured method, and (d) organizational leaders focus on metrics (Schroder et al., 2008). The organizational contingency theory and previous research concerning the adoption of Lean Six Sigma shape the semistructured interview questions. These two concepts were the foundation for the development of my semistructured interview questions.

Additionally, previous research instruments provided information, background, and ideas for the development of my data collection instrument. A semistructured interview protocol developed by Nonthaleerak and Hendry (2008) that was later modified and adopted by Chakraborty and Tan (2012) provided examples of questions and a data collection process that I incorporated into my case study protocol. Another case study by Krueger et al. (2014) provided a detailed list of semistructured interview questions, some of which I was able to adopt. Additionally, two studies by Dora et al. (2016) and Lameijer et al. (2016) provided practical examples of case study data collection and analysis steps and process that I also incorporated into my case study protocol.

I addressed content validity through member checking and bracketing. Yin (2018) defined member-checking as having interviewees review interview transcripts and draft reports to confirm accuracy. Bracketing involves the researcher being aware of their preconceived knowledge and biases regarding the subject and setting those aside during the research process (Eddles-Hirsch, 2015). I examined my views about the study and worked to keep them set aside during data collection and analysis.

My thoughts on Lean Six Sigma were shaped from training and Lean Six Sigma project experience while working to earn my BB certification. The George Group

conducted the training I received. The George Group was a consulting firm founded by Michael George, who is credited with the development of Lean Six Sigma. The training involved best-case examples of large manufacturing companies with programs structured using the four elements of Lean Six Sigma. The organization I worked for, and other agencies modified those elements to fit environments in which they operated. I wanted to know why they modified elements from best practice examples and how they could be successful in doing so. I tried keep an open mind regarding what I observed and bracketed preconceived views on Lean Six Sigma to develop a valid study.

Semistructured interview questions are open-ended to elicit responses with depth that I analyzed using the central research question. Yin (2018) said case study interviews should resemble a guided conversation. The goal is to conduct a fluid rather than structured interview to garner in-depth answers. Questions guided discussion regarding Lean Six Sigma organization and contingency factors that may contribute to customization of these elements. Additionally, documents related to implementation and adoption of Lean Six Sigma as well as researcher field notes contributed to the data pool for analysis.

Procedure for Recruitment, Participation, and Data Collection

The information collected for this research answered this overall research question: How do leaders customize Lean Six Sigma for organizational factors found in public agencies in the United States? Merriam and Tisdell (2016) said one of the characteristics of qualitative research is that the researcher is the primary instrument for data collection and analysis. I collected data that should answer the research question

from semistructured interviews, organizational documents, and the researcher's field notes. I also analyzed the collected data to determine any themes related to answering the research question.

My case study protocol outlined the plan for data collection (see Appendix B). The concept of the case study protocol contains details for data collection and is especially crucial for validity if conducting a multiple case study. The protocol contains an overview of the case study to include the research question and purpose of the study. The protocol also includes a description of the data collection procedures, including the advised consent notice. The semistructured interview questions and an outline of the case report are added to close-out the protocol.

The design for the data collection plan was based on Yin's four principles of data collection. The principles are (a) use multiple sources of evidence, (b) create a case study database, (c) maintain a chain of evidence, and (d) exercise care when using data from social media. Using these four principles will strengthen the validity of data collection and analysis of the case study. Developing a sound case study protocol and adhering to the four principles provided by Yin supported the trustworthiness of the results.

I incorporated Yin's four principles in my case study design to promote a sound data collection process. The use of multiple sources of evidence provided an opportunity to explore the case in more depth and allows for triangulation. Triangulation from multiple sources of evidence strengthens the construct validity of the case study. For this case study, I triangulated data from the semistructured interviews, documents describing the organization's Lean Six Sigma program, and my field notes.

The development and use of a case study database to organize and store data for analysis enabled me to review and retrieve data effectively. The case study database consists of files of recorded interviews, transcripts of those interviews, organizational documents, and field notes stored in a password-protected Dropbox folder, as well as a backup stored on a password-protected external flash drive. The other component of the case study database was the MAXQDA 2020 program. This Computer-Assisted Qualitative Data Analysis Software (CAQDAS) provided me the tools to sort, organize, and analyze evidence. Incorporating a logical system of organization within the database aided in the retrieval of the evidence and may enable another researcher to replicate my analysis.

The principle of establishing a chain of evidence supported my research by linking the case study findings with the data collected. This chain of evidence will permit anyone to follow the path from the research question, data collection and analysis, to my findings. My chain of evidence, supported by an organized database, assisted in establishing trustworthiness for the case study. Lastly, researchers are advised to use caution when using social media as a source of data, and I did not collect or use any evidence from social media sources (Yin, 2018).

Information was collected once Institutional Review Board (IRB) approval was received (10-07-20-0185593) and continued until a sufficient amount of data were collected to provide confirmatory evidence that addressed the research question (Yin, 2018). Cases selected for study were federal and state government agencies that use Lean, Six Sigma, or Lean Six Sigma for quality process improvement. Participants

interviewed were Lean Six Sigma program managers, improvement specialists, and leaders/managers involved with the implementation of Lean Six Sigma in their organization. I emailed a recruiting request (Appendix C) and called prospective participants to determine suitability for the study. Once selected, participants were sent an individual informed consent form to participate in the research.

To conduct a multiple case study, I needed to examine at least two case organizations that meet the criteria for selection. If I had been unable to secure the necessary number of qualified participants, I would have had to modify my research plan. If was able to secure the cooperation of seven participants that met my criteria.

Semistructured telephone interviews were scheduled to allow for not more than 45 minutes with the participant. I scheduled interviews at the convenience of the participant. Before the interview, I emailed the participant the semistructured interview questions (Appendix A) along with the informed consent form for review. Emailing the interview questions in advance enabled the participant an opportunity to be better prepared to provide the in-depth answers required for analysis.

I conducted interviews telephonically. Due to the nature of the research topic, interpretation of visual responses of the participant was not necessary. Also, to aid in the convenience of conducting the interview, I avoided the use of virtual meeting tools. The recording of the telephone interview was done using the TapeACall application and backed up with a digital voice recorder. Recordings were transcribed using Rev.com. Once the interview transcript was completed, I incorporated member checking by allowing the participant three days to review and make any corrections before any

analysis began. There were no follow-up interviews required with any participant. Once data collection was completed, all participants were notified and thanked for their participation. The participants were also be given the option to receive a draft of the report to review for accuracy, but none requested the report for review.

Data Analysis Plan

Analysis of qualitative data is primarily a process of making sense of the data collected in its various forms. (Merriam & Tisdell, 2016). The process of making meaning of the data should be organized and systematic, beginning with case study design through the data collection process and data analysis plan. The data collected were from interviews, related organizational documents, and my field notes. Using multiple sources of data in analysis supports triangulation which adds to the credibility of the research. The use of a CAQDAS supported the analysis of this data. I used MAXQDA 2020 developed by VERBI GmbH, as the CAQDAS to assist with data analysis.

The primary source of data for qualitative analysis is word-based. Analyzing word-based data can be accomplished by the process of coding (Miles et al., 2014). Coding is a process where the researcher breaks down the data into smaller segments or *data chunks*, and then assigns a word or short phrase that provides a salient, or essence-capturing, meaning to this data chunk (Saldana, 2016). MAXQDA 2020 provided the tools to support the analysis process by storing, organizing, sorting the data, visualizing the coding process, and providing various means to report and display the analyzed data (Houghton et al., 2015).

Saldana (2016) explained that coding is a two-cycle process. The first cycle of coding reviews and initially assigns codes to portions of data. The second cycle of coding works with the results of first cycle coding to begin the process of categorization, and thematic or conceptual organization (Saldana, 2016). The method of analysis that was used for the first-cycle coding of this multiple case study was inductive. Codes emerged from an analysis of the data and not from a predetermined list of codes as in a deductive method. The data were related to the theme of the study because my research question was the foundation for the semistructured interview questions, which, in turn, were developed from the conceptual framework of the study. The use of a priori codes may also have limited the exploration of any rival explanations that may have arisen during analysis.

First cycle coding used initial, process, and in vivo coding methods. Second cycle coding was completed using the pattern coding method. These coding methods are inductive and permitted me to identify and capture broad ideas and actions in the participant's voice. Coding was done within each case before any cross-case analysis began. The analysis process was iterative and continued until I was satisfied that codes, categories, and themes identified and developed met the needs of the study's purpose. Discrepant cases were not encountered but would have been analyzed in the same manner as other cases. Explanations for the discrepant data would have been developed and addressed during the synthesis of the results.

Issues of Trustworthiness

The issues of credibility (internal validity), transferability (external validity), dependability (reliability), and confirmability (objectivity) are especially crucial in qualitative inquiry. Due to the reliance on the researcher as the instrument for data collection and analysis, these factors must be addressed in the case study process and protocol to ensure trustworthiness and ethics. The credibility of qualitative research depends on rigorous methods, the credibility of the researcher, and a philosophical belief in the qualitative method (Patton, 2002). I have described the case study protocol for collecting and analyzing data, and in this section, I will discuss how I will address issues of trustworthiness with the study.

Credibility

Credibility, known as internal validity in qualitative research, addresses how research findings reflect reality (Merriam & Tisdell, 2016). Internal validity can be addressed first by ensuring rich descriptive data from multiple sources are collected for each case. A reflection of reality is achieved in a multi-case study by developing a rich description of each case. I incorporated member checking of interview transcripts by allowing the participant three days to review the transcript before conducting analysis. Triangulation of the data from multiple sources and analysis that involves building explanations, addressing rival explanations, pattern matching, or the use of logic models, builds internal validity. I attempted to ensure credibility by developing a rich description of each case, triangulating data from multiple sources, and conducting member checking of the data collected.

Transferability

Transferability, or external validity, addresses how the findings from this multiple case study can be applied to other situations (Merriam & Tisdell, 2016). The nature of qualitative research makes it challenging to establish transferability and generalization because each case presents data from a unique situation. Some steps can be taken to address the external validity of the case study. The first action to address external validity in a multiple case study is to establish a replication logic for the selection of cases (Yin, 2018). Replication logic is the scheme, with some theoretical basis, used to select the cases for study (Yin, 2018). In this multiple case study, I employed a literal replication logic to identify cases that are predicted to produce similar results. I based the literal replication logic on the four criteria used to select eligible organizations for this multiple case study. Additionally, using cross-case analysis and exploring rival explanations are tactics that were also employed to address external validity.

Dependability

Dependability, or reliability of the research study, was enforced with the development and use of a case study plan that includes the case study database, protocol, and an established chain of evidence (Figure 1), as advised by Yin (2018). I established a case study database to organize and store data. My case study protocol (Appendix B) formulated and ensured a logical and organized plan for data collection across multiple cases. I maintained a chain of evidence, as depicted in Figure 1, to demonstrate a link between the multiple case study purpose, research question, data collection, data analysis, and report of findings.

Figure 1

Case Study Chain of Evidence

The chain of evidence will enable others to see the link to the elements of the research and findings, providing the audit trail for the case study.

Confirmability

Confirmability, or objectivity, was addressed by first understanding the position of the researcher in the study. I am a certified Lean Six Sigma BB who earned my certification and has experience conducting projects in a government agency. Individual bias cannot be removed entirely to create a perfectly neutral observer. I must understand where I stand concerning the purpose of the research and report this to the audience. Employing the concept of bracketing, I attempted to temporarily set aside any beliefs or preconceived ideas during the study. In addition, I mitigated reactivity by using the case study protocol and employing quality interview practices. Another method to ensure confirmability was to conduct respondent validation, or member checking. Participants reviewed their interview transcripts prior to my analysis to ensure their interview statements were valid.

Ethical Procedures

I strove to conduct a thorough, valid, reliable, and ethical research project. In addition to dealing with matters of trustworthiness, I needed to remain aware of ethical procedures and practices to ensure the safety and privacy of participants. The first step in that process was to apply for and receive IRB approval before collecting any data. The

IRB approval number for this study is 10-07-20-0185593**.** Individual consent, both in writing and orally, was received before conducting the interviews. Also, participants understood their ability to opt-out of an interview if they felt it was necessary. Lastly, interview transcripts will be made available to participants for a limited time for validation or correction. I did not encounter any additional ethical issues. I did not collect data from my place of work, nor did I have any conflicts of interest, power differentials, or other relationships with any participants.

Organizations and participants were not identified, and a pseudonym convention was employed to ensure anonymity in the report. Any data considered confidential by an organization or participant will remain protected and, if addressed in the report, was done so in a manner that did not break confidentiality. Data collected are stored in a password-protected Dropbox cloud storage location, a password-protected external drive, and in the case study project folder in MAXQDA 2020 on a password-protected laptop. The data will be retained for five years after the report is published.

Summary

The purpose of this qualitative exploratory multiple case study was to understand how leaders customize Lean Six Sigma for organizational factors found in public agencies in the United States. In this chapter, I outlined the methodology I designed for this multiple case study research. My description of the methodology included a review of the research design, the role of the researcher, and an extensive discussion of the methodology. I also noted the logic for selecting the cases, a description of the data collection instrument and processes, as well as provide a description of the data analysis

plan. Lastly, I addressed issues of trustworthiness and ethical considerations in the design and conduct of my research plan. In Chapter 4 I discussed the specifics of the research setting, data collection and analysis, results, and how trustworthiness was addressed.

Chapter 4: Results

The purpose of this qualitative exploratory multiple case study was to understand how leaders customize Lean Six Sigma for organizational factors found in public agencies in the United States. Using a qualitative multiple case study design, data were collected and analyzed from seven semi-structured interviews built on 15 interview questions based on this research question: How do leaders customize Lean Six Sigma for organizational factors found in public agencies in the United States? In addition to interview data, documents from participants describing the Lean Six Sigma program in their organizations were analyzed and contributed to results. Chapter 4 contains information about the research setting, demographics of participants, data collection and analysis, evidence of trustworthiness, study results, and a conclusion.

Research Setting

This qualitative exploratory multiple case study included seven participants from six government organizations that employ Lean Six Sigma for process improvement. Participants were recruited from a variety of sources. Walden University's participant pool was a source for two participants and my posts on the LinkedIn professional social media platform yielded two more. The three remaining participants were identified through snowball sampling. A total of 19 individuals were contacted to participate in this research, but only seven met the participant criteria or chose to contribute to the research.

The primary source of data collection was semi-structured interviews. Interviews were conducted via telephone and recorded for transcription. Once participants consented to interviews, I scheduled telephone calls to meet their schedules. One participant's

interview was conducted in the evening after work hours, and the remaining took place during the workday.

The COVID-19 pandemic negatively affected collection of data for this research. All participants mentioned the impact of the pandemic on their operations. All mentioned that training had been suspended and some improvement projects were discontinued because of limits to in-person activities. Some potential participants chose not to take part because their organization had suspended Lean Six Sigma operations. One potential participant had been furloughed.

Demographics

The population for this qualitative exploratory multiple case study was employed at federal and state agencies that employ Lean Six Sigma as part of their agencies' continuous improvement programs. Two participants, each with a different role, were from the same organization. The five other participants represented five separate organizations. A purposeful sampling strategy was used to address federal, state, and local agencies that used Lean, Six Sigma, or Lean Six Sigma as a standalone quality process improvement program or part of an overall continuous improvement program. The Lean, Six Sigma, or Lean Six Sigma programs were currently active. All agencies had a Lean Six Sigma program with a manager and trained improvement specialists (GB, BB, or MBB) as well as a history of completed improvement or current active projects. General demographics such as age and gender were not considered in this research and not collected from participants (see Table 3).

Table 3

Participant Demographics

Participant	Organization	Position	LSS Certification
1A	State Military Department	Program Director	None
2A	State Military Department	Deployment Director	BB
3B	Federal Health Provider	Improvement Specialist	YB
4C	State Higher Ed Agency	Vice Chancellor	GB
5D	State Military Department	Deployment Director	BB
6E	DOD Agency	Coach/Mentor	MBB
7F	DOD Repair Facility	Project Manager	GB

Data Collection

My data collection plan was centered on Yin's four principles of data collection. The principles are: (a) use multiple sources of evidence, (b) create a case study database, (c) maintain a chain of evidence, and (d) exercise care when using data from social media. These four principles are the basis for the case study protocol (see Appendix B) developed to guide data collection for this study. The case study protocol defined by Yin is designed to keep the researcher focused on the topic. Developing the protocol also serves to prepare the researcher to anticipate problems that may arise during data collection.

I sought a purposeful sample of participants through three sources. First, I posted a study invitation on a professional social network platform. I also had my research listed in Walden University's participant pool. My last source for participants was snowball sampling. Three sources produced 19 responses, of which seven (37%) were qualified and agreed to participate in research. The seven participants represented six federal or state governmental organizations in the United States.

I sent an electronic mail introduction to each potential participant describing my research, which included selection criteria (see Appendix C). If the individual and their organization met the study criteria, I sent them an invitation to participate, along with semistructured interview questions and the consent form. I used my Walden University email address. If individuals met the study criteria and consented to be interviewed, I scheduled telephone interviews that best met their time requirements. In all cases, I called participants at their preferred telephone number during scheduled interview times and conducted interviews.

All interviews were conducted by telephone and recorded using the TapeACall telephone application. The average duration of interviews was 35 minutes and 53 seconds, with the longest lasting 45 minutes and 19 seconds and the shortest lasting 19 minutes and 39 seconds. Telephone interviews began with my reading from the opening script in the interview guide (see Appendix A). Once participants consented verbally to interviews, I begin recording. Once interview questions had been addressed, I closed the interview with the concluding script from the interview guide. The interview consisted of 15 questions developed to address the research question for my study.

Once each interview ended, I retrieved the recorded audio file of the interview from the TapeACall application and transferred it to my Dropbox cloud-based case study folder. I then uploaded the interview audio file to Rev.com for transcription. Transcripts of interviews were returned within 36 hours from Rev.com. I reviewed transcripts for accuracy and then emailed them to participants for member checking. Each participant was informed that they would receive a copy of the transcript for review and could

provide comments, revisions, or withdraw from the study within 3 days. All seven participants confirmed receipt of their transcripts, and two responded with minor revisions. After the 3-day member check period, transcripts and audio files were uploaded to MAXQDA 2020 for organization, coding, and analysis.

After experiencing difficulties getting IRB approval to partner with a Department of Defense organization, I had to adjust how I sought participants for my research. As previously described, I sought participants using LinkedIn, the Walden University Participant Pool, and snowball sampling. I did not employ virtual meeting tools for interviews. The seven interviews were completed by telephone. A last modification from my case study plan was a change in CAQDAS software from NVivo 12 to MAXQDA 2020. The change was necessary due to an operating system upgrade to my computer that rendered NVivo 12 incompatible with my operating software. MAXQDA 2020 provided the same organization and data analysis capabilities as NVivo 12.

Data Analysis

Data were analyzed to discern how leaders customize Lean Six Sigma for organizational factors found in public organizations in the United States. Data were collected from seven participants representing six public sector organizations via semi-structured interviews, organizational documents, and researcher field notes. Once interviews were transcribed and reviewed by participants, transcripts and documents were loaded into MAXQDA 2020 for organization and analysis. Additionally, I developed and maintained analytic memoranda throughout the data collection and analysis process.

These memoranda along with documents collected from participants also contributed to triangulation of data during the analysis process.

Data analysis began once data were transferred to MAXQDA 2020. I read through each transcript and document without coding to become more familiar with data contained in each. As I collected multiple documents, I went back and reviewed previously coded documents where patterns and similarities began to emerge. My analysis employed the two-cycle coding process. First cycle coding involved using an inductive in vivo coding method. In vivo coding involves using a word or short phrase directly from participant transcripts to identify codes (Saldana, 2016). Coding within the first cycle was conducted within case before analyzing codes across cases. Once first cycle coding was complete, I moved to the second cycle coding process.

Second-cycle coding involves pattern coding to organize codes into categories based on previous research and semistructured interview questions. The interview guide for the semistructured interviews consisted of 15 questions (see Table 4).

Table 4

Semistructured Interview Questions and Code Categories

Interview Questions	Category
Questions 1-2	Participant Lean Six Sigma Demographics
Questions 3-4	Adoption of Lean Six Sigma
Questions 5a-5e, 6, 8	Organization of Lean Six Sigma
Questions 7, 9-11	Customization Factors

Using pattern coding, I grouped codes from first cycle analysis into categories. Continued analysis of codes allowed for emergence of themes within each category.

Further review and synthesis of themes based on similarities and patterns allowed for formulation of four emergent themes in Table 5.

Table 5

Categories and Emergent Themes

Category	Theme
Adoption of Lean Six Sigma	1. Leaders encouraged adoption of Lean Six Sigma to improve efficiency
Organization of Lean Six Sigma	2. A parallel-meso structure and associated elements were not fully implemented
Customization Factors	3. Lean Six Sigma process improvement process is perceived as too complex and time consuming
	4. Leaders did not sustain support for the program

I interviewed seven participants representing six organizations to collect necessary data from interview transcripts, organizational documents, and field notes to address the central research question. Using MAXQDA 2020, I organized and analyzed data in a two-cycle process employing in vivo and pattern coding techniques. From this analysis emerged four themes that addressed how leaders customized Lean Six Sigma for organizational factors in public organizations within the United States (see Table 6).

Table 6

Summary of Data Collection and Analysis

Subject	Quantity
Sources of Data	
Organizations Represented	6 Organizations
Participants Interviewed	7 Participants
Interview Transcripts	7 transcripts/82 pages
Document Received	5 Documents/19 pages
Researcher Field Notes	14 Notes/14 pages
Total Pages Analyzed	115 Pages
Results	
Codes Identified	314 Codes
Categories Developed	3 Categories
Themes Evolved	4 Themes

Evidence of Trustworthiness

Patton (2002) said the human factor is both the greatest strength and weakness of qualitative research. Qualitative research relies on the researcher as the primary instrument for data collection and analysis. Because of this role, issues of trustworthiness and ethics must be addressed. The credibility of qualitative research depends on adherence to rigorous methods. In this section, I address how I approached issues of trustworthiness during collection and analysis of data for this research.

Credibility

Credibility or internal validity explains how research results reflect reality (Merriam & Tisdell, 2016). Efforts to ensure credibility include member checking of interview transcripts and triangulation of data from multiple sources. Although only three of the six organizations provided additional data for analysis, I also used researcher memos and field notes based on interviews and observations during the analysis process

for triangulation. Efforts to ensure credibility included the development of rich descriptive data from multiple sources. Additionally, following procedures stipulated by Walden University's IRB also ensured credibility of this research.

Transferability

Transferability involves how findings from this multiple case study can be applied to other situations. Due to the nature of qualitative research, transferability and generalization is a challenge because each case presents unique data. I established a literal replication logic for case selection to attempt to identify cases that would predict similar results. Employing cross case analysis for this multiple case study supported transferability as well as addressing rival explanations that arose during data analysis.

Dependability

Dependability or reliability was addressed through the development and use of a case study protocol and adhering to a chain of evidence. The case study protocol was formulated to ensure a logical and organized plan to collect, organize, and analyze data from multiple cases. The foundation of the protocol was the concept of the chain of evidence. Following the chain of evidence was used to maintain links between multiple cases and the study's purpose, research question, data collection, analysis, and reported findings. Following the case study protocol ensured that I maintained dependability in terms of collection, analysis, and reported results of the multiple case study.

Confirmability

Confirmability or objectivity was managed by following the developed case study protocol, employing sound qualitative interview practices, conducting respondent

validation, and researcher bracketing. Following the case study protocol and using good interview practices mitigated any negative influences. Respondent validation ensured the validity of interview data. Researcher bracketing ensured that I set aside any preconceived ideas about findings.

Study Results

The focus of this qualitative exploratory multiple case study was to address the research question: How do leaders customize Lean Six Sigma for organizational factors in public agencies in the United States? My research involved collecting data through semistructured interviews with seven participants representing six public agencies. Interview transcripts, organizational documents about Lean Six Sigma programs, and analytic memos were analyzed to identify codes within the texts. The codes were categorized then synthesized to formulate emergent themes. Four themes emerged from the data through the analysis process I employed for this research.

Theme 1

The first theme that was revealed during analysis characterized both how and why these public agencies adopted Lean Six Sigma. The data that yielded this theme was collected during the semistructured interviews with questions 3 and 4. The questions asked were, why did your organization adopt LSS/CI and how was LSS/CI started in your organization? From the participant's response to these questions, the theme emerged that adoption of Lean Six Sigma was driven by senior leaders in response to a need to improve efficiency within their organizations.

Analysis revealed that seven of the seven (100%) participants provided responses that confirmed this theme. Participant 1A described Lean Six Sigma as “a top driven system.” Participant 2A noted the motivation for adopting Lean Six Sigma in their organization as, “the leadership at the time was a very progressive leadership team who was looking at how to improve the organization and grow the organization.” A succinct statement of why another organization’s leaders wanted to adopt Lean Six Sigma was quoted by Participant 4C as “we're going to run government like a business type thing.” Both Participants 5D and 6E both illustrated their senior leader’s motivations as a “need to improve the organization.” Participant 7F described a situation where his organization was encouraged to “streamline the process” and Lean was what he adopted to accomplish that end. The documents provided by three participants all identified that organizations sought to adopt Lean Six Sigma to improve efficiency and quality.

There was also some discussion from Participants 1A, 2A, 4C, 5D, and 6E (71%) about seeing other organizations using Lean Six Sigma or being encouraged to adopt the program from their higher-level organization. Participant 2A, “and our senior leadership at the time said, ‘Hey, this is a pretty good opportunity, it's a pretty good effort, let's jump on board and try to train some of our people.’" Participant 5D noted, “So we started with the NGB model because we didn't have anything else to go on.” Participant 4C related that his organization’s senior leader came from a business background and was familiar with Lean Six Sigma. His previous experience led to his effort to run government like a business, as previously noted.

Theme 2

This theme emerged from the data based on questions 5a through 5e, question 6 and 8 in the interview guide. I employed these questions to explore how each organization designed and structured their Lean Six Sigma program. The concept of a parallel-meso structure was proposed by Schroeder et al. (2008). It portrays a program composed of a parallel-meso structure; this structure includes trained improvement specialists, employment of a structured project management process to identify and solve problems, and use of project performance metrics (Schroeder et al., 2008). These elements differentiate Lean Six Sigma from other quality management initiatives.

About program level management, Participant 1A stated that employ an "additional duty, if you will, CPI Deployment Director." Participant 5D declared "we don't yet have a process improvement office where all they do is process improvement as their primary role." In addition to program management, participants addressed the issue of full-time GB or BBs within their program. Participant 3B clearly stated that "we don't have anybody that's just doing Lean Six Sigma full-time." Participants 1A, 2A, 5D, and 6E (57%) all described their trained and certified GB and BBs performing process improvement as an additional duty to their current position. Six (86%) of the seven participants and five (83%) of the six organizations do not have a full-time Lean Six Sigma program manager or full-time belts. The common refrain was, "it's an additional duty appointment to a full-time job."

The Lean Six Sigma structured project management process is the five-step DMAIC process. Participants reported that the only use of DMAIC was when belt

candidates employed the process during their training and certification program. Participant 5D related that most improvements were, “more quick wins and Kaizens than actually trying to do a full on DMAIC.” Participant 4C summarized this issue with the DMAIC process this way; “I guess I could put it this way. It's a complicated methodology compared to some.”

Project selection, management, and reporting was generally reported to be informal with a few exceptions. Participant 2A described their process as, “you may have a director or a manager say, ‘I got an issue I need help with.’ And we will guide one of our belts towards that manager to do a project.” Participant 5D identified a project identification process that involved senior leaders as part of their strategic planning process. Process improvement metric reporting was noted as informal or, as Participant 4C stated,

> I think the first year that we had it, there may be some reporting maybe to the board and to the chancellor where we talked about the number of projects and maybe the estimated savings. I think that only happened one time in terms of that formal sort of reporting.

Participants 5D and 7F (29%) noted that some presentation of process improvement projects was provided to leaders. Participant 5D said that the process owner is briefed on the status of an improvement project. Participant 7F presents improvement project results as part of his organization’s regular operations briefings to senior leaders.

The last element of this theme involves training of improvement specialists. Four (67%) of the organizations represented did not conduct their own training for GB or BBs.

Each organization employed outside, or contracted trainers. This also included the mentoring of GB and BB candidates as they work to complete their certification projects.

Theme 3

Theme 3 and Theme 4 emerged from questions 7, 9, 10, and 11 found in the semistructured interview guide. These open-ended interview questions were asked to explore the factors that may have influenced leader decisions on how they customized Lean Six Sigma for their organizations.

This theme was mentioned during interviews with Participants 1A, 2A, 4C, 5D, and 6E (71%). Participant 4C provided a unique description of this phenomenon with the following quote,

> I would say with a high level of senior level championing, there was a pretty quick initial pickup. Then there was mixed use adoption of it as people kind of got trained. It probably is one of those things that... I guess I could put it this way. It's a complicated methodology compared to some. I don't want to say it's clunky, but it is kind of clunky. Maybe cumbersome can be the better word for it.

Participant 2A, while discussing the aversion to develop full DMAIC projects, stated, “We're just trying to get the correct answer and get it back out the door again.” Participant 1A likened Lean Six Sigma training and process improvement projects as, “it's like going after a master’s program, you got to really want to do it, or a Doctorate if you will.” Participant 5D observed “that only a fifth of them actually got certified.”, when describing the difficulty of the training and certification process.

Theme 4

The data that produced Theme 4 were collected from five (71%) of the seven participants responding to the semistructured interview questions 7 and 9-11 that were listed previously. This theme reenforces the concept that leader engagement is the primary critical success factor for the implementation and sustainment of a program such as Lean Six Sigma (Juliani & Oliveira, 2020; Rexeisen et al., 2018; Zhang et al., 2011). A lack of leadership engagement in the program can also influence the structure of the Lean Six Sigma program in an organization. Data from this research identified leadership were a factor in how Lean Six Sigma was customized in these public organizations.

Participants 1A and 2A described the leadership support as "There's not a whole lot of leadership involvement in the Lean Six Sigma program." Participant 3B observed leadership engagement as "hit or miss." Participant 5D noted that "If the key leaders in the organization don't understand the value in it and encourage, and protect the program, no one else plays along…" Participant 6E provided this insight about Lean Six Sigma, "to have a BB or MBB or GB for that matter, this is very much a self-driven or leader-initiated opportunity that just, I think it's underutilized…"

Another observation from some of the participants was that Lean Six Sigma was not viewed as a priority in their organizations. Participant 2A, "We're going to focus on the core missions, not the outside missions to look at how to make it efficiencies better." Participant 4C described the views of Lean Six Sigma in their organization, "…you can think of continuous improvement as one of those. I think that Lean Six Sigma was seen as being in that category of a support activity, number one."

Discrepant Cases and Nonconfirming Data

Only Organization F (14%), a Department of Defense equipment repair facility, was portrayed as having a full-time GB responsible for identifying and conducting process improvement projects that supported the repair operation. Participant 7F also noted that this individual worked as part of the quality control office for the repair operation. Contrary to four (67%) of the six other organizations represented, Organization B and F conducted some in-house training of employees in Lean Six Sigma or the Lean improvement process. These facts were contrary to the other four organizations studied for this research.

Summary

The purpose of this qualitative exploratory multiple case study was to better understand how leaders customize Lean Six Sigma for organizational factors found in public agencies in the United States. Data were collected after conducting seven semistructured interviews and collecting documents related the Lean Six Sigma program in three of the six organization represented. The data were analyzed using a two-cycle coding process that revealed the four themes represented in this chapter. These four themes: (a) leaders encouraged adoption of Lean Six Sigma to improve efficiency, (b) a parallel-meso structure and associated elements were not fully implemented, (c) Lean Six Sigma processes perceived as too complex and time consuming, and (d) leaders did not sustain support for the program.

Chapter 5 includes an interpretation of findings and discussion of the limitations of the study. Additionally, I address recommendations and implications of this research in terms of positive social change, theory, and practice.

Chapter 5: Discussion, Conclusions, and Recommendations

The purpose of this research was to gain an understanding of how leaders in public agencies customize Lean Six Sigma for organizational factors such as leadership engagement, staffing, or quality improvement culture. This was a qualitative research study designed to answer the research question: How do leaders customize Lean Six Sigma for organizational factors in public agencies in the United States? The conceptual framework for this research was grounded in the definition of Lean Six Sigma and contingency theory of organizations.

This exploratory multiple case study analysis of semistructured interviews and documents from seven participants representing six public organizations revealed four themes. The first theme that emerged from data was that leaders encouraged adoption of Lean Six Sigma to improve efficiency within their organizations. The next theme was that a parallel-meso structure and associated elements were not fully implemented in public agencies. Another theme that emerged was that leaders perceived the Lean Six Sigma process improvement process as too complex and time-consuming. The final theme was that leaders did not sustain support for the Lean Six Sigma program in their organizations.

Interpretation of Findings

This qualitative exploratory multiple case study was undertaken to understand how leaders customize Lean Six Sigma for organizational factors found in public agencies in the United States. Analysis of data from interviews with seven participants representing six public organizations led to four themes. Themes emerged from

semistructured interviews and analysis of documents provided by these participants. The 15-question semistructured interview guide was designed to address three categories of inquiry: reasons for adoption of Lean Six Sigma, organization of Lean Six Sigma, and customization factors. Results were used to address a gap in literature I identified in Chapter 2 regarding lack of data regarding how elements of Lean Six Sigma are customized in public agencies due to organizational contingencies.

Theme 1

The first theme that emerged from an analysis of the data was that leaders of organizations chose to adopt Lean Six Sigma because they believed it was a proven tool to improve the efficiency of their organizations. Participants responded to questions about adoption by identifying that organizational leadership were instrumental in the adoption of Lean Six Sigma. All participants stated Lean Six Sigma was seen as a proven method to improve efficiency for their senior leaders. Documents provided by three participants also supported this theme.

Analysis confirmed top management's essential influence on quality improvement. Further, research identified leadership as a critical success factor for the implementation and adoption of Lean Six Sigma in organizations. Implementing a program such as Lean Six Sigma requires top management initiative and support.

Lean Six Sigma is considered a universal solution for quality improvement in organizations (George, 2003; Pyzdek & Keller, 2014). Examples of successful adoptions of Lean Six Sigma can influence others to adopt it as well. Three participants mentioned that their top management saw this quality improvement methodology in other

organizations and wanted to mimic that success in their agency. One participant noted that their senior leader had previous experience with Lean Six Sigma, and therefore wanted to see it implemented in the current organization.

Results also confirm that Lean Six Sigma is considered a proven methodology for organizations to employ to improve efficiency. Participants' interviews and additional documents confirmed research on why public sector organizations adopt Lean Six Sigma and influence those leaders have during that adoption.

Theme 2

The second theme that emerged from data was that there was limited evidence regarding four key elements of Lean Six Sigma established in researched organizations. Schroeder et al. (2008) said Six Sigma had four elements: parallel-meso structure, improvement specialists, a structured method, and a focus on metrics. The results of my research determined that leaders did not fully establish these four elements of Lean Six Sigma.

Four Lean Six Sigma programs were managed by someone as an additional duty; managing Lean Six Sigma was not their primary function. The remaining two organizations employed a manager full-time, although one noted that their program manager also had other duties to perform. None of the participants interviewed said their organization created a separate Lean Six Sigma program office. Research of SMEs described how some implemented Lean Six Sigma by integrating it into their existing organization without the need to develop a parallel-meso structure for management of the program (Kumar et al., 2011; Taylor & Taylor, 2014; Timans et al., 2016).

All participants reported that BBs, GBs, and YBs performed those functions as an additional duty. Participants described support to continue to train and certify belts. This allowed managers to maintain a pool of employees who understood the process and tools used to identify and implement improvements within their organizations. Participants said not having full-time belts reduced the likelihood of conducting full DMAIC projects.

McLean et al. (2015) said limiting full-time resources for project management was directly related to reduced improvement results. Another result of having BBs work additional duties is the limited number of DMAIC improvement projects completed. Five participants said the only DMAIC projects completed were those done to satisfy belt certification projects. Much of the other improvement projects completed were either Kaizen or quick-win projects. These projects are smaller in scope and scale and require less time to complete. They can be managed by those working part-time but generally yield smaller results or improvements. Only one participant noted that their organization placed a focus on metrics for the Lean Six Sigma program. The other six participants described an occasional interest in reporting improvement success, usually as part of some regular operational briefing or presentation.

Data analysis confirms alternatives to the employment of the parallel-meso model structure and other elements of Lean Six Sigma. These four elements are often found in large manufacturing organizations. Zu et al. (2008) said a successful adoption of Lean Six Sigma must be accompanied by top management's acceptance of organizational structure. SMEs and government agencies can modify or limit their Lean Six Sigma

structure to fit their specific organizational contingencies with some success (Kumar et al., 2011; Moya et al., 2019; Sodhi et al., 2020).

Theme 3

The concept of complexity and time were the most numerous coded responses from data collected and discussed by all seven participants. Specifically, this theme involves thoughts about employment of the DMAIC framework for improvement projects. Using the DMAIC process to identify, solve, and implement process improvement can be complex, detailed, and time consuming. Four participants said many of the employees they send for Lean Six Sigma training may complete the 2 to 4 weeks of training but fail to earn their belt certification due to the requirement to complete a DMAIC project. Additionally, managing a DMAIC project is time consuming, making it difficult for a part-time project leader.

There is research that corelates with these findings regarding complexity of the Lean Six Sigma structured method. McLean et al. (2015) said the time improvement projects take to complete can be a hindrance. Also, improvement projects take time away from primary responsibilities of team members. Managers were reluctant to approve DMAIC projects because of perceived diversions from primary responsibilities of the organization. DMAIC projects came with a high cost and were long and complex (Thomas et al., 2009; Uluskan, 2021). These factors lead to a limited management structure for Lean Six Sigma and focus on less demanding process improvement frameworks such as Kaizen or quick wins. Full-time improvement specialists are a key element to a traditionally structured Lean Six Sigma program. None of the organizations

in this research employed an improvement specialist full-time. Leaders of these organizations chose to train employees in Lean Six Sigma and have them conduct improvements as part of their normal responsibilities, which supports a continuous improvement philosophy.

The fact that public agency managers for organizations studied here find the process complex and time consuming is a factor that contributed to their decisions to customize Lean Six Sigma. Leaders find that DMAIC project take too long to complete leads to the use of Kaizen and quick-win projects of smaller scope limited results. Leaders in public agencies also recognized that earning a Lean Six Sigma certification is difficult for many to achieve. Public agency leaders ultimately chose to either customize Lean Six Sigma to fit their organization or alter their organization to fit it.

Theme 4

The final theme that emerged from data involved factors that influence the customization of Lean Six Sigma. This theme was derived from the second leading coding of responses from six participants. Leadership engagement or lack thereof is the leading CSF (Abu Bakar et al., 2015; Laureani & Antony, 2018; Maleyeff, 2014). Findings in my research identified leadership as being a critical factor in terms of both the decision to implement Lean Six Sigma and as a factor in how it is structured and customized in those organizations.

I showed that leadership can be both a positive and negative influence. Although it is a CSF for implementing and sustaining Lean Six Sigma, leadership can either encourage or discourage its development. Lack of leadership support can affect the

sustainment of Lean Six Sigma in organizations. The nature of leadership in public organizations can also complicate continued sustainment of Lean Six Sigma. The complex nature of management and leadership in the public sector is a possible negative factor in terms of shaping and sustaining Lean Six Sigma (Antony et al., 2016; Fryer et al., 2007; Rodgers & Antony, 2019).

Leadership both encouraged the implementation and limited the development of Lean Six Sigma in public organizations. Leaders of these public agencies employed Lean Six Sigma without a dedicated program office using additional duty improvement specialists. The factors that affected its customization include lack of top management support during sustainment and perceptions of a complex and time-consuming improvement methodology. These findings are reflected in the literature, specifically in the public sector.

Limitations of the Study

Qualitative research and the case study design possess inherent limitations. Researcher bias, limited generalization, and nature of data collection and analysis provide a basis to question credibility of the research and findings (Maxwell, 2013). The first limitation I addressed was bias I possessed as the primary instrument for data collection and analysis. I employed bracketing to offset any bias. Bracketing is the concept of the researcher being aware of their biases and setting them aside during the research process (Eddles-Hirsch, 2015). My next effort to limit any credibility issues was to incorporate triangulation in data analysis. My work to include other documents in addition to semistructured interviews was controlled by what documents participants would provide.

Triangulation was limited to analysis of documents provided for three of the six organizations represented in this research. Additional efforts to enforce credibility included the development of a robust case study protocol. Following this protocol ensured that I replicated research steps with each participant. Additionally, member-checking was used with each participant to verify transcriptions of semistructured interviews.

An unanticipated limitation was a result of the COVID-19 pandemic. The effect of the pandemic on organizations made it difficult to recruit participants for my research. Many organizations, including public agencies, reduced operations and moved employees to work from home. As a result, I solicited participants using LinkedIn, Walden University's participant pool, and snowball sampling. My research design included selection criteria for participants which contributed to slow and limited responses. These factors forced an extension of the data collection period for my research and limited the number of participants interviewed from each agency.

Recommendations

My analysis and results provided some insight regarding how leaders of public agencies in the United States customized their Lean Six Sigma programs to align organizational factors. The first theme that evolved during my analysis of the data was that leaders sought to implement Lean Six Sigma to improve efficiency. Top management customized their programs by not employing full-time belts and program management, while limiting the use of full DMAIC. Leading factors identified via data analysis were perceptions of the leaders of the agencies studied of the DMAIC

framework being too complex and time consuming, and top management provided restrained support to sustain programs within their organizations. Future research should continue to explore the adoption and customization of Lean Six Sigma in public organizations, employing alternative methodologies and further exploration of findings from this research.

Methodological Recommendations for Research

Due to the limited response in my search for participants, a first recommendation would be to replicate this qualitative exploratory multiple case study with the goal of identifying and collecting data from several participants representing each public agency studied. Additionally, collecting multiple operational documents from each agency would allow for more significant triangulation of the data analyzed. Another recommendation for qualitative research would be to conduct a single case study of one public organization to examine how its leadership customized Lean Six Sigma. This could provide an opportunity for the researcher to explore specific organizational factors and their influence on management decisions regarding their Lean Six Sigma program.

A quantitative method may provide insight into how public agency leaders customize Lean Six Sigma for organizational factors. A quantitative survey method could be employed to explore public agencies that use Lean Six Sigma as recommended by Fletcher (2018). A survey can also be used to identify specific customizations or to correlate between various factors and results of customization. A mixed methods approach can also be attempted to further research in public agency Lean Six Sigma customization.

Recommendations for Future Research

The four themes from my research that illustrate how public agency leaders customized Lean Six Sigma provide opportunities for future research that can examine how Lean Six Sigma is structured in public organizations in the United States. The first recommendation is to conduct research into specifically how and why the four elements of (a) a parallel-meso structure, (b) use of improvement specialists, (c) a structure method for problem solving and project management, and (d) a focus on process improvement metrics, as identified in Schroeder et al. (2008) definition of Lean Six Sigma, is structured and used in public organizations. The next recommendation for research would be to evaluate the effectiveness of a Lean Six Sigma program that does not employ full-time program management and improvement specialists, does not regularly use the DMAIC project structure, and does not regularly monitor improvement metrics. Lastly, I would recommend research into identifying and developing a framework for the implementation of Lean Six Sigma in public organizations. Research on a framework for implementation would provide government agency management the tools to implement an effective model of Lean Six Sigma for their organization.

Implications

A review of the literature identified that there is a limited understanding of how leaders of public organizations may customize Lean Six Sigma for organizational factors during implementation. Failure to successfully implement a strategy such as Lean Six Sigma can waste resources and make subsequent change efforts more challenging. My research efforts sought to add to the knowledge about Lean Six Sigma implementations

in public agencies based on factors within those organizations. The findings may prove useful to scholars, public agency leaders, and Lean Six Sigma practitioners. This section contains implications for positive social change, theory, and practice.

Implications for Positive Social Change

A better understanding of how leaders in public agencies customize Lean Six Sigma for organizational contingencies may support management in other public organizations to lead successful implementations of the process improvement methodology. Lean Six Sigma provides a systematic and focused approach to streamline and improve processes (Fletcher, 2018). Previous research has proven Lean Six Sigma to be effective in improving the efficiency and cost-effectiveness in public agencies (Fletcher, 2018; Rodgers & Antony, 2019). There is a growing demand to improve the quality and cost effectiveness of government services and the past year's efforts to address the COVID-19 pandemic has proven that need.

Public agency leaders who better understand the capabilities, capacity, and complexity of Lean Six Sigma can better prepare their organization to implement the improvement strategy. Understanding that a program such as Lean Six Sigma can be customized to align the contingencies of their organization can aid in the decision whether to adopt it. In addition to understanding its structure and complexity, findings from this research confirmed previous studies that identified leadership support and encouragement as a critical factor in implementation and sustainment Lean Six Sigma. Sony et al. (2020) reported that improving public service through increased efficiency and effectiveness can improve public health, safety, and overall services to the

communities that these organizations serve. A functioning and effective Lean Six Sigma program can enhance those efforts.

Implications for Theory

In my review of the literature, I concluded that there is a gap in the understanding of how leaders in public agencies within the United States modify Lean Six Sigma for organizational factors. The themes from this qualitative exploratory multiple case study allowed me to confirm previous research that leadership engagement is a CSF to the implementation and sustainment of Lean Six Sigma. I identified leaders' concern with the complexity and time involvement of Lean Six Sigma projects as issues of concern related to the process improvement projects using the DMAIC framework. Lastly, the four themes that emerged from my analysis of the data confirmed and extend knowledge about how leaders customized elements found in the Schroeder et al. (2008) definition of Lean Six Sigma.

This qualitative case study design limits generalization of results (Yin, 2018), yet my research can provide a basis for replication for future research seeking to explore the customization of Lean Six Sigma. My research also contributes to a growing body of research in examining the application of Lean Six Sigma in the public sector. Researchers have recognized the necessity of exploring how to make public agency operations more effective by employing the systematic and focused Lean Six Sigma methodology. My study provides results that are a small contribution to the body of knowledge regarding Lean Six Sigma customization and its employment in the public sector.

Implications for Practice

Antony et al. (2019) demonstrated that an initiative such as Lean Six Sigma start well, but fail to have a lasting effect due to several factors. Approximately 60% of Lean Six Sigma programs fail (Albliwi et al., 2014; Jadhav et al., 2014). Yet, Lean Six Sigma has proven to provide a focused and systematic approach to process improvement that government organization can employ. I explored how public agency leaders customized Lean Six Sigma for factors in their organizations and the findings may assist others looking at implementing the process improvement methodology.

My qualitative exploratory multiple case study may provide insights to top management contemplating the feasibility of Lean Six Sigma for their public organizations. Those considering Lean Six Sigma should understand that leaders must become engaged and remain engaged with the program to ensure success. Leaders contemplating Lean Six Sigma should understand that the framework most used to identify waste and develop improved processes requires knowledgeable, trained specialists using an established framework that some may find complex. Lastly, managers must understand the structure of effective Lean Six Sigma programs and the roles that trained specialist play. This knowledge could allow leaders to make effective decisions on how to customize Lean Six Sigma to best fit their organizations and provide the quality improvements most sought.

Conclusions

Business leaders implement Lean Six Sigma to satisfy customers, lower costs, and increase profits. Leaders in public organizations look to Lean Six Sigma for the similar

purposes of satisfying their customers and to gain economic efficiencies in operations. Leaders who lack an understanding of Lean Six Sigma or who lead poor implementations can cost their organizations resources, reputation, and endanger future change efforts. Leaders who understand what Lean Six Sigma can provide and what resources it requires can better lead a successful implementation and support quality improvements.

This qualitative exploratory multiple case study sought to understand how leaders customize Lean Six Sigma for organizational factors in public agencies in the United States. My research was affected by the COVID-19 pandemic which limited my ability to recruit multiple participants for more than one of the organizations studied. Analysis was hindered by not having enough material to properly triangulate data between participant interviews and organizational documents. Nonetheless, I developed and followed a sound case study protocol that ensured the replication of sound data collection and analysis for all data sources. My findings did confirm or extend previous research in Lean Six Sigma, its implementation, and its employment in the public sector.

Leadership engagement is a CSF for the implementation and sustainment of Lean Six Sigma in any organization. My findings add to a long list of research that has made this determination. My research findings demonstrate that leadership is also a factor in determining how an organization customizes their Lean Six Sigma program. One of the responsibilities of organizational leaders is to decide how resources such as staffing are allocated. If leaders decide not to employ full-time BBs or program managers, then their Lean Six Sigma program may provide limited results. Lastly, leaders must also understand that using the DMAIC project framework is time consuming and complex.

The use of part-time BBs and other improvement specialists may extend the timeline for completing improvement projects or limit successful completion.

As the COVID-19 pandemic has demonstrated, having effective and efficient public agencies can be critical to public health, safety, and overall satisfaction. Government agencies serve the public interest and Lean Six Sigma can provide the leaders of those agencies a focused and methodological approach to increasing efficiency. Some practitioners adhere to a best practice, universal model of a Lean Six Sigma implementation and structure within organizations. My findings contribute to growing body of research that illustrates that Lean Six Sigma can be useful in the public sector and it can be customized for organizational factors.

References

Abu Bakar, F. A., Subari, K., & Mohd Daril, M. A. (2015). Critical success factors of Lean Six Sigma deployment: A current review. *International Journal of Lean Six Sigma*, *6*(4), 339. https://doi.org/10.1108/ijlss-04-2015-0011

Albliwi, S. A., Antony, J., & Lim, S. A. H. (2015). A systematic review of Lean Six Sigma for the manufacturing industry. *Business Process Management Journal*, *21*(3), 665-691. https://doi.org/10.1108/BPMJ-03-2014-0019

Albliwi, S., Antony, J., Abdul Halim Lim, S., & van der Wiele, T. (2014). Critical failure factors of Lean Six Sigma: A systematic literature review. *International Journal of Quality & Reliability Management*, *31*(9), 1012-1030. https://doi.org/10.1108/IJQRM-09-2013-0147

Amar, K., & Davis, D. (2008). A review of Six Sigma implementation frameworks and related literature. *Proceedings of the International MultiConference of Engineers and Computer Scientists*, *II*.

Anthony, S., & Antony, J. (2016). Academic leadership and Lean Six Sigma: A novel approach to systematic literature review using design of experiments. *International Journal of Quality & Reliability Management*, *33*(7), 1002-1018. https://doi.org/10.1108/IJQRM-03-2015-0047

Antony, J. (2014). Readiness factors for the Lean Six Sigma journey in the higher education sector. *International Journal of Productivity and Performance Management*, *63*(2), 257-264. https://doi.org/10.1108/IJPPM-04-2013-0077

Antony, J., & Banuelas, R. (2002). Key ingredients for the effective implementation of Six Sigma program. *Measuring Business Excellence*, *6*(4), 20-27. https://doi.org/10.1108/13683040210451679

Antony, J., & Karaminas, H. (2016). Critical assessment on the Six Sigma Black Belt roles/responsibilities, skills, and training: A global empirical study. *International Journal of Quality & Reliability Management*, *33*(5), 558-573. https://doi.org/10.1108/IJQRM-08-2014-0106

Antony, J., Kumar, M., & Madu, C. N. (2005). Six sigma in small- and medium-sized UK manufacturing enterprises: Some empirical observations. *The International Journal of Quality & Reliability Management*, *22*(8/9), 860-874. https://doi.org/10.1108/02656710510617265

Antony, J., Rodgers, B., & Cudney, E. A. (2017a). Lean Six Sigma in policing services: Case examples, lessons learnt and directions for future research. *Total Quality Management & Business Excellence*, *0*(0), 1-13. https://doi.org/10.1080/14783363.2017.1327319

Antony, J., Rodgers, B., & Cudney, E. A. (2017b). Lean Six Sigma for public sector organizations: Is it a myth or reality? *International Journal of Quality & Reliability Management*, *34*(9), 1402-1411. https://doi.org/10.1108/IJQRM-08-2016-0127

Antony, J., Rodgers, B., & Gijo, E. V. (2016). Can Lean Six Sigma make UK public sector organisations more efficient and effective? *International Journal of*

Productivity and Performance Management, *65*(7), 995-1002. https://doi.org/10.1108/IJPPM-03-2016-0069

Antony, J., Sony, M., Dempsey, M., Brennan, A., Farrington, T., & Cudney, E. A. (2019). An evaluation into the limitations and emerging trends of Six Sigma: An empirical study. *The TQM Journal*, *31*(2), 205–221. https://doi.org/10.1108/TQM-12-2018-0191

Baird, K., Hu, K. J., & Reeve, R. (2011). The relationships between organizational culture, total quality management practices and operational performance. *International Journal of Operations & Production Management*, *31*(7), 789–814. https://doi.org/10.1108/01443571111144850

Chakraborty, A., & Tan, K. C. (2012). Case study analysis of Six Sigma implementation in service organisations. *Business Process Management Journal*, *18*(6), 992–1019. http://dx.doi.org.ezp.waldenulibrary.org/10.1108/14637151211283384

Dahlgaard, J. J., & Dahlgaard-Park, S. M. (2006). Lean production, six sigma quality, TQM and company culture. *The TQM Magazine*, *18*(3), 263–281. https://doi.org/10.1108/09544780610659998

Deming, W. E. (1994). Leadership for quality. *Executive Excellence*, *11*(6), 3–5.

Donaldson, L. (2001). *The contingency theory of organizations*. SAGE Publications, Inc. https://doi.org/10.4135/9781452229249

Dora, M., Kumar, M., & Gellynck, X. (2016). Determinants and barriers to lean implementation in food-processing SMEs – a multiple case analysis. *Production*

Planning & Control, *27*(1), 1–23. https://doi.org/10.1080/09537287.2015.1050477

Drohomeretski, E., Gouvea da Costa, S. E., Pinheiro de Lima, E., & da Rosa Garbuio, P. A. (2014). Lean, Six Sigma and Lean Six Sigma: An analysis based on operations strategy. *International Journal of Production Research*, *52*(3), 804–824. https://doi.org/10.1080/00207543.2013.842015

Dubey, R., Gunasekaran, A., Childe, S. J., Wamba, S. F., & Papadopoulos, T. (2015). Enablers of Six Sigma: Contextual framework and its empirical validation. *Total Quality Management & Business Excellence*, *0*(0), 1–27. https://doi.org/10.1080/14783363.2015.1075877

Eddles-Hirsch, K. (2015). Phenomenology and educational research. *International Journal of Advanced Research*, *3*(8), 12. http://www.journalijar.com/article/5631/phenomenology- and-educational-research/

Fan, Y., French, M. L., Duray, R., & Stading, G. L. (2017). Service strategy to improve operational capabilities in the public sector. *The Service Industries Journal*, *37*(11–12), 703–725. https://doi.org/10.1080/02642069.2017.1304928

Fletcher, J. (2018). Opportunities for Lean Six Sigma in public sector municipalities. *International Journal of Lean Six Sigma*, *9*(2), 256–267. https://doi.org/10.1108/IJLSS-07-2017-0086

Fryer, K. J., Antony, J., & Douglas, A. (2007). Critical success factors of continuous improvement in the public sector: A literature review and some key findings. *The TQM Magazine*, *19*(5), 497–517. http://dx.doi.org/10.1108/09544780710817900

Furterer, S., & Elshennawy, A. K. (2005). Implementation of TQM and Lean Six Sigma tools in local government: A framework and a case study. *Total Quality Management & Business Excellence*, *16*(10), 1179–1191. https://doi.org/10.1080/14783360500236379

George, M. L. (2003). *Lean Six Sigma for service: How to use Lean speed and Six Sigma quality to improve services and transactions*. McGraw-Hill.

Goulding, C. (2005). Grounded theory, ethnography, and phenomenology: A comparative analysis of three qualitative strategies for marketing research. *European Journal of Marketing*, *39*(3/4), 294–308. https://doi.org/10.1108/03090560510581782

Hilton, R. J., & Sohal, A. (2012). A conceptual model for the successful deployment of Lean Six Sigma. *The International Journal of Quality & Reliability Management*, *29*(1), 54–70. http://dx.doi.org/10.1108/02656711211190873

Hoerl, R. W., Montgomery, D. C., Lawson, C., & Molnau, W. E. (2001). Six Sigma black belts: What do they need to know? / Discussion / Response. *Journal of Quality Technology*, *33*(4), 391–435. https://doi.org/10.1080/00224065.2001.11980094

Hofer, C. W. (1975). Toward a Contingency Theory of Business Strategy. *Academy of Management Journal*, *18*(4), 784–810. https://doi.org/10.2307/255379

Houghton, C., Murphy, K., Shaw, D., & Casey, D. (2015). Qualitative case study data analysis: An example from practice. *Nurse Researcher (2014+); London*, *22*(5), 8. http://dx.doi.org/10.7748/nr.22.5.8.e1307

Jadhav, J. R., Mantha, S. S., & Rane, S. B. (2014). Exploring barriers in lean implementation. *International Journal of Lean Six Sigma*, *5*(2), 122–148. https://doi.org/10.1108/IJLSS-12-2012-0014

Jayaram, J., Ahire, S. L., & Dreyfus, P. (2010). Contingency relationships of firm size, TQM duration, unionization, and industry context on TQM implementation—A focus on total effects. *Journal of Operations Management*, *28*(4), 345–356. https://doi.org/10.1016/j.jom.2009.11.009

Jones, E. C., Parast, M. M., & Adams, S. G. (2010). A framework for effective Six Sigma implementation. *Total Quality Management & Business Excellence*, *21*(4), 415–424. https://doi.org/10.1080/14783361003606720

Juliani, F., & de Oliveira, O. J. (2020). Lean Six Sigma principles and practices under a management perspective. *Production Planning & Control*, *31*(15), 1223–1244. https://doi.org/10.1080/09537287.2019.1702225

Kotter, J. P. (2007). *Leading change: Why transformation efforts fail*. Harvard Business School Press. www.hbrreprints.org

Kregel, I., & Coners, A. (2018). Introducing Lean Six Sigma to a German municipality: An action research report. *International Journal of Lean Six Sigma*, *9*(2), 221–237. https://doi.org/10.1108/IJLSS-02-2017-0019

Krueger, D. C., Parast, M. M., & Adams, S. (2014). Six Sigma implementation: A qualitative case study using grounded theory. *Production Planning & Control*, *25*(10), 873–889. https://doi.org/10.1080/09537287.2013.771414

Kumar, M., Antony, J., Madu, C. N., Montgomery, D. C., & Park, S. H. (2008). Common myths of Six Sigma demystified. *The International Journal of Quality & Reliability Management*, *25*(8), 878–895. http://dx.doi.org/10.1108/02656710810898658

Kumar, M., Antony, J., & Tiwari, M. K. (2011). Six Sigma implementation framework for SMEs—A roadmap to manage and sustain the change. *International Journal of Production Research*, *49*(18), 5449–5467. https://doi.org/10.1080/00207543.2011.563836

Kumar, M., Khurshid, K. K., & Waddell, D. (2014). Status of Quality Management practices in manufacturing SMEs: A comparative study between Australia and the UK. *International Journal of Production Research*, *52*(21), 6482–6495. https://doi.org/10.1080/00207543.2014.948574

Kumar, S., & Bauer, K. F. (2010). Exploring the use of Lean thinking and Six Sigma in public housing authorities. *The Quality Management Journal*, *17*(1), 29–46. https://doi.org/10.1080/10686967.2010.11918259

Kuvvetli, Ü., & Firuzan, A. R. (2017). Applying Six Sigma in urban public transportation to reduce traffic accidents involving municipality buses. *Total Quality Management & Business Excellence*, 1–26. https://doi.org/10.1080/14783363.2017.1297198

Lameijer, B. A., De Mast, J., & Does, R. J. (2017). Lean Six Sigma deployment and maturity models: A critical review. *The Quality Management Journal*, *24*(4), 6–4. https://doi.org/10.1080/10686967.2017.12088376

Lameijer, B. A., Veen, D. T. J., Does, R. J. M. M., & De Mast, J. (2016). Perceptions of Lean Six Sigma: A multiple case study in the financial services industry. *Quality Management Journal*, *23*(2), 29–44. https://doi.org/10.1080/10686967.2016.11918470

Lande, M., Shrivastava, R. L., & Seth, D. (2016). Critical success factors for Lean Six Sigma in SMEs (Small & Medium Enterprises). *The TQM Journal*. https://doi.org/10.1108/TQM-12-2014-0107

Laureani, A., & Antony, J. (2017). Leadership and Lean Six Sigma: A systematic literature review. *Total Quality Management & Business Excellence*, 1–29. https://doi.org/10.1080/14783363.2017.1288565

Laureani, A., & Antony, J. (2018). Leadership – a critical success factor for the effective implementation of Lean Six Sigma. *Total Quality Management & Business Excellence*, *29*(5–6), 502–523. https://doi.org/10.1080/14783363.2016.1211480

Laux, C., Johnson, M., & Cada, P. (2015). Project barriers to Green Belts through critical success factors. *International Journal of Lean Six Sigma*, *6*(2), 138–160. https://doi.org/10.1108/IJLSS-02-2014-0006

Lloréns-Montes, F. J., & Molina, L. M. (2006). Six Sigma and management theory: Processes, content, and effectiveness. *Total Quality Management & Business Excellence*, *17*(4), 485–506. https://doi.org/10.1080/14783360500528270

Maleyeff, J. (2014). Sustaining public sector Lean Six Sigma: Perspectives from North America. *Management and Organizational Studies*, *1*(2), p92. https://doi.org/10.5430/mos.v1n2p92

Maleyeff, J., Arnheiter, E. A., & Venkateswaran, V. (2012). The continuing evolution of Lean Six Sigma. *TQM Journal; Bingley*, *24*(6), 542–555. http://dx.doi.org/10.1108/17542731211270106

Maxwell, J. A. (2013). *Qualitative research design: An interactive approach* (3rd ed.). SAGE Publications, Inc.

McAdam, R., Antony, J., Kumar, M., & Hazlett, S. A. (2014). Absorbing new knowledge in small and medium-sized enterprises: A multiple case analysis of Six Sigma. *International Small Business Journal*, *32*(1), 81–109. https://doi.org/10.1177/0266242611406945

McAdam, R., Miller, K., & McSorley, C. (2016). Towards a contingency theory perspective of quality management in enabling strategic alignment. *International Journal of Production Economics*. https://doi.org/10.1016/j.ijpe.2016.07.003

McLean, R. S., Antony, J., & Dahlgaard, J. J. (2015). Failure of Continuous Improvement initiatives in manufacturing environments: A systematic review of the evidence. *Total Quality Management & Business Excellence*, *0*(0), 1–19. https://doi.org/10.1080/14783363.2015.1063414

Merriam, S. B., & Tisdell, E. J. (2016). *Qualitative research: A guide to design and implementation* (4th ed.). John Wiley & Sons.

Meza, D., & Jeong, K.-Y. (2013). Measuring efficiency of lean six sigma project implementation using data envelopment analysis at Nasa. *Journal of Industrial Engineering and Management*, *6*(2), 401. http://dx.doi.org.ezp/10.3926/jiem.582

Miles, M. B., Huberman, A. M., & Saldana, J. (2014). *Qualitative data analysis: A methods sourcebook* (3rd ed.). SAGE Publications, Inc.

Milner, C. D., & Savage, B. M. (2016). Modeling continuous improvement evolution in the service sector: A comparative case study. *International Journal of Quality and Service Sciences*, *8*(3), 438–460. https://doi.org/10.1108/IJQSS-07-2016-0052

Moya, C. A., Galvez, D., Muller, L., & Camargo, M. (2019). A new framework to support Lean Six Sigma deployment in SMEs. *International Journal of Lean Six Sigma*, *10*(1), 58–80. https://doi.org/10.1108/IJLSS-01-2018-0001

Näslund, D. (2013). Lean and six sigma—Critical success factors revisited. *International Journal of Quality and Service Sciences*, *5*(1), 86–100. http://dx.doi.org.ezp/10.1108/17566691311316266

Netland, T. H. (2015). Critical success factors for implementing lean production: The effect of contingencies. *International Journal of Production Research*, *0*(0), 1–16. https://doi.org/10.1080/00207543.2015.1096976

Nonthaleerak, P., & Hendry, L. (2008). Exploring the six sigma phenomenon using multiple case study evidence. *International Journal of Operations & Production Management*, *28*(3), 279–303. http://dx.doi.org.ezp/10.1108/01443570810856198

Patton, M. Q. (2002). *Qualitative research and evaluation methods* (3rd ed.). Sage Publications, Inc.

Pepper, M. P. J., & Spedding, T. A. (2010). The evolution of Lean Six Sigma. *International Journal of Quality & Reliability Management*, *27*(2), 138–155. https://doi.org/10.1108/02656711011014276

Pyzdek, T., & Keller, P. A. (2014). *The Six Sigma handbook: A complete guide for green belts, black belts, and managers at all levels* (4th ed.). McGraw-Hill.

Rexeisen, R. J., Jr, E. L. O., & Garrison, M. J. (2018). Lean six sigma and assurance of learning: Challenges and opportunities. *Journal of Education for Business*, *93*(5), 260–266. https://doi.org/10.1080/08832323.2018.1457619

Rockart, J. (1979). Chief executives define their own data needs. *Harvard Business Review*, *57*(2), 81–93. http://europepmc.org/abstract/med/10297607

Rodgers, B., & Antony, J. (2019). Lean and Six Sigma practices in the public sector: A review. *International Journal of Quality & Reliability Management*, *36*(3), 437–455. https://doi.org/10.1108/IJQRM-02-2018-0057

Rogers, E. M. (2003). *Diffusion of innovations* (5th ed.). Free Press. www.amazon.com

Saldana, J. (2016). *The coding manual for qualitative researchers* (3rd ed.). SAGE Publications, Inc.

Schroeder, R. G., Linderman, K., Liedtke, C., & Choo, A. S. (2008). Six Sigma: Definition and underlying theory. *Journal of Operations Management*, *26*(4), 536–554. https://doi.org/10.1016/j.jom.2007.06.007

Shah, R., Chandrasekaran, A., & Linderman, K. (2008). In pursuit of implementation patterns: The context of Lean and Six Sigma. *International Journal of Production Research*, *46*(23), 6679–6699. https://doi.org/10.1080/00207540802230504

Sila, I. (2007). Examining the effects of contextual factors on TQM and performance through the lens of organizational theories: An empirical study. *Journal of Operations Management*, *25*(1), 83–109. https://doi.org/10.1016/j.jom.2006.02.003

Silvestro, R. (2001). Towards a contingency theory of TQM in services - How implementation varies on the basis of volume and variety. *International Journal of Quality & Reliability Management*, *18*(3), 254–288. https://doi.org/10.1108/02656710110383520

Snee, R. D. (2010). Lean Six Sigma—Getting better all the time. *International Journal of Lean Six Sigma*, *1*(1), 9–29. http://dx.doi.org.ezp/10.1108/20401461011033130

Sodhi, H. S., Singh, D., & Singh, B. J. (2020). A conceptual examination of Lean, Six Sigma and Lean Six Sigma models for managing waste in manufacturing SMEs. *World Journal of Science, Technology and Sustainable Development*, *17*(1), 20–32. https://doi.org/10.1108/WJSTSD-10-2019-0073

Sony, M., Naik, S., & Antony, J. (2020). Lean Six Sigma and social performance: A review and synthesis of current evidence. *Quality Management Journal*, *27*(1), 21–36. https://doi.org/10.1080/10686967.2019.1689799

Sousa, R., & Voss, C. A. (2001). Quality management: Universal or context dependent? *Production and Operations Management*, *10*(4), 383–404. https://doi.org/10.1111/j.1937-5956.2001.tb00083.x

Sousa, R., & Voss, C. A. (2008). Contingency research in operations management practices. *Journal of Operations Management*, *26*(6), 697–713. https://doi.org/10.1016/j.jom.2008.06.001

Stake, R. E. (2006). *Multiple case study analysis* (Kindle). The Guilford Press. www.amazon.com

Suárez-Barraza, M. F., & Miguel-Dávila, J. A. (2014). Assessing the design, management, and improvement of Kaizen projects in local governments. *Business Process Management Journal*, *20*(3), 392–411. https://doi.org/10.1108/BPMJ-03-2013-0040

Sunder M. V., & Mahalingam, S. (2018). An empirical investigation of implementing Lean Six Sigma in Higher Education Institutions. *The International Journal of Quality & Reliability Management; Bradford*, *35*(10), 2157–2180. http://dx.doi.org/10.1108/IJQRM-05-2017-0098

Swink, M., & Jacobs, B. W. (2012). Six Sigma adoption: Operating performance impacts and contextual drivers of success. *Journal of Operations Management*, *30*(6), 437–453. https://doi.org/10.1016/j.jom.2012.05.001

Taylor, A., & Taylor, M. (2014). Factors influencing effective implementation of performance measurement systems in small and medium-sized enterprises and large firms: A perspective from Contingency Theory. *International Journal of Production Research*, *52*(3), 847–866. https://doi.org/10.1080/00207543.2013.842023

Thomas, A., Barton, R., & Chuke-Okafor, C. (2009). Applying lean six sigma in a small engineering company—A model for change. *Journal of Manufacturing Technology Management*, *20*(1), 113–129. http://dx.doi.org.ezp/10.1108/17410380910925433

Timans, W., Ahaus, K., van Solingen, R., Kumar, M., & Antony, J. (2016). Implementation of continuous improvement based on Lean Six Sigma in small- and medium-sized enterprises. *Total Quality Management & Business Excellence*, *27*(3–4), 309–324. https://doi.org/10.1080/14783363.2014.980140

Tsironis, L. K., & Psychogios, A. G. (2016). Road towards Lean Six Sigma in service industry: A multi-factor integrated framework. *Business Process Management Journal*, *22*(4), 812–834. https://doi.org/10.1108/BPMJ-08-2015-0118

Uluskan, M. (2021). Enhancing Six Sigma understanding: Insights into various dimensions and aspects of Six Sigma. *Engineering Management Journal*, *0*(0), 1–30. https://doi.org/10.1080/10429247.2020.1852806

Viagi, A. F., Panizzolo, R., & Biazzo, S. (2016). Enablers and constraints in implementing lean manufacturing: Evidence from Brazilian SMEs. *Journal of Lean Systems*, *2*(3), 64–86. http://www.nexos.ufsc.br/index.php/lean/article/view/1741

Womack, J. P., Jones, D. T., & Roos, D. (1990). *The machine that changed the World: The triumph of lean production-Toyota's secret weapon in the global car wars that is revolutionizing world industry [Kindle version]*. Free Press. http://www.amazon.com

Wu, S. J., Zhang, D., & Schroeder, R. G. (2011). Customization of quality practices: The impact of quality culture. *The International Journal of Quality & Reliability Management*, *28*(3), 263–279. http://dx.doi.org.ezp/10.1108/02656711111109883

Yadav, G., & Desai, T. N. (2016). Lean Six Sigma: A categorized review of the literature. *International Journal of Lean Six Sigma; Bingley*, *7*(1), 2–24. https://doi.org/10.1108/ijlss-05-2015-0015

Yadav, G., Seth, D., & Desai, T. N. (2018). Application of hybrid framework to facilitate lean six sigma implementation: A manufacturing company case experience. *Production Planning & Control*, *29*(3), 185–201. https://doi.org/10.1080/09537287.2017.1402134

Yin, R. K. (2018). *Case study research and applications: Design and methods* (Sixth). SAGE Publications, Inc.

Zhang, D., Linderman, K., & Schroeder, R. G. (2012). The moderating role of contextual factors on quality management practices. *Journal of Operations Management*, *30*(1–2), 12–23. https://doi.org/10.1016/j.jom.2011.05.001

Zhang, D., Linderman, K., & Schroeder, R. G. (2014). Customizing quality management practices: A conceptual and measurement framework. *Decision Sciences*, *45*(1), 81–114. https://doi.org/10.1111/deci.12059

Zhang, W., Hill, A. V., & Gilbreath, G. H. (2009). *Six sigma: A retrospective and prospective study*. http://www.pomsmeetings.org/ConfPapers/011/011-0254.pdf

Zhang, W., Hill, A. V., & Gilbreath, G. H. (2011). A research agenda for Six Sigma research. *The Quality Management Journal*, *18*(1), 39–53. https://doi.org/10.1080/10686967.2011.11918301

Zu, X., Fredendall, L. D., & Douglas, T. J. (2008). The evolving theory of quality management: The role of Six Sigma. *Journal of Operations Management*, *26*(5), 630–650. https://doi.org/10.1016/j.jom.2008.02.001

Zwetsloot, I. M., Kuiper, A., Akkerhuis, T. S., & de Koning, H. (2018). Lean Six Sigma meets data science: Integrating two approaches based on three case studies. *Quality Engineering*, *30*(3), 419–431. https://doi.org/10.1080/08982112.2018.1434892

Appendix A: Interview Guide

Participant No: _____

Job

Title:_____

___

Organization:

_____

Start Time: _____ Finish Time:

_____

Introduction

Thank you in advance for agreeing to be a part of this study. The interview will take approximately 45 minutes to complete. The purpose of this qualitative exploratory multiple case study is to understand how leaders customize Lean Six Sigma for organizational factors found in public agencies in the United States. During the interview, I will take notes as you respond. The interview will be recorded to facilitate accurate analysis of your responses. I will email you a transcript of the interview within three to five days to verify for accuracy or, if you would like to change a response. In the remote possibility that I need to ask additional questions, I will contact you to schedule a follow-up interview using this same process. If you would like, I can provide you a copy of the report once I complete my research. You have the right to stop the interview based on the consent agreement that you signed earlier. Do you have any questions before we begin? Are you ready to start the interview?

Research Question

How do leaders customize Lean Six Sigma for organizational factors found in public agencies in the United States?

Interview Guide

1. How long have you been with this organization and what is your role/position?

2. What training, experience, and certifications do you have with Lean Six Sigma (LSS) and/or Continuous Improvement (CI)?

3. What is your role with your organization's LSS/CI program?

4. Why did your organization adopt LSS/CI?

5. How was LSS/CI started in your organization?

6. How does your organization structure its LSS/CI program?

    a. Is there an LSS/CI program manager?

    b. What is the level of management involvement in the LSS/CI program?

    c. Does your organization employ full-time Green or Black belts? Why or Why not?

    d. Does your organization use a structured method to manage improvement projects, such as the DMAIC methodology, Kaizen, A3, or quick wins?

    e. Does management monitor improvement project results such as project metrics, cost savings, financial results, etc.?

7. How are LSS projects managed (selection, size, durations, etc.)?

8. What factors influenced the decisions on how to structure the LSS/CI program?

9. Does your organization train individuals for roles in LSS/CI (GB & BBs, etc.)?

10. How has the LSS/CI program evolved or changed since its adoption?

11. What factors influenced any changes?

12. What barriers are there to implementing or managing the LSS/CI program?

Conclusion

This concludes my interview. I thank you for your time and thoughtful participation in my research. As stated at the beginning, I will email you a transcript of this interview for your review. You may contact me with any questions or corrections you would like to make at: jeffrey.farrell@waldenu.edu. If I do not hear from you within three days of sending the transcript, I will assume that you consent to its use in my research. Also, if you would like, I will send you a copy of my report once it has been accepted by my university. Thank you. I will now end the recording.

Appendix B: Case Study Protocol

I. Overview of the Case Study

A. Research purpose: The purpose of this qualitative exploratory multiple-case study is to understand how leaders customize Lean Six Sigma for organizational factors found in public agencies in the United States.

B. Research question: How do leaders customize Lean Six Sigma for organizational factors found in public agencies in the United States?

C. Conceptual framework: The conceptual framework for this study is grounded in the definition and elements of Lean Six Sigma, formulated by Schroder et al. (2008) and the contingency theory of organizations (Donaldson, 2001).

1. Elements of Six Sigma:

    a) a parallel-meso structure,

    b) improvement specialists,

    c) a structured method, and

    d) a focus on metrics

D. Role of the protocol in guiding the case study researcher: This protocol serves as an agenda for the inquiry conducted for the purpose of answering the primary research question for this multiple case study. The protocol will aid in ensuring dependability of the case study methods, findings, and conclusions.

II. Data Collection Procedures

A. The researcher will recruit participants from (a) purposeful sampling with a literal replication logic. Solicitation for participants will be posted on LinkedIn and in Walden University's Participant Pool. The selection criteria for inclusion in the study are:

1. A federal, state or local agency that uses Lean, Six Sigma, or Lean Six Sigma as a stand-alone quality process improvement program or as part of an overall continuous improvement program.

2. The Lean, Six Sigma, or Lean Six Sigma or continuous improvement program is active and currently in use.

3. A Continuous Improvement or Lean Six Sigma program with a manager and trained improvement specialists (GB, BB, or MBB).

4. A history of completed improvement projects or current active projects.

B. Prepare informed consent forms for each participant.

C. Review and finalize interview questions.

D. Collect and review organizational documents related to Lean Six Sigma.

E. Prepare for telephone interview and conduct test of technology and interview recording.

F. Conduct interviews and collect the data to be analyzed.

III. Protocol Questions

A. How long have you been with this organization and what is your role/position?

B. What training, experience, and certifications do you have with Lean Six Sigma (LSS) and/or Continuous Improvement (CI)?

C. What is your role with your organization's LSS/CI program?

D. Why did your organization adopt LSS/CI?

E. How was LSS/CI started in your organization?

F. How does your organization structure its LSS/CI program?

1. Is there an LSS/CI program manager?

2. What is the level of management involvement in LSS/CI?

3. Does your organization employ full-time GB or BBs? Why?

4. Does your organization use a structured method to manage improvement projects, such as the DMAIC methodology, Kaizen, A3, or quick wins?

5. Does management monitor improvement project results such as project metrics, cost savings, financial results, etc.?

G. How are LSS projects managed (selection, size, durations, etc.)?

H. What factors influenced the decisions on how to structure the LSS/CI program?

I. Does your organization train individuals for roles in LSS/CI (GB & BBs, etc.)?

J. How has the LSS/CI program evolved or changed since its adoption?

K. What factors influenced any changes?

L. What barriers are there to implementing or managing the LSS/CI program?

IV. Data Collection Tools

A. Digital recording of the interviews.

B. Transcripts of the interviews created from the recordings.

C. Organizational documents related to Lean Six Sigma.

D. Researcher field notes.

E. Case study database.

V. Outline of Case Study Report Contents

A. Overview of the study.

B. Presentation of the findings.

C. Implications for organizations.

D. Implications for social change.

E. Recommendations of best practices.

F. Recommendations for further study.

G. Summary and conclusions.

VI. Data Analysis Techniques and Tools

A. Coding (within case and cross-case)

B. Analysis tools

1. MAXQDA 2020

2. Microsoft Excel

VII. Trustworthiness Methods

A. Dependability

1. Case study database

2. Case study protocol

3. Established chain of evidence

B. Credibility

1. Rich description of each case

2. Multiple sources of evidence

3. Triangulation from multiple sources of data

C. Transferability

1. Use of a literal replication logic

2. Use of cross case analysis

3. Explore rival explanations

D. Confirmability

1. Understand my position in relation to the topic of study

2. Bracketing

3. Follow the case study protocol

E. Ethical Procedures

1. No data collection until IRB approval

2. IRB approval # 10-07-20-0185593

3. Member checking

4. Organizational and individual consent

5. Anonymity of participants and organizations

6. Secure data

Appendix C: Recruiting Request

My name is Jeffrey Farrell. I am a doctoral student at Walden University, and I am working on my dissertation researching how government organization's structure and use Lean Six Sigma as a process improvement methodology. The purpose of my study is to understand how leaders customize Lean Six Sigma for organizational factors found in public agencies in the United States. I understand you may be involved in your organization's Lean Six Sigma or continuous improvement program and may be able to assist in my research.

I am conducting a multiple case study. The data collection process will entail conducting interviews with Lean, Lean Six Sigma, or Organizational Improvement program managers and other members involved with the program. The interviews will be conducted telephonically and would last not more than 45 minutes. Upon completion, I will have the interview transcribed and provide a copy for you to review. If you choose to review the transcript and provide any additional feedback, it will take another approximately 30 minutes.

If you are interested in participating in my study, or would like more information, please email me at jeffrey.farrell@waldenu.edu.

Thank you in advance for your consideration.

Respectfully,

Jeffrey A. Farrell
Doctoral Candidate
Walden University Researcher's
Signature:_____Date:_____