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Assessment of Leadership Styles and Lean Six Sigma Critical Success Factors in the Aerospace and Defense Industry

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ASSESSMENT OF LEADERSHIP STYLES AND LEAN SIX SIGMA CRITICAL SUCCESS FACTORS IN THE AEROSPACE AND DEFENSE INDUSTRY

by

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ABSTRACT

The Aerospace and Defense industry has shifted into a global competitive market that is prioritizing innovative advancements in technological capabilities. Corporations are now having to further develop customer focused strategies based in adding value while reducing costs. Large manufacturing corporations often embrace continuous improvement methodologies, such as Lean Six Sigma, for process improvement. Many organizations have received minimal benefit from the methodology which may link back to leadership and culture. This research examined which styles of leadership are most effective when trying to gain the most value from Lean Six Sigma within manufacturing. The research study surveyed 112 black belt practitioners from one large Aerospace and Defense organization with multiple manufacturing locations in the United States. The study analyzed the relationship between laissez-faire, transactional, and transformation leadership styles and the Lean Six Sigma critical success factors of top management, project selection, and training. The results found that both transactional and transformational leadership styles had a positive correlation while the laissez-faire leadership style had a negative correlation. The results also found that laissez-faire, transactional, and transformational leadership did not predict the success of LSS implementation These findings demonstrate black belt practitioners with transactional and transformational leadership styles positively influence the benefits derived from Lean Six Sigma implementation.

This research is dedicated to the loving memory of Nan and Grandad.

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TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

LIST OF ACRONYMS

A&D	Aerospace and Defense
CITI	Collaborative Institutional Training Initiative
CSF	Critical Success Factor
DMAIC	Define, Measure, Analyze, Improve, Control
DOD	Department of Defense
FRLM	Full Range Leadership Model
IBM	International Business Machines
IRB	Institutional Review Board
JIT	Just-In-Time
KPI	Key Performance Indicator
LSS	Lean Six Sigma
MLQ	Multifactor Leadership Questionnaire
OD	Organizational Development
SME	Small and Medium Enterprises
SMED	Single Minute Exchange of Die
SPSS	Statistical Package for the Social Sciences
TQM	Total Quality Management
TLI	Transformational Leadership Inventory
VSM	Value Stream Mapping

CHAPTER ONE: INTRODUCTION

The Aerospace and Defense (A&D) industry is a global infrastructure that supports the manufacturing of advanced aerospace and military products. Globalization has created a fast-paced competitive market that requires organizations to meet rapid changes in customer demand (Jonsdottir, Ingason, & Jonasson, 2014). Recent surges of innovations and advancements in technology has created customer focused strategies of adding value and reducing costs to remain globally competitive against other organizations (Wang, Nguyen, Le, & Hsueh, 2018). The A&D industry has always been prone to budget cuts, thus spurring the need to compete as technology matures and costs increase (Papin & Kleiner, 1998). U.S. Defense contractors are facing multiple challenges when addressing innovation including limited budgets for development and foreign threats from low-cost competition (Steinbock, 2014). The primary approach for adding value and reducing cost is accomplished by choosing and implementing process improvement methodologies.

Two common continuous improvement methodologies are six sigma and lean. Six sigma is a process improvement methodology that enables organizations to understand and improve their processes through higher rates of quality and lower operating costs (Antony, 2008; Suresh, Antony, Kumar, & Douglas, 2012). Lean manufacturing is a method that aims to reduce waste or "non-value added" variables from processes without compromising productivity. Lean Six Sigma (LSS) combines both into a systematic approach that utilizes statistical analysis to minimize defects per million opportunities to 3.4 while simultaneously removing waste from production processes (Spedding & Pepper, 2010).

The technical nature of organizations within the A&D industry require leaders who can adapt to shifting circumstances. Leadership is collectively defined as modeling values and beliefs that will empower and motivate people to unite to achieve a shared common goal (Emmerling, Canboy, Serlavos, & Batista-Foguet, 2015; Yukl, 2011). Organizational goals remain rooted in providing value to customers while simultaneously driving out inefficiencies. Dating three decades, Hull (1990) argued that to survive in a global economy the United States must continuously develop technology, shift focus to a global management perspective, and improve upon current work practices. The evolving digital environment has triggered higher customer demands that must be addressed through customization and agility within manufacturing (Sousa & Rocha, 2019).

Leadership theory has been heavily researched over the last century and has observed multiple theories. The theories range from behavioral approaches that focus on internal behaviors to inspirational vision based approaches (Emmerling et al., 2015). A prominent leadership theory model proposed by Bass and Avolio (2004) provides a comprehensive Multifactor Leadership Questionnaire (MLQ) that measures five transformational factors, 2 transactional factors, and 2 laissez-faire factors. The LSS methodology requires culture change, customer focus, process management, and statistical analysis of data (Antony, 2004). A common reason for organizational failure of LSS implementation is due to leadership's lack of commitment and focus on the culture (Testani & Ramakrishnan, 2011)(Testani & Ramakrishnan, 2011). Leading culture change to create an innovative environment through transformational leadership is one of the primary components for success (Chen & Zhang, 2011).

Background

Originally introduced in the 1980's by Motorola, six sigma has become one of the leading approaches for continuous improvement because it generated a global standard for measuring quality in relation to performance and cost (Stankalla, Koval, & Chromjakova, 2018). Though comparable to previous quality management techniques, leading organizations have touted that six sigma transformed their respective organization (Schroeder, Linderman, Liedtke, & Choo, 2008; Shafer & Moeller, 2012). Snee (2010) articulated that General Electric, Honeywell, Du Pont, and American Standard used the LSS methodology to spur leadership growth. Key findings from Laureani and Antony's (2017) systematic review exampled the necessity for leadership when sustaining LSS improvements. In their study which focused on six sigma and leadership, Suresh et al. (2012) proposed future research on needing to validate leadership variables that would enable successful six sigma deployment.

A systematic review of continuous improvement failures in manufacturing environments by McLean and Antony (2014) identified lack of management leadership as a core theme. Direct leadership styles favor process focused continuous improvement while supportive leadership styles favor cultural improvement (Brown, Eatock, Dixon, Meenan, & Anderson, 2008). Inability to identify processes for improvement through LSS create leadership impediments concerning project success and employee involvement (Pamfilie, Andreea, & Draghici, 2012). Lack of successful projects or engagement from the team further muddle the leadership traits that are necessary to lead and facilitate the LSS methodology. Swain, Cao, and Gardner's (2018) research provided multiple newer leadership theories that still required understanding how leadership traits and characteristics impact LSS success. The continuous piecemeal contributions

to leadership theory in relation to LSS have not yet collectively replaced the comprehensive model proposed by Bass and Avolio (2004).

Problem Statement

Lineberger and Hussain's (2018) A&D financial performance study reports annual revenues reaching $685.6 billion with a 2.7% increase from 2017 across the entire industry. United States companies accounted for 60% of the global revenue with Europe accounting for the next 31.4%. The five largest companies by revenue are Boeing, Airbus Group, Lockheed Martin, General Dynamics, and Northrop Grumman (Lineberger & Hussain, 2018). These figures present a compelling case for companies to sustain and continuously improve to capture market position in the sector. Snee (2010) estimates that large companies utilizing LSS effectively can expect a 1-2% return on sales per year.

Though numerous benefits for continuous improvement programs have been posited resistance is met through investment costs, training, and increased pressure on current workloads (Wilson, Bhuiyan, & Baghel, 2006). Galli (2018) identified leadership not understanding the necessary approaches during LSS deployment and sustainment as one of the largest risks to success. A literature review of 34 identified critical failure factors for LSS found poor leadership vision and support as a top ten contributor (Albliwi, Antony, Abdul Halim Lim, & van der Wiele, 2014). However, Laureani and Antony's (2017) direct study on leadership and LSS found supporting results for transformational leadership that aligned the business strategy and goals with continuous improvement. A limitation of their study is that it was unable to empirically research which style of leadership would optimize LSS implementation. The correlation between

transactional, transformational, and laissez-faire leadership styles identified in an A&D organization and LSS CSFs will be the focus of this study.

Purpose of the Study

The purpose of this study is to quantitively evaluate if there is a relationship between self-assessed leadership styles and three LSS critical success factors (CSF). The three type of leadership styles as defined by the MLQ are laissez-faire, transactional, and transformational. The three LSS s defined from the literature are management commitment, project selection, and training. A study of the relationship between leadership styles and LSS CSFs will provide valuable insight within the A&D industry. The organization that will be studied currently invests significant resources and capital into independent leadership and LSS training curriculums. Since the introduction of LSS three decades ago, it has continued to be researched and developed within academia. The literature provides multiple case studies of the methodology being led by certified black belts within corporations. Pandey (2007) classified master black belts as mentors to fellow black belts and change agent leaders for developing the organization to six sigma capability. Black belts implement the methodology on a project level by leading and assisting participating team members. The ability to lead and execute these projects is tied in with management commitment, projection selection, and training. The study will also explore how the leadership styles correlate with the three CSFs to provide quantitative evidence to drive industry changes to current practices.

Research Questions

Research Question 1: What is the relationship between a black belt's laissez-faire leadership style as defined by the MLQ and LSS CSFs (management commitment, project selection, and training)?

$H_0$1: There is no relationship between a black belt's laissez-faire leadership style as defined by the MLQ and LSS CSFs (management commitment, project selection, and training).

Alternate Hypothesis 1: There is a relationship between a black belt's laissez-faire leadership style as defined by the MLQ and LSS CSFs (management commitment, project selection, and training).

Research Question 2: What is the relationship between a black belt's transactional leadership style as defined by the MLQ and LSS CSFs (management commitment, project selection, and training)?

$H_0$2: There is no relationship between a black belt's transactional leadership style as defined by the MLQ and LSS CSFs (management commitment, project selection, and training).

Alternate Hypothesis 2: There is a relationship between a black belt's transactional leadership style as defined by the MLQ and LSS CSFs (management commitment, project selection, and training).

Research Question 3: What is the relationship between a black belt's transformational leadership style as defined by the MLQ and LSS CSFs (management commitment, project selection, and training)?

$H_0$3: There is no relationship between a black belt's transformational leadership style as defined by the MLQ and LSS CSFs (management commitment, project selection, and training).

Alternate Hypothesis 3: There is a relationship between a black belt's transformational leadership style as defined by the MLQ and LSS CSFs (management commitment, project selection, and training).

Research Question 4: Does a black belt's laissez-faire leadership style, transactional leadership style, and transformational leadership style, as defined by the MLQ-5X, predict the success of LSS implementation (management commitment, project selection, and training)?

$H_0$4: There is no predictability between a black belt's laissez-faire leadership style, transactional leadership style, and transformational leadership style, as defined by the MLQ, and the success of LSS implementation (management commitment, project selection, and training).

H_A4: There is predictability between a black belt's laissez-faire leadership style, transactional leadership style, and transformational leadership style, as defined by the MLQ, and the success of LSS implementation (management commitment, project selection, and training).

Nature of the Study

The study will be a quantitative correlation study focused on evaluating the relationship between leadership styles and three CSFs to explore if any relationships exist. An online survey questionnaire will be administered to black belt practitioners within Corporation XYZ. The survey will collect basic demographic information, self-rated leadership styles, and perspective on three LSS CSFs. The study is quantitative because it is measuring Likert scale numerical responses from the MLQ-5X and LSS CSFs surveys. The location for the proposed study is across multiple sites within a large A&D Corporation.

The quantitative research study will evaluate the relationship between the independent variables of transformational, transactional, and laissez-faire leadership styles and the dependent

variables of management commitment, project selection, and training. The population for this study includes a non-random sample of 430 black belt practitioners that are actively involved in implementing continuous improvements across multiple locations within the United States. The black belts work within multiple functions and roles directly or indirectly supporting manufacturing activities.

Significance of the Study

Organizations in the A&D industry are always needing to optimize business practices due to the regulatory nature of the environment which causes continuous improvement challenges (Abollado & Shehab, 2018). One methodology for improving business practices is through LSS which improves process performance and removes excessive waste (Thomas, Francis, Fisher, & Byard, 2016). Manville, Greatbanks, Krishnasamy, and Parker (2012) suggested that successful implementation of LSS must occur through bottom-up strategies that empower employees to drive decision making with top management support. Employees commonly associated with the execution of the LSS methodology are trained black belts (Pyzdek & Keller, 2003). Therefore, how black belts lead and make decisions using the methodology is the crux of successful LSS implementation.

Singh and Rathi (2019) noted that LSS implementation was more prevalent in non-manufacturing industries along with the A&D industry lacking awareness of using LSS for continuous improvement. Ebrahimi, Moosavi, and Chirani (2016) also identified a lack of empirical data for how transactional and transformational leadership styles impact manufacturing organizations. The signifigance of this study is that it seeks to quantify how different Full Range Leadership Model (FRLM) (Bass & Avolio, 2004) leadership styles of black belts correlate with

LSS success factors within an A&D manufacturing organization. Analysis of the LSS literature identified that many studies did not provide empirical findings to guide practitioners or contribute to the body of knowledge (Muraliraj, Zailani, Kuppusamy, & Santha, 2018). The outcomes of this research will provide new findings to further build upon in relation to leadership, LSS, and the A&D manufacturing industry.

Summary

Chapter 1 introduced the background overview of the problem statement and identified the purpose of the study. The three LSS success factors were assessed through different leadership styles of black belt practitioners in A&D corporation XYZ. The independent variables in the study included laissez-faire, transactional, and transformational leadership styles. The dependent variables included LSS CSFs of top management commitment, project selection, and training. Four research questions were hypothesized to examine what relationships may exist between both sets of variables. The results from this study will help guide organizations on which types of leadership styles may impact the benefits received from LSS implementation. Chapter 2 includes a literature review of leadership theories, continuous improvement methodologies, FRLM leadership styles, and LSS.

CHAPTER TWO: LITERATURE REVIEW

The intent of this literature review is to support the goals and objectives of the study through prior research conducted on leadership theories and the LSS methodology. The summarized review findings will facilitate the identification of gaps in the current literature and encourage further contribution to the compiled body of knowledge. The literature review is comprised of three core sections which include Leadership Theories, Continuous Improvement Methodologies, and Leadership Styles and LSS. Leadership theories of behavior, contingency, transactional, and transformational along with continuous improvement methodologies of total quality management (TQM), six sigma, lean, and LSS will be holistically reviewed and discussed in greater detail. The review of each discipline is focused within a manufacturing context and the A&D sector.

The databases utilized for the literature review included Compendex (Ei Engineering Village and Inspec), ScienceDirect, Emerald Insight, Google Scholar, and ProQuest (Dissertations and Theses). Keyword searches for leadership theory included common phrases and variants of behavioral leadership, contingency leadership, transactional leadership, transformational leadership, laissez-faire leadership, FRLM, MLQ. Keyword searches for continuous improvement included common phrases and variants of six sigma, LSS, lean manufacturing, LSS CSFs, and LSS critical failure factors. Journals, books, and conferences were screened through study title name and initial review of the abstract. If study abstracts contained potential findings or summarizations related to the core section topics, then those studies were downloaded and saved to RefWorks for later investigation for incorporation to the literature review.

Discussion

The A&D industry is an environment comprised of regulations, ongoing continuous improvement efforts, and strong global competition (Abollado & Shehab, 2018). The A&D sector has always been prone to budget cuts thus spurring the need to compete as technology and cost leaders through multiple strategies including TQM (Papin & Kleiner, 1998). Defense projects run well into hundreds of millions of dollars and require system linkage across multiple smaller projects to be considered efficient (Frinsdorf, Zuo, & Xia, 2014). LSS was first observed in the early 2000's and has since expanded the foundation of TQM. The concept of lean originated from Toyota while six sigma originated from Motorola with both following independent paths since the 1980's (Laureani & Antony, 2017). LSS is a combined continuous improvement methodology that focuses on customer value, reduced costs, and improved quality (Pamfilie et al., 2012).

Thompson's (2005) case study within a military organization reported a leadership competency initiative to integrate multiple levels of different leaders to LSS initiatives. An aerospace company that was facing production challenges implemented LSS and experienced an estimated around 2 million pounds in savings (Thomas et al., 2016). Research studying quality management personality traits speculated personnel having lower openness to continuous improvement activities with a preference for current established practices (Lounsbury, Loveland, Gibson, & Levy, 2014). Antony (2004) identified that prioritizing improvement projects using subjective judgement was one of the limitations of six sigma effectiveness. According to Habidin and Yusof (2013), "Leadership effectiveness allows employee involvement in continual improvement activity, effective communication and collaboration, and better dissemination of operation information and organization strategy in managing quality improvement" (p. 63). The

relationship between leadership styles presented in Bass and Avolio's (2003) MLQ and CSFs for LSS effectiveness will be the aim of this literature review.

Leadership Theories

Behavior Theory

Decades of leadership theory research has created difficulty for scholars when attempting to categorize the relationships between certain behaviors and their effects (Yukl, 2008). Two studies in the 1940's performed at Ohio State University and the University of Michigan began investigating the behavioral approach (Northouse, 2018). Both studies were significant because of relative timing and congruency in findings thus defining task-oriented and relationship-oriented approaches for behavioral leadership (Spain, 2019). Task-oriented leadership aims to solve group problems, achieve goals, and overcome obstacles through task related behaviors (Bass, 1960). Relationship-oriented leadership focuses on the team and creating strong relationships with customers and different functional departments (Cserháti & Szabó, 2014). The dichotomy between these two perspectives is relevant in theory but is seldom found in practice because of situational-based leadership (Laureani & Antony, 2017).

During the 1950's and 1960's researchers conducted numerous additional studies at both universities to find a common leadership theory to explain all situations (Northouse, 2018). Following this research, the Managerial Grid model was created which combined two organizational variables of concern for production and concern for people (Blake, Mouton, Barnes, & Greiner, 1964). Concern for production is measured through task-oriented and concern for people is measured through relationship-oriented.

The grid has two axes with values between 1 and 9. The horizontal axis represents production concern and the vertical axis represents people concern. The leader can assign a value on each axis to obtain perspective on how they perceive themselves and how their employees perceive them. For example: a 1,9 leader values people being comfortable, a 5,5 leader drives production to a point where people are not dissatisfied. and a 9,9 leader strives to find optimal solutions for the organization and worker (Fisher, 2009). Taucean, Tamasila, and Negru-Strauti (2016) summarized the multiple leadership approaches on the grid which include:

1. Impoverished Management (1,1): The leader is failing to structure and support an environment that is both beneficial to the employees or business. There is a loss of synergy and cohesiveness amongst the team.
2. Country Club Management (1,9): The leader is relationship focused and firmly believes that a satisfied team will work diligently and produce positive results. Employees enjoy a stress-free workplace at the expense of proper guidance from leader.
3. Authority-Compliance Management (9,1): The leader is an absolute autocrat that views their employee's needs secondary to the organizational goals and objectives. Rigid policies and infrastructure dominate the group along with punishment as the primary motivator.
4. Middle of the Road Management (5,5): The leader assumes a balanced view of both production concerns and people concerns for their employees. Accommodating both perspectives often lead to average results.

5. Team Management (9,9): The leader aligns the organizations goals and objectives along with employee's needs to create a highly productive and motivating work environment. The employees understand the higher purpose of their work and are fully committed.

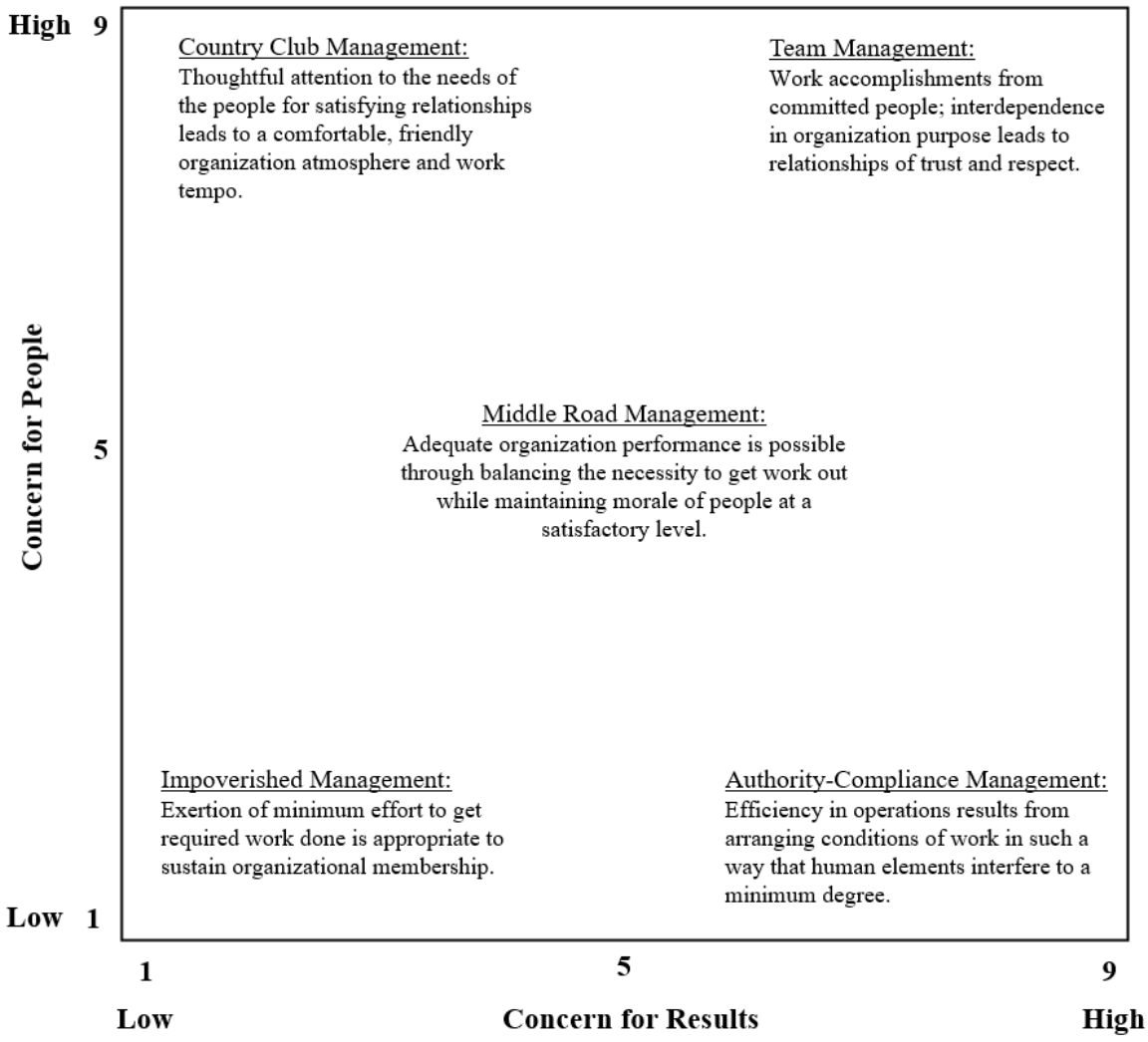

Figure 1: Managerial Grid. (Blake & McCanse, 1991)

Team management maximizes both concern for people and concern for results and is considered the ideal target to achieve for management. In review of early management theory practices from the 1900's, employee investment balanced with meeting production goals was found to be the optimal approach (Wren & Bedeian, 1994). Sherman, Oppedisano, and Armandi

(2003) found the managerial grid to be insufficient for explaining leader types that were subject to common situational constraints. Behavioral theory fails to offer leadership success in all scenarios and has led into further research on other theories that are more encompassing for situational factors (Halaychik, 2016). The contingency theory subsequently followed explaining and compounding the situational aspects not defined in behavioral leadership.

Contingency Theory

The contingency theory explains the varying situational factors involved in leadership to provide the most effective and suitable leadership style for a given scenario (Oc, 2018). It argues that there is not one exact style of leadership that fits every situation or every leader in that situation. The contingency theory is comprised of four primary theories which include: The Fiedler's contingency model, Hersey and Blanchard's situational leadership theory, path-goal theory, and leadership substitute theory (Laureani & Antony, 2017a).

Fiedler's model identifies task-oriented or relationship leadership styles. How effective the leader is with their subordinates is based on how much influence and control they possess in each situation (Sherman et al., 2003). This is measured against two main variables which are the leader's attributes (style) and situational control (Ayman, Chemers, & Fiedler, 1995). Therefore, the model builds upon behavior theory through the inclusion of situational contingency as a variable.

Fiedler (1967) created the Least-preferred coworker (LPC) questionnaire for leaders to rate individuals to determine if they are task-oriented or relationship-oriented. The questionnaire is used to rate the least favorable co-worker using adjectives on an 8 point scale; a higher score representing a relationship-oriented style and a lower score representing a task-oriented style

with that individual (Spain, 2019). The leader's competency to control the situation with their subordinates is viewed through three contingency variables which are leader-member relations, task structure, and position power (Fiedler, 1967). Seymour & Elhaleem (1991) defined the three variables as:

- Leader-member relations: The amount of trust and confidence subordinates within the group have for their leader.
- Task structure: The structure and formalization of tasks for the subordinates in the group to perform.
- Position power: The degree of influence and authority the leader is perceived to have from the subordinates in the group.

Situations resulting from these three variables are assigned as highly favorable, intermediate, or unfavorable. Task-oriented leaders align with highly favorable or unfavorable situations and relationship-oriented leaders align with intermediate situations (Türk, Toomet, & Altmäe, 2013; Yukl, 2011). Fiedler's model expands upon behavior theory through the view that there are multiple routes a leader can take based on the situation to obtain success within their team (Halaychik, 2016; Spain, 2019). However, a shortcoming of Fiedler's model is that it treats the leadership style as an absolute match for a situation therefore limiting flexibility (Emmerling, Canboy, Serlavos, & Batista-Foguet, 2015).

The Hersey-Blanchard theory draws parallels to Fiedler's model but differentiates itself through the situational aspect. Effectiveness is measured through being able to succeed in multiple situations using different styles of leadership. The leader must be able to adapt their style using directive and supportive dimensions in conjunction with the competence and commitment of their followers (Northouse, 2018). The theory functions through a sliding scale

of employee maturity level using four dynamic leadership styles of directing, coaching, supporting, and delegating (Halaychik, 2016). The scale begins with directing and assumes low ability of the employee and high involvement from the leader. As the employee matures within their skills and capabilities the leader can transition into a less direct oversight roles.

Path-goal theory contrasts situational leadership by correlating leadership style with employee characteristics and organizational goals (Northouse, 2018). The leader carries the responsibility of motivating and guiding their employees to achieve goals and minimize obstacles (Sherman, Oppedisano, & Armandi, 2003). There are currently four primary behaviors that leader's exhibit in this theory. House (1996) identifies these four behaviors as directive, supportive, participative, and achievement oriented. The directive leader relates with task-oriented leadership and is known for providing direction that is supported by a framework of schedule, rules, and processes. The supportive leader relates with relationship-oriented leadership and is considered with subordinate wellbeing and personal needs. The participative leader is a true team player and empowers subordinates to be involved in the decision-making process for higher fulfillment of purpose within the organization. The achievement oriented leader strives for continuous performance improvement through benchmark goals, encouragement, and excellence (House, 1996). A key distinction with these four behaviors is that they are situational and will require the leader to change based on the nature of the task (Spain, 2019).

Leadership substitute theory strives to remove the necessity for extensive leadership and instead encourages subordinates to lead themselves in different situations (Schriesheim, 1997). In comparison to situational leadership, research has found leadership substitute to emphasize subordinate initiative through guidance and motivation that negates needing the leader (Howell,

Bowen, Dorfman, Kerr, & Podsakoff, 1990). Yukl (2011) identified the independent variable as supportive leadership and the situational variables as task, team, and organizational attributes. In review of employee performance outcomes Muchiri and Cooksey (2011) found substitutes for leadership to have a positive impact on organizational performance in the context of the three dependent variables mentioned earlier. A case study examining these situational variables found minor significance in the hypothesized interactions but concluded that further research is still valuable for theory development (de Vries, Roe, & Taillieu, 2002). Dionne, Yammarino, Atwater, and James (2002) examined 49 organizations and reported that their results did not support the situational variables of the theory. The author's concluded that prior significance reported in other studies within the literature may be suspect from bias.

The contingency theory provides substantial consideration of both task-oriented and relationship-oriented views. The model capitalizes on the leader's role with a subordinate in each situation while disenchanting the myth that there is one optimal route as believed in behavioral theory (Spain, 2019). The primary weakness of the contingency theory identified by Halaychik (2016) is that leaders will become prone to only evaluating situational variables while failing to see larger long-term goals. Halaychik (2016) further emphasizes that leaders may become unpredictable by adjusting to the rotating wheel of varying styles for each unique situation. Naturally, this would create a lack of confidence and trust within the leader from their subordinates. Transactional and transformational leadership theory provide approaches to build trust and create an innovative atmosphere using team perspective (Xie et al., 2018).

Transactional and Transformational Theory

Transactional leadership and transformational leadership are comprised of two contrasting views: transactional focusing on task-orientation and transformational focusing on relationship-oriented (Tyssen, Wald, & Spieth, 2014). The leader's role is to provide a infrastructure of policies and goals to facilitate the employee being able to execute tasks (Halaychik, 2016). Transactional leadership motivates employees to complete tasks through rewards or punishments. Three dimensions of transactional leadership are contingent reinforcement, active management-by-exception, and passive management-by-exception.

Northouse (2018) defines contingent reinforcement as followers who subscribe to their leader's agenda of tasks for rewards or punishment. In management-by-exception, active leader's take initiative before goal departures occurs while passive leader's do not take initiative until after the fact (Den Hartog, Van Muijen, & Koopman, 1997). The key difference being that the active leaders are ahead of their problems while passive leaders are behind theirs. Though transactional leadership does have a purpose in some scenarios the effectivity is often challenged. This is primarily due to a leader and employee relationship that is built on transactions that aim to reward or punish in each situation. Lack of consideration for other factors a leader or organization may face has led this theory to be highly criticized amongst scholars (McCleskey, 2014). In a review of leadership and quality work culture in financial institutions, Ali, Jangga, Ismail, Kamal, and Ali (2015) discovered transactional leadership as having the highest influence on work culture.

Contrasting transactional leadership is transformational leadership which involves inspiration, vision, and prioritizing the needs of the individual while aligning the goals of the organization (Den Hartog, Van Muijen, & Koopman, 1997). In highly innovative cultures the

transformational leader is known for addressing problems from the bottom up, unique contributions, creativity, and empowering their followers (Bass & Avolio, 1993). To comprehend innovation and being able to spur change Cummings and Worley's (2014) discussion of organizational development (OD) presents the following high-level flow chart:

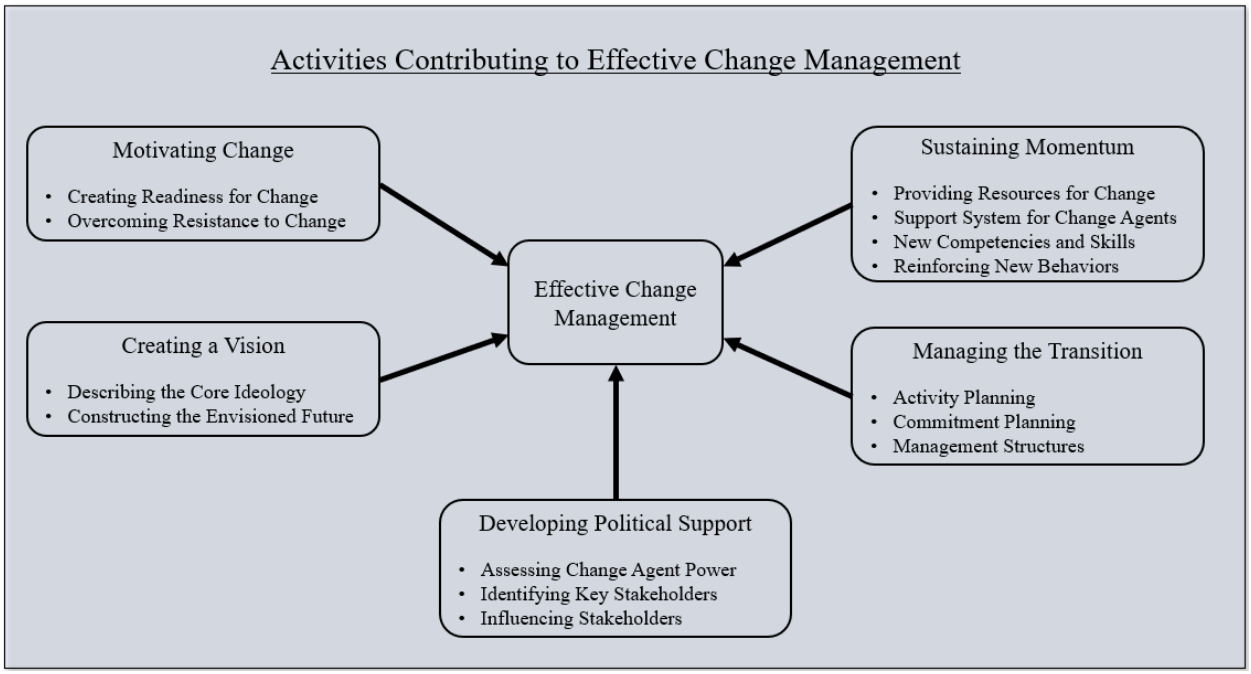

Figure 2: Activities Contributing to Effective Change Management. (Cummings & Worley, 2014)

Several of the components for effective change management listed above reflect the ideologies found in transformational leadership. The leader must have a future oriented vision, motivate beyond current barriers, and provide resources. Transformational leadership is modeled through the four I's which are idealized influence, inspirational motivation, intellectual stimulation, and individualized consideration.

For an effective organizational leader Bass & Avolio (1994) summarized the four I's as follows: Idealized influence explains how well followers view their leader as a role model and

someone they want to emulate in the work environment. The leader is known for displaying respected traits and achieving success. Inspirational motivation is how well the leader can "paint the picture" of important goals and easily motivate followers to participate. High energy and optimism are regularly displayed character traits. Intellectual stimulation involves the degree to which the leader can creatively challenge their followers to problem solve and create a new baseline of standards. These activities stimulate new perspectives and innovation. Individualized consideration concerns the leader's ability to cater to individual differences and personalities found within the followers of their team. Offering stretch assignments and empowering through additional responsibility are key elements for effectiveness (Bass & Avolio, 1994). These four dimensions example the true strength of transformational leadership for both the followers and organization.

Research investigating leadership styles and innovation in manufacturing companies found a significant relationship between transformational leadership and exploratory innovation (Ebrahimi, Moosavi, & Chirani, 2016). The author's population for the study included approximately 5000 manufacturing companies and utilized the MLQ proposed by Bass and Avolio. A study concerning CEO leadership styles and innovation found that transformational leadership styles were more effective when compared to transactional leadership in dynamic organizations (Prasad & Junni, 2016). Strang's (2005) case study found positive correlation between leaders displaying transformational behaviors and organizational output (deliverables, metrics, customer satisfaction). Xie et al. (2018) postulated transformational leadership is more conducive for innovative environments but transactional leadership provides value for teams in other situations. This contradicts the current literature that transactional leadership is inferior

when compared with transformational leadership. These positive findings for transformational leadership provide key insights for A&D corporations wanting to pursue exploratory innovation.

Full Range Leadership Model

The FRLM was originally proposed by Bass (1985) and has been a focal point of scholarly review and exploration for over twenty years (Muenjohn & Armstrong, 2008). Building on Burns's (1978) original view of transactional and transformational leadership, Bass argued both styles are complimentary and not exclusive events in the leadership continuum (Notgrass, 2014). Bass based most of his research on the initial shortcomings of Burns' (1978) research with emphasis on the power of transformational leadership (Stewart, 2006). Khanin's (2007) case study review of both philosophies found Burns's (1978) rooted in the political realm with Bass's (1985) perspective grounded in military training.

"The full range leadership theory represents nine single-order factors comprised of five transformational leadership factors, three transactional leadership factors, and one non-transactional laissez-faire leadership" (Antonakis, Avolio, & Sivasubramaniam, 2003). The single factors identified by Bass include; idealized influence behavior, idealized influence attribution, intellectual stimulation, individualized consideration, inspirational motivation, contingent reward, active management by exception, passive management by exception, and laissez-faire (Bass, Avolio, Jung, & Berson, 2003). Laissez-faire leadership is a non-existent relationship between a leader and follower with research deeming it the most ineffective style (Avolio, 2011). Figure 3 from Bass and Avolio (1995) provides a comprehensive diagram of the model.

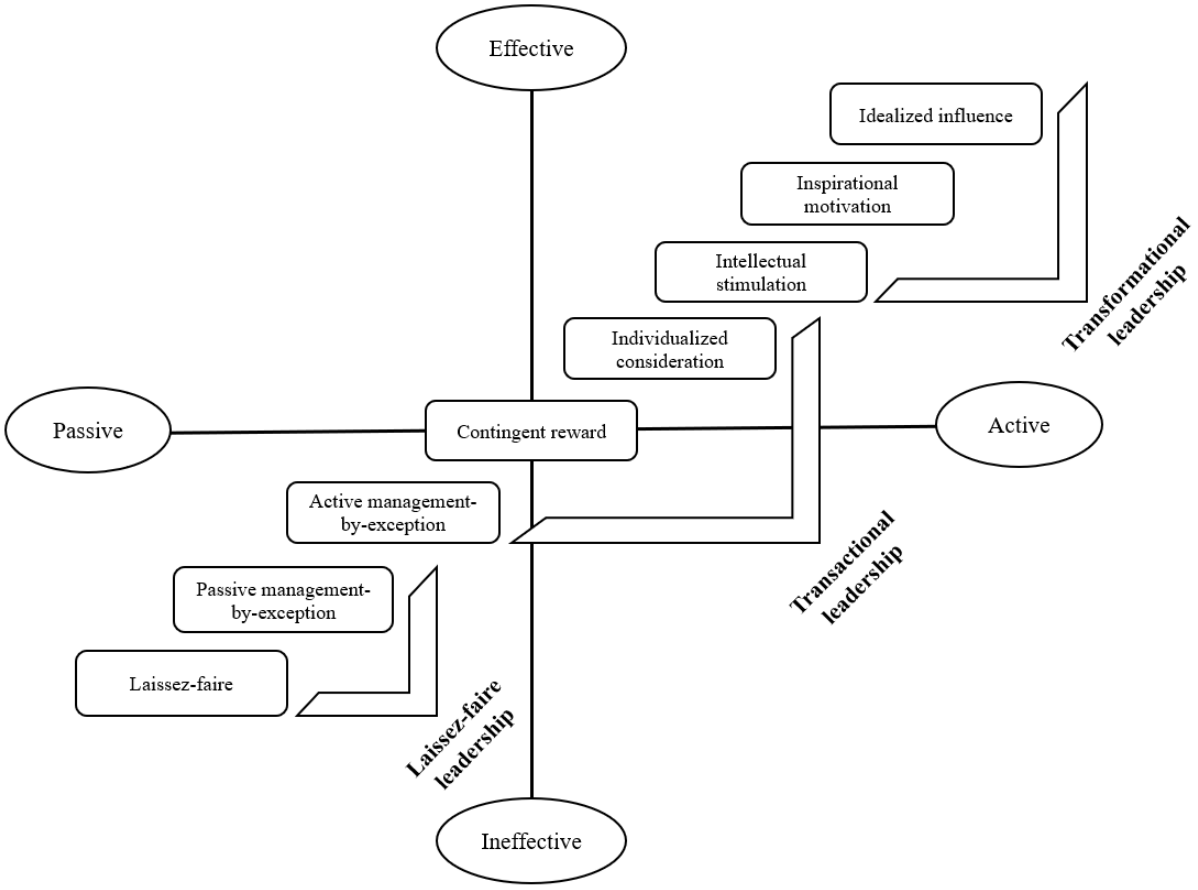

Figure 3: Full Range Leadership Model Diagram. (Bass & Avolio, 1995).

Transformational leadership takes the highest precedence by being both active and effective. Coming next is transactional styles floating around the neutral point of the scale. Laissez-faire leadership is ranked last as both passive and ineffective. A hierarchical scale of effectiveness is observed through these three categories showing that all styles can be found in any leader (Vigoda-Gadot, 2007). Discussions of each component can be found in previous sections of the literature review. By having the full range leadership theory developed, Bass then created a practical assessment tool known as the MLQ (Ebrahimi et al., 2016).

The current version of the MLQ is Form 5X which is a subsequent result of continuous modifications and ongoing research (Bass & Avolio, 2004). Earlier versions were found to have

misleading wording, factor validity, and scaling issues (Avolio, Bass, & Jung, 1999). The questionnaire is survey based containing 45 items with 36 items tied to leadership factors and 9 items tied to assessing three leadership outcomes (Antonakis et al., 2003). The 36 items consist of five transformational, three transactional, and one laissez-faire factors. The MLQ has become the common assessment tool for organizational science research to measure transformational and transactional leadership styles (Tejeda, Scandura, & Pillai, 2001).

By using the MLQ as an assessment tool, the FRLM can combine various leadership theories while including additional elements of how to transform individuals for achieving greater organizational effectiveness (Antonakis, 2001). Avolio (2011) summarized that transactional leadership is applicable for goal setting and monitoring, however, transformational leadership sustains higher levels of performance. A key strength of the model is that it accommodates multiple styles while striving to shift leaders to the transformational end of the dynamic scale (Kirkbride, 2006). A study assessing MLQ validity through leadership styles and organizational profit in a transportation company found positive correlation for transformational leadership instead of transactional leadership (Rowold & Heinitz, 2007).

Continuous Improvement

Total Quality Management

Competitive work environments stemming from multiple types of organizations over the last few decades has spurred continual product improvements to exceed customer needs (Kumar, Khurshid, & Waddell, 2014). This created the TQM management philosophy which drives continuous quality improvement through organizational processes and services (Topalović, 2015). TQM was created by Edward Deming and took form in Japan during the 1950's because

of western American management not welcoming it (Bajpai, 2018). Deming (1986) proposed fourteen points of management which are:

1. Create constancy of purpose towards improvement of product and services.
2. Adopt the new philosophy and awaken to the need for leadership change.
3. Eliminate mass inspection by building a higher quality product.
4. Cease the practice of awarding business purely on the price tag.
5. Constant continuous improvement for the system of production and service.
6. Institute training.
7. Institute leadership.
8. Drive out fear from the company.
9. Remove barriers between employee's and departments.
10. Eliminate slogans and targets demanding higher levels of productivity.
11. Eliminate work standard quotas on the production floor. Eliminate management by objectives and by numerical goals.
12. Eliminate barriers that rob employees of pride in their workmanship or contributions.
13. Institute education and self-improvement programs.
14. Achieve the transformation through action.

Deming delineated management not knowing the difference between special cause and common cause variation within processes as the core problem for achieving higher levels of quality (Bakir, 2005; Waldman, 1994). Organizations aiming to grow and compete must be customer-oriented and embody management that drives continuous improvement approaches that are facilitated through TQM (Irani, Beskese, & Love, 2004). Customer satisfaction with a product or service is measured by loyalty through repeat business over extended periods of time

which indicates adherence to the TQM model (Topalović, 2015). Deming (1986) highlights that the fourteen points above must counteract the seven deadly diseases which are:

1. Lack of constancy of purpose.
2. Emphasis on short-term profits.
3. Evaluation by performance, merit rating, or annual review of performance.
4. Mobility of management.
5. Running a company on visible figures alone.
6. Excessive medical costs.
7. Excessive costs of warranty fueled by lawyers who work for contingency fees.

Top management bears the responsibility of implementing and managing the initiatives that support the TQM philosophy within the organization (Sahoo & Yadav, 2018). These top level leaders play a significant role in open communication, forecasting necessary changes to the TQM framework, and taking responsibility for the constant improvement of quality (V. Singh, Kumar, & Singh, 2018). A synopsis from the three most renowned quality experts echoes these statements. Crosby, Juran, and Deming unanimously agreed on the extent at which management is responsible for taking ownership of providing leadership towards quality management within TQM implementation (Richardson, 1997).

Increasing competition during the 1990's along with utilization from the Department of Defense (DoD) spurred the introduction of TQM into the aerospace industry (Papin & Kleiner, 1998). The United States DoD was attempting to remain profitable against a wavering defense budget (McCarthy & Elshennawy, 1991). During this same time a similar continuous improvement methodology called Six Sigma was gaining traction across multiple industries. Large financial gains were being reported in the 1990's such as General Electric and Allied

Signal saving around 2 billion dollars from six sigma implementation (Patel & Desai, 2018). The late 1990's saw a general decline in TQM literature as the United States began showing interest in Six Sigma for its Define, Measure, Analyze, Improve, Control (DMAIC) approach that aligned with Western work philosophy (Andrea, 2011).

Six Sigma

Six Sigma is a continuous improvement methodology that was introduced by Motorola in the 1980's and was quickly adopted by International Business Machines (IBM) and General Electric for its ability to satisfy multiple organizational needs (Aboelmaged, 2010). Galli (2018) states "At its core, Six Sigma has a primary purpose of process variation reduction. By reducing variation, the processes are easier to manage and the cost will ultimately decrease" (p. 81). The goal of continuous variation reduction in Six Sigma is to achieve 3.4 defects per million opportunities (DPMO) for each critical characteristic identified by the product or process (Maleyeff, 2004). This goal is achieved through continuous improvement projects that are led by trained black belts and green belts that use the DMAIC methodology (Pulakanam & Voges, 2010).

TQM was a powerful transformational philosophy that lacked the structural means to execute sustained improvements and develop business metrics (Spedding & Pepper, 2010). Six sigma has four key aspects that differentiate it from TQM. Cost savings from projects, continuous improvement through culture and process, strong linkage between tools and techniques, and a solid foundation of certified experts. (Antony, Kumar, & Madu, 2005). Schroeder et al. (2008) highlight the distinctions between TQM and Six Sigma below:

- Both methodologies value customer input at the organizational and project levels.

- Six Sigma relies on the DMAIC approach that connects different tools in the process while TQM focuses on process ownership.
- Both methodologies require top management support. Six Sigma relies on leadership for the overall improvement process by utilizing champions.
- TQM teams are inclusive and ongoing in specific work areas through charters. Six Sigma teams are formed at the top management level to solve specific problems and then dissolved immediately after.

Zu, Fredendall, and Douglas's (2008) study on six sigma identified practices that were consistent with Schroeder et al.'s (2008) research: the use of quantified improvement metrics and establishing a framework when performing improvement projects. The framework should contain customer input, metrics that meet goals, and management selected improvement projects that can be financially measured for return on investment (Pyzdek, 2003). Little q projects are those that address lower level processes while Big Q projects address higher level organizational goals to achieve customer satisfaction (Dinesh Kumar, Saranga, Ramírez-Márquez, & Nowicki, 2007). Projects are led by certified experts in the six sigma methodology.

The three primary belts recognized in the industry are green belts, black belts, and master black belts. Pandey (2007) classifies master black belts as mentors to fellow black belts and change agent leaders for developing the organization to six sigma capability. Black belts implement the methodology on a project level by leading and assisting participating team members. Green belts support projects through active participation and integrate the tools and knowledge into their regular job function (Pandey, 2007). Management's role is to select projects that will link customer goals (big Y) through process goals (small y) for organizational improvement (Ray & Das, 2010). Project champions align the strategic business needs with the

selected improvement projects and support their teams with resources (Linderman, Schroeder, Zaheer, & Choo, 2003).

Lack of global six sigma certification standards have led many organizations to be wary of external belt certifications thus requiring internal certification programs (Laureani & Antony, 2012). Organizations should focus on selecting employees with prior manufacturing floor experience that also possess the required blend of technical and people skills for certification (Lee-Mortimer, 2006). Variability in the six sigma training curriculum for belt certification is a limitation of the methodology within organizations (Antony et al., 2019). A counter to this limitation is training programs that offer practice of the tools in realistic work environments and also encourage student feedback for improving the training curriculum (Mueller & Cross, 2019). Six sigma tools range across multiple levels of complexity for different projects through classification schemes that all stem from the DMAIC methodology (Uluskan, 2016).

Lean Manufacturing

Lean is a concept (Krafcik, 1988) derived from The Toyota Production System which aims to eliminate waste using just-in-time (JIT) production and automatic processing (Ohno, 1988). The term ‘lean production’ was popularized by the book “The Machine That Changed The World” (Womack, Jones, & Roos, 1990). Lean manufacturing strives for perfection through high quality, low costs, and eliminating all activities that the customer will not pay for (Kumar & Kumar, 2012). Important concepts of lean are the combination of continuous improvement initiatives through waste removal, multifunctional teams, and pull systems with zero defects (Karlsson & Åhlström, 1995). In 2007, a United States manufacturing study interviewing 433

participants discovered that 70% of their companies applied lean production as the primary continuous improvement strategy (Abolhassani, Layfield, & Gopalakrishnan, 2016).

Lean identifies and removes non-value added activities of manufacturing or service processes (Dahlgaard-Park, Andersson, Eriksson, & Torstensson, 2006). Value-added activities support the pull system of products at a set price and rate to maximize customer satisfaction (Goshime, Kitaw, & Jilcha, 2019; Womack & Jones, 1996). The common seven forms of waste are transportation, inventory, motion, waiting, over-production, over-processing, and defects (Spedding & Pepper, 2010). The eighth waste of 'unused employee creativity' accounts for lost value from not properly tapping into the knowledge of the workforce (Liker, 2004). Removing these eight forms of waste consistently within large production systems is the aim of lean manufacturing (Vinodh & Asokan, 2019).

Dresch et al. (2019) identified the following lean tools to improve efficiency in Brazilian manufacturing small and medium enterprises (SME): 5S, Visual Management, Standard Work, Poka-Yoke, Kanban, and Single Minute Exchange of Die (SMED). The Value Stream Mapping (VSM) tool is used in manufacturing processes to quickly visualize waste and create action plans for improvement (Dinis-Carvalho, Guimaraes, Sousa, & Leao, 2018). Dadashnejad and Valmohammadi (2019) state:

> One of most important tools for lean production is VSM, which identifies and reduces errors, losses, waiting time and improves value adding time, leading to enhanced product quality through empowering production unit in terms of production risk and cost reduction in the long term.

Alaskari, Ahmad, & Pinedo-Cuenca's (2016) research of manufacturing SMEs identified that 5S, Kanban, Poka-Yoke, and SMED were the best tools for influencing the key performance

indicators (KPI) of quality, cost, and schedule. 5S is a Japanese philosophy that models workplace improvements through sort, set in order, shine, standardize, and sustain principles (Randhawa & Ahuja, 2017). Kanban is a visual management tool used to signal product movement to support manufacturing pull systems for the JIT principle (Thomas, 2018). Abolhassani et al. (2016) study in the US manufacturing industry found poka-yoke (mistake proofing) as the most implemented tool by lean practitioners. SMED is a technique used to streamline machine setup times to a goal of less than 10 minutes for mitigating idle time and process bottlenecks (J. Singh, Singh, & Singh, 2018).

The five principles of lean; add value for the customer, identify the value stream, continuous production flow, a pull system, and perfection (Womack & Jones, 1996) require a blend of techniques that are based in TQM and JIT theories (Bendell, 2006). Lean manufacturing has possible pitfalls which include customer dissatisfaction, stifled innovation, thin supply chains, and ineffective continuous improvement (Chen, Lindeke, & Wyrick, 2010). Lean focuses on waste between process steps while six sigma emphasizes a statistical approach to improve processes through variation reduction (Antony, 2011). Nave (2002) highlights the key distinctions between lean and six sigma in Table 1.

Table 1: Lean and Six Sigma Comparison

Methodology	Lean	Six Sigma
Main objective	Remove process waste	Reduce process variation
Application guidelines	1. Identify value 2. Identify value stream 3. Flow 4. Pull 5. Perfection	1. Define 2. Measure 3. Analyze 4. Improve 5. Control
Assumptions	- Removing waste will improve business performance - Multiple smaller improvements are better than systems analysis	- There is a problem to solve - Data is valued - System output improves when process variation is reduced
Focus	Flow focused	Problem focused
Primary effect	Reduced flow time	Uniform process output
Secondary effects	- Less variation - Uniform output - Less inventory - Flow - performance measure for managers - Quality improvements	- Less waste - Faster throughput - Less inventory - Fluctuation - performance measure for managers - Quality improvements
Criticisms	Statistical or system analysis not valued	- Processes improved independently - System interactions not considered

Note. From How to compare six sigma, lean and theory of constraints. (Nave, 2002).

The secondary effects from lean and six sigma in Table 1 complement the other philosophy while both creating less inventory and higher quality. Organizations implementing only lean or six sigma in isolation may fail because each philosophy contributes towards different aspects of organizational performance (Arnheiter & Maleyeff, 2005). Pacheco, Pergher, Vaccaro, Jung, and ten Caten (2015) inferred that both philosophies are complementary and combining both into a single model is feasible. Bentley and Davis (2010) state the fusion of lean and six sigma improvement methods is required because:

- Lean itself cannot bring a process under statistical control.
- Six sigma alone cannot dramatically improve process speed or reduce invested capital.

- Both enable the reduction of the cost of complexity (p. 4).

Lean Six Sigma

LSS encompasses the complementary benefits offered by both the lean and six sigma continuous improvement methodologies. Implementing lean in isolation narrows available tools for improvement while implementing six sigma in isolation results in a loss of strategic vision (Spedding & Pepper, 2010). Khaled's (2013) analysis of the A&D industry found that the use of six sigma techniques was gaining more prominence due to reductions in costs and time. Zhang, Irfan, Khattak, Zhu, and Hassan's (2012) literature review of LSS found that the military industry uses the methodology to focus on process improvement and root cause investigation. Arnheiter and Maleyeff's (2005) comparative study on lean and six sigma integration identified six primary tenets that are summarized in Figure 4. The six sigma approach provides the lowest cost for the producer while the lean approach adds the highest value to the customer. Combination of both disciplines results in an optimal trajectory of higher customer value and lower cost for the organization.

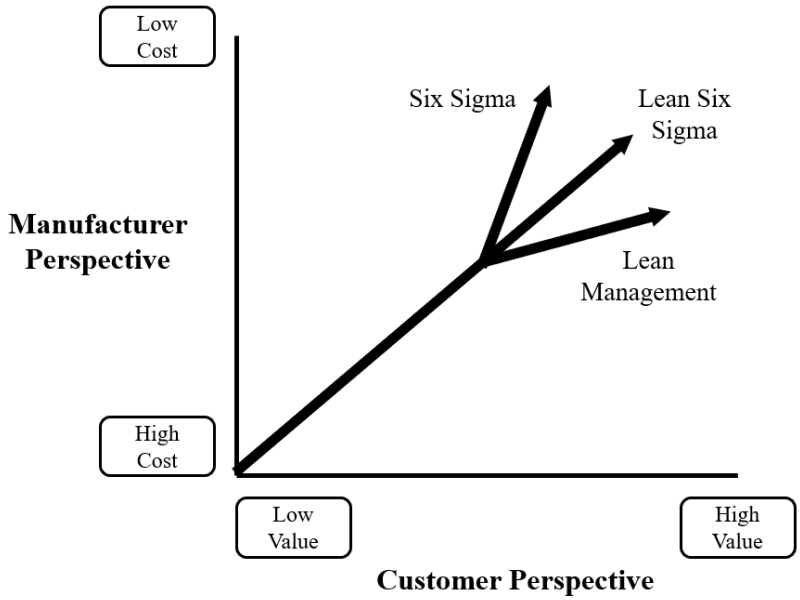

Figure 4: The Advantage of Lean Six Sigma. (Arnheiter & Maleyeff, 2005)

Sreedharan and Raju's (2016) literature review of LSS in multiple industries annotated gaps in deployment methodologies and how to apply tools within DMAIC. A systematic review of the manufacturing industry found lack of implementation guidelines and not understanding how to use the tools within the top five limitations for LSS (Albliwi, Antony, & Lim, 2015). Raval and Kant's (2017) exhaustive study on 58 LSS frameworks observed numerous inconsistencies and concluded that only 1 framework was comprehensive. The authors discussed academic "conceptual" frameworks that lack practicality and urged researchers to utilize corporate practitioner input. Singh and Rathi's (2019) review of LSS implementation found the manufacturing industry still needing further research despite overall growth of the philosophy within the sector.

Laureani and Antony (2012) highlighted the evolution of quality management knowledge and tools occurring independently from the business realm. The parallel yet delayed application between academia and organizations support Raval and Kant's (2017) and Singh and Rathi's

(2019) findings. Nonetheless, organizations can identify and align with CSFs to influence successful implementation. Rungasamy, Antony, and Ghosh (2002) stated "CSFs are those which are essential to the success of any program or technique, in the sense that, if objectives associated with the factors are not achieved, the application of the technique will perhaps fail catastrophically" (p. 218). Snee (2010) articulated for LSS to be successful the organization must have the following eight items:

1. Financial results.
2. Involved top management leadership.
3. DMAIC methodology
4. Project completions within six months.
5. Defined goals and objectives.
6. Certified practitioners.
7. Voice of customer and variation reduction.
8. Statistical analysis.

A case study of 40 large manufacturing organizations that implemented LSS experienced positive financial results, satisfied customers, and multiple types of reductions within the manufacturing processes (Antony, Snee, & Hoerl, 2017). The current LSS literature identifies multiple key CSFs including top management commitment, project selection, and training (Abu Bakar, Subari, & Mohd Daril, 2015; Frinsdorf et al., 2014; Manville, Greatbanks, Krishnasamy, & Parker, 2012; Muraliraj et al., 2018; Näslund, 2013; Raja Sreedharan, Vijaya Sunder, & Raju, 2018; Setijono, Laureani, & Antony, 2012; Walter & Paladini, 2019). Albliwi et al.'s (2014) literature review of critical failure factors posited lack of management support, lack of training, and poor project selection as the primary three causes of unsuccessful LSS deployment. The

success factors identified by these authors all share common themes of management, project selection, and training.

Top Management Commitment

LSS is a top-down initiative that starts with top management commitment and diffuses down through the hierarchical chain (Alexander, Antony, & Rodgers, 2019). Results from an empirical study querying LSS professionals reported management commitment as the highest CSF with an average score of 4.63 out of 5 (Setijono, Laureani, & Antony, 2012). Organizations with top management leaders committed to aligning objectives and supporting the right improvement projects have experienced the highest dollar savings (Antony & Gupta, 2019). An element of project support is regular reviews and interactions with black belts to understand project progress and facilitate organizational learning (Laux, Johnson, & Cada, 2015).

Management's ability to switch focus from financial indicators to overall organizational performance subsequently addresses bottom line profits and costs (Galli, 2018). The paradigm shift from linear cost reduction targets to holistic management fosters innovation and creativity within the workforce (Bendell, 2006). Implementation barriers mostly stem from organizational culture and change resistance rather than LSS methodology or tools (Assarlind, Gremyr, & Bäckman, 2013). Management often overlooks the ideologies that dictate cultural response and influence during continuous improvement initiatives (Knapp, 2015). An analysis of emerging viewpoints for LSS reported that the methodology must be infused with culture, training, and leadership (Rodgers, Antony, He, Cudney, & Laux, 2019).

Project Selection

Companies selecting projects using an ad-hoc approach are more likely to be unsuccessful than companies using the portfolio approach (Zimmerman & Weiss, 2005). The ad-hoc approach is organizations relying on projects champions to choose and support individualized projects (Ward, Poling, & Clipp, 2008). Project portfolio management is a continuous evaluation of projects, prioritizations, and resources for agile alignment to organizational objectives (Padhy, 2017). The portfolio approach results in strategic organizational goals "Big Y" being flowed down to the operational levels to be executed through "small y" projects (Duarte, Montgomery, Fowler, & Konopka, 2012). Pyzdek (2003) defined the project portfolio being comprised of customer value projects, shareholder value projects, and other six sigma projects, which all require feasibility analysis for selection.

LSS projects are based in the DMAIC methodology which acts as a framework for blending tools from both lean and six sigma (Albliwi et al., 2015). The project charter sets the foundation for projects by outlining the problem definition, scope, team members, and timeline for completion (Swarnakar & Vinodh, 2016). Manufacturing projects lacking clear problem definitions and goals are not likely to achieve optimal solutions or substantial results (McLean & Antony, 2014). Antony and Gupta (2019) further identified scope creep as a failure factor needing to be addressed through documentation of boundaries and roles during the charter phase. Laux et al.'s (2015) study on manufacturing green belt project barriers identified project selection, project management, and leadership as significant factors that can negatively impacted timely completions.

Setijono and Dahlgaard (2007) presented a project selection methodology focused on addressing perceived customer value instead of pursuing only Big Q or little q projects. Kirkham,

Garza-Reyes, Kumar, and Antony's (2014) study on European manufacturing organizations identified subjective and objective prioritization methods. The study reported that 42% of large manufacturing organizations used "gut feel" subjective methods to select improvement projects. Mast and Lokkerbol (2012) concluded that ill-structured projects emphasizing human subjectivity and personal values are poor candidates for the DMAIC methodology. Pyzdek (2003) stressed that management decisions for project selections should be grounded in stakeholder requirements and objective data. Performing stakeholder analysis to capture "voice of customer" inputs during the define phase streamlines selection of customer-focused projects (Elias, 2016).

Cserháti and Szabó's (2014) study on organizational events identified leadership and interpersonal skills as critical project success factors. Creasey (2007) elaborated that LSS encompasses project management and change management when analyzing aspects of organizational change. According to Sony, Naik, and Therisa (2019), "The behavioral aspect of LSS initiatives like leadership, change management, organizational learning, creativity, etc., should be used in LSS program. Quality management is incomplete without these soft elements" (p. 426). Employees involved in project selection are more likely to participate in management supported projects with less resistance (Galli, 2018). Effective project management and change management are highly correlated with transformational leadership (Lertwattanapongchai & Swierczek, 2014).

Training

Sony, Naik, and Therisa's (2019) study on reasons for discontinued LSS initiatives identified lack of training and disuse of certified belts as contributors. Walter and Paladini (2019)

review of Brazilian publications found consensus that training was a costly pursuit requiring leadership to support it. Snee (2010) offered rebuttal to the costly training paradigm by proposing real-world project training occurring outside of a superficial classroom environment. Linking business goals to project training outcomes would reframe "training" as tangible continuous improvement (Snee, 2010).

According to Pyzdek and Keller (2003), "Black Belts, Green Belts, and Master Black Belts learn tools and techniques in the context of following the DMAIC approach to drive organizational change" (p. 29). Belt training occurs internally within the organization or through multiple external certification options. Lack of trust in LSS global certification standards for training and competency has led organizations to be doubtful of external certifications (Antony et al., 2017). Alexander at al. (2019) further argued that training offered by consultants is often purposely narrowed to only provide specific aspects of the methodology.

Laureani and Antony's (2012) review of LSS certification standards found that 77% of large companies generating revenues above $1 billion used their own internal certification process. The authors observed an overall shift to internal training with only 15% of certifications coming from external renowned societies. The general risk to internal training is organizational isolation from standards that guide the framework through extensive tool training and project selection. Näslund (2013) inferred that employees trained to treat all tools equally regardless of the problem may impede project success. Common implementation practices of integrating lean tools into the DMAIC approach have led practitioners to overemphasize six sigma projects and negatively associate lean as a toolkit (Thomas et al., 2016). Champion reliance on untrained experts for project selection input induces improper tool selection (Duarte et al., 2012). Antony

and Gupta (2019) discussed learning continuity between projects and training programs drawing parallels with Snee's (2010) viewpoint for improved training and tool selection.

Albliwi et al.'s (2015) systematic review of the manufacturing industry ranked cause and effect analysis, VSM, 5S, design of experiments, and pareto charts as the top five most common LSS tools. The authors explain that tools with minimal statistics are approachable and used more frequently than other advanced tools. Sony, Naik, and Therisa (2019) urged against comfort choices and propose situational tool selection reinforced through continuous technical and behavioral training. Figure 5 highlights tools that are specific to lean and six sigma with the intersection representing LSS tools.

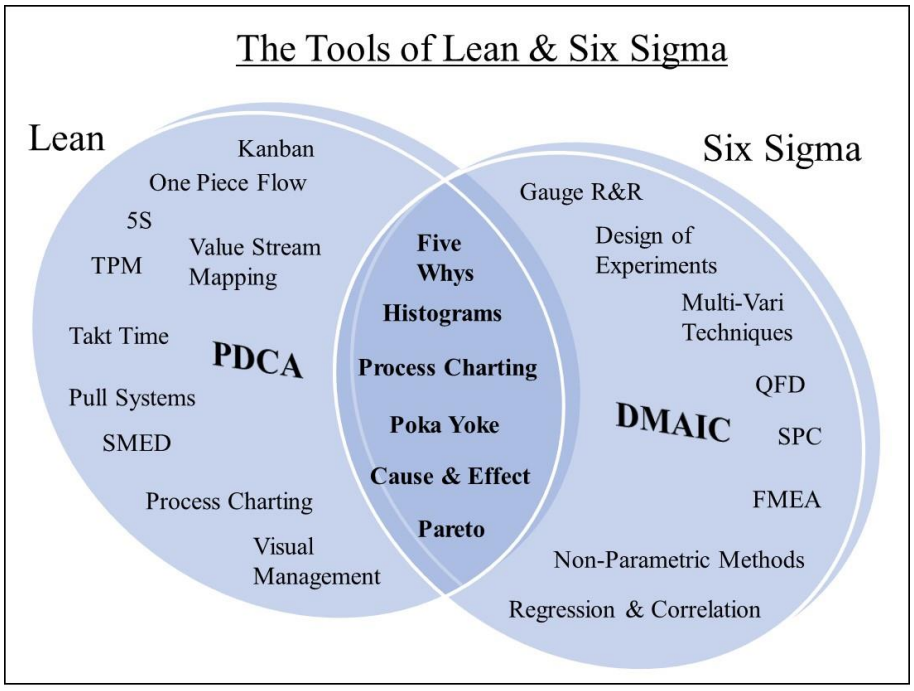

Figure 5: The Tools of Lean & Six Sigma. (Lee-Mortimer, 2006)

In relation to project management, Pyzdek and Keller (2003) provided a comprehensive list of commonly used tools in each phase of the DMAIC cycle. Sreedharan and Raju (2016) systematic review across different industries found no common implementation model defining when and

where to use tools. Organizations using both lean and six sigma tools in parallel for problem solving, instead of simultaneously, struggle with prioritization and fiscal benefit (Salah, Rahim, & Carretero, 2010). Corbett's (2011) case study of two Baldrige Award recipient organizations found that LSS tools were chosen based on project complexity rather than sequential application. These findings suggest undertones of organizational alignment and strong leadership given the level of prestige necessary for the Baldridge Award.

Leadership Styles and Lean Six Sigma

Laureani and Antony's (2019) review of leadership and LSS found a symbiotic relationship supporting continuous improvement and overall success. Leadership's role is to guide cultural transformation through vision, influence, and measurable results (Suresh, Antony, Kumar, & Douglas, 2012). Albliwi et al.'s (2014) review of critical LSS failures identified insufficient vision and lack of supportive leadership as contributing factors. McLean and Antony (2014) proposed a current state assessment of motivations, organizational culture, and management leadership to remedy failures associated with continuous improvement efforts in manufacturing. These findings suggest LSS has a strong dependency on leadership involvement to mitigate failures that are often observed from using the methodology. Figure 6 summarizes the relationship between leadership and LSS.

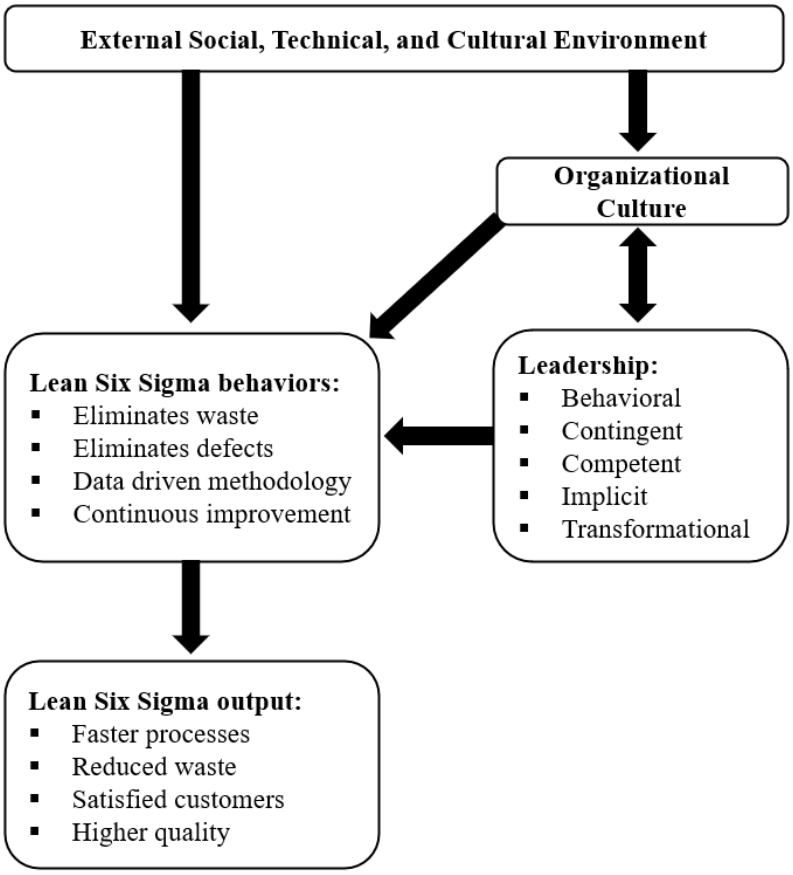

Figure 6: Model of Leadership, Culture, and LSS. (Laureani & Antony, 2018)

Organizational transformation for continuous improvement includes reduction of bureaucratic layers, openness to creative risk, and leadership commitment through the 'Do what you say and say what you do' motto (Pyzdek & Keller, 2003). Cultural change requires a motivated workforce sharing goals and values that are a direct product of focused leadership commitment (Pamfilie et al., 2012). Knapp (2015) explained the active role of leadership in teaching and mentoring the culture is to mitigate resistance barriers during implementation. Top-down management commitment must be matched with bottom-up leadership along all levels of the organizational hierarchy (Antony & Gupta, 2019). Manville et al.'s (2012) case study discussed empowering middle management with strategic leverage in choosing projects to

maximize operational return. Leadership must occur through top-management strategy and through middle management project execution (Antony, Gupta, Sunder M, & Gijo, 2018).

Laureani and Antony's (2019) review of emerging themes since 2000 observed "new" leadership styles that lack uniqueness and share commonality with established leadership styles. Setijono et al.'s (2012) empirical study identified the growing importance of leadership styles to practitioners during implementation that was not as pronounced in the literature. A study performing qualitative analysis of effective leadership traits for LSS highlighted visibility, communication, consistency, and the three C's (connection, competence, character) as critical traits (Laureani & Antony, 2017b). Alexander et al. (2019) identified the main challenge of implementing LSS is a lack of strong leadership at every level. In relation to continuous improvement efforts within manufacturing, transaction and transformational leadership were found to have positive impacts on quality management practices (Laohavichien, Fredendall, & Cantrell, 2009)(Laohavichien, Fredendall, & Cantrell, 2009). These findings recognize the importance that leadership plays in LSS implementation.

Transactional leadership is most effective in chain-of-command organizations with established business practices while transformational leadership seeks to disrupt those environments through innovation and synchronization of tasks and relationships (Halaychik, 2016). Within an innovation context, Oke, Munshi, and Walumbwa (2009) drew distinctions that transactional leadership is suited for implementation while transformational leadership is suited for cultivating post-implementation activities. Both leadership styles embrace innovation but transactional drives results at any cost while transformational focuses on empowering the culture (Guo-yi & Jian-sheng, 2011). Knapp (2015) found that transformational leadership coupled with innovative developmental cultures resulted in successful LSS implementation. Of multiple

recommendations, the author highlighted that leadership style would significantly influence LSS implementation. With the goal to remain competitive, the A&D industry will face challenges when transitioning classical top-down transactional structures into more open transformational structures.

Summary

The literature review explored the broad and encompassing history of leadership theory and continuous improvement methodologies common to the manufacturing industry. The discussed leadership theories of behavior, contingency, transactional, and transformational, all influenced the comprehensive FRLM proposed by Bass (1985). Continuous improvement methodologies of TQM, six sigma, lean, and LSS were holistically discussed and compared. Decades of research and organizational prototyping across multiple sectors identified the LSS methodology for spurring customer satisfaction in manufacturing environments (M. Singh & Rathi, 2019).

Though LSS has provided impressive gains for key organizations, there is a portion of organizations that have not been able to reap any benefits. It is often hard to isolate the exact causes that may have contributed to organizations receiving no value from the LSS methodology. The literature identifies multiple critical failure factors contributing to implementation and sustainment efforts. Antony and Gupta (2019) summarized the following regarding LSS process improvement project failures:

The top ten reasons in our opinion include lack of commitment and support from top management; poor communication practices; incompetent team; inadequate training and learning; faulty selection of process improvement methodology and its associated

tools/techniques; inappropriate rewards and recognition system/culture; scope creepiness; sub-optimal team size and composition; inconsistent monitoring and control; and resistance to change (p. 367).

It is not surprising that top management commitment is first on the list of top ten reasons for project failures. Leadership must begin at the top and allow itself to flow down throughout the organization. The other nine reasons for failures all include aspects in which leadership would have significant influence. Thompson's (2005) study of a military organization seeking continuous improvements summarized that combining leadership and LSS provided a high probability for maximum benefit. Reed (2020) studied sixteen aerospace manufacturing business leaders to analyze the criteria they used to make LSS projects successful. Four common themes emerged from the study results which were planning, objectives, training, and collaboration. It can therefore be observed that A&D corporations should ensure leadership is an integral part of their LSS initiatives.

A recurring theme identified in the literature is that LSS is a powerful methodology subject to human alignment and integration. The three CSFs of management commitment, project selection, and training correlate more with human-based interactions than the structure of the methodology itself. Laureani and Antony (2018) expressed this relationship through Figure 6, which depicts the interrelatedness of leadership, culture, and LSS. An A&D corporation pursuing LSS independent of leadership would struggle to realize maximum benefits derived from the methodology. These literature review findings conclude that utilizing LSS short of organizational investment in the right leaders will hinder successful LSS implementation and sustainment within the A&D industry.

CHAPTER THREE: RESEARCH METHODOLOGY

The purpose of this methodology chapter is to describe the methods that were used to conduct the research study. Chapters 1 and 2 summarized the necessary background information and literature review findings which provided the motivation for this quantitative correlation study. The intent of this study was to examine if any statistical relationships existed between trained black belts self-rated leadership styles and three critical LSS success factors within A&D Corporation XYZ. This chapter will discuss the population and sample, survey instruments, validity, reliability, data processing procedures, and ethical assurances for participants.

Research Questions

To answer the primary research objective, the following research questions were created to examine the relationship between black belt leadership styles and CSFs of LSS within the A&D industry.

Research Question 1: What is the relationship between a black belt's laissez-faire leadership style as defined by the MLQ and LSS CSFs (management commitment, project selection, and training)?

$H_0$1: There is no relationship between a black belt's laissez-faire leadership style as defined by the MLQ and LSS CSFs (management commitment, project selection, and training).

H_A1: There is a relationship between a black belt's laissez-faire leadership style as defined by the MLQ and LSS CSFs (management commitment, project selection, and training).

Research Question 2: What is the relationship between a black belt's transactional leadership style as defined by the MLQ and LSS CSFs (management commitment, project selection, and training)?

$H_0$2: There is no relationship between a black belt's transactional leadership style as defined by the MLQ and LSS CSFs (management commitment, project selection, and training).

H_A2: There is a relationship between a black belt's transactional leadership style as defined by the MLQ and LSS CSFs (management commitment, project selection, and training).

Research Question 3: What is the relationship between a black belt's transformational leadership style as defined by the MLQ and LSS CSFs (management commitment, project selection, and training)?

$H_0$3: There is no relationship between a black belt's transformational leadership style as defined by the MLQ and LSS CSFs (management commitment, project selection, and training).

H_A3: There is a relationship between a black belt's transformational leadership style as defined by the MLQ and LSS CSFs (management commitment, project selection, and training).

Research Question 4: Does a black belt's laissez-faire leadership style, transactional leadership style, and transformational leadership style, as defined by the MLQ-5X, predict the success of LSS implementation (management commitment, project selection, and training)?

$H_0$4: There is no predictability between a black belt’s laissez-faire leadership style, transactional leadership style, and transformational leadership style, as defined by the MLQ, and the success of LSS implementation (management commitment, project selection, and training).

H_A4: There is predictability between a black belt's laissez-faire leadership style, transactional leadership style, and transformational leadership style, as defined by the MLQ, and the success of LSS implementation (management commitment, project selection, and training).

Research Methods and Design(s)

The proposed research methodology is a quantitative correlation study to examine the relationship between trained black belts leadership styles and three CSFs for LSS. Quantitative research is based on drawing from a sample of a larger population against limited variables while qualitative research examines a smaller population with a more rigorous level of detail (Black, 1999). Major characteristics of quantitative research is a need to explain a relationship between variables while relating those variables using statistical analysis (Creswell, 2002). Leedy, Ormrod, and Johnson (2019) explained that data collection and analysis are two separate steps in quantitative research, while data collection and analysis are cyclical and iterative in qualitative research. The research data for this study was collected and subsequently analyzed, therefore, a qualitative methodology was not selected.

The design of the study is non-experimental in nature because the researcher is not randomizing control groups or altering variables. The study is not manipulating influencing factors or trying to find cause-and-effect relationships as is common in experimental designs (Leedy, Ormrod, & Johnson, 2019). The study is a correlational design because it is seeking to understand if any relationships exist between black belt leadership styles and CSFs of LSS. The use of surveys is one method to collect the data to allow the researcher to analyze if any relationships in the research questions exists. The type of survey design is cross-sectional, which analyzes data at one point in time to examine the current attitudes or opinions of individuals regarding a specific topic (Creswell, 2021).

The independent variables in this study are the three leadership styles of transformational, transactional, and laissez-faire. The dependent variables in this study are the three CSFs of management commitment, project selection, and training. An independent variable is one that the

researcher studies for its possible effects on one or more variables… A dependent variable is a variable that is potentially influenced by an independent variable" (Leedy et al., 2019, p. 193). Each independent variable will be related to each dependent variable to understand if, and to what extent, a relationship exists. The quantitative data for each variable was collected via an online survey designed to answer the proposed research questions.

Population and Sample

The population for this study was internally trained black belt practitioners within A&D Corporation XYZ. XYZ is a Fortune 500 company comprised of over 75,000 employees across multiple business departments throughout the United States. XYZ is involved in the development and manufacturing of defense and commercial related products. The corporation utilizes the LSS methodology for continuous improvement initiatives across the enterprise. XYZ provides their own internal training courses for green belt and black belt certification that align with industry standards.

The sample for this study included a non-random sample of black belt practitioners that are actively involved in continuous improvement initiatives across multiple locations within the United States. The practitioners work within multiple functions directly or indirectly supporting manufacturing activities. There are an estimated 430 black belt practitioners across the multiple locations. The researcher anticipated a 25% survey response rate which estimates to about 108 participating black belts. A meta-analysis of survey response rates across 45 different comparisons found online surveys had an 11% lower response rate than other methods (Manfreda, Bosnjak, Berzelak, Haas, & Vehovar, 2008).

Materials / Instruments

The materials for this research study consisted of a three section survey collecting demographics, MLQ-5X leadership styles, and LSS CSFs. The demographics section was used to collect qualitative information about the participants within the sample. The demographic questions included the type of current role, leader or individual contributor, type of work environment, years of training as a black belt, and how many LSS projects were supported annually. The demographic questions are non-intrusive but were able to provide a summary of the sampled participants. This allowed the researcher to have insight into the participants when results of the research study were analyzed.

The three leadership styles of transformational, transactional, and laissez-faire were measured using the self-rater MLQ-5X questionnaire (Bass & Avolio, 2004). The self-rater MLQ-5X contains 45 detailed "I…" statements that are measured on a Likert-scale ranging from 1 = Not at all to 5 = Frequently, if not always. The questions seek to identify and quantify various types of leadership behaviors that correlate with organizational and individual success. The three leadership styles are measured across nine different scales within the questionnaire. An average is calculated for each scale by summing up the total scores from respective questions and then dividing it by the total numbers of responses (Bass & Avolio, 2004). A sample of the questionnaire can be referenced in Appendix B.

The third section of the survey consisted of 15 questions regarding three LSS CSFs of management commitment, project selection, and training. The questions were formulated based on summarized literature review findings completed prior to the study. The survey was evaluated by a panel of three internal master black belts to ensure comprehensiveness and relevance. The

panel reviewed the survey material by asking clarifying questions and making suggestions with respect to unique A&D considerations. The researcher considered all feedback and modified the section accordingly to improve participant response rate. The third section of the survey can be referenced in Appendix C.

Data Procedure Methodology

Data Collection

The method for data collection was through an electronic online survey using XYZ's licensed survey software. An electronic survey is a non-intrusive and cost effective approach when attempting to increase response rates. "An online survey respondent is free to complete the questionnaire at her or his convenience, which may increase the likelihood of participation" (Sax, Gilmartin, & Bryant, 2003, p. 409). An online survey has far less costs than a paper survey when studying larger sample sizes (Leedy et al., 2019). The 430 participants for the study were identified through an internal training repository on the LSS department's SharePoint.

Each participant received an email with a brief introduction and explanation of the research study. To ensure complete comfort for the participants the contact information of the researcher and Institutional Review Board (IRB) were provided. The bottom of the email contained an electronic link to the survey. It was clearly stated that clicking the link was an active form of consent for participating in the study. The survey was completely anonymous to ensure the confidentiality of the participants was not violated.

The survey collected qualitative demographic information and quantitative ordinal data that is common to surveys. The demographic questions did not collect information on gender, race, salary, or protected groups. Each survey submission was documented in XYZ's software

database with a randomly generated record ID number and the respective responses from each participant. The expected time to complete the survey was 20 minutes. The data collection occurred over a period of one month with weekly reminders to encourage a higher response rate.

Data Processing

The data was processed through XYZ's internal survey software which provides security protection measures against data breaches and cyber threats. With the research study having been solely conducted within Corporation XYZ, protective measures were required by their legal department. In addition to protecting participants anonymity, XYZ's OD team mediated the transfer of the survey data from the software to the researcher. The anonymous nature of the study ensured the researcher was completely blind to all participants who participated within the study. The researcher did not need to access any sources of information about the participants during or after the research study.

The collected survey data was collected through a Microsoft Excel file which was provided to the researcher. The OD team deleted the survey and all related data from their software after the study concluded. The collected data was only accessible by the researcher during and after the study. The de-identified data from the study will be stored in a secure encrypted location that will be locked and password protected by the researcher. Per University of Central Florida policy, the de-identified data will be stored for a minimum of 5 years after study closure and then destroyed by the researcher.

Data Analysis

Data analysis for this study was accomplished through statistical analysis procedures using the Statistical Package for the Social Sciences (SPSS) analysis software. The demographic data was analyzed through summary statistics displaying the frequency and percentages of responses. The MLQ questionnaire and LSS CSFs response data were analyzed using descriptive and inferential statistics. The descriptive statistics included calculating the means and standard deviations for all the study variables. The research questions were analyzed through correlation testing of the independent variables of laissez-faire, transactional, transformational leadership styles to the dependent variables of management commitment, project selection, and training.

Only 112 of the 430 surveys sent to the study sample were completed. There were 30 surveys that were started and not completed. These surveys only had responses in section one and not sections two or three. These surveys were removed from the analysis to prevent outliers from misrepresenting the data. Of the completed surveys, the response rate was approximately 26% for the research study. Response rates can vary based on the type of survey and the targeted sample. A survey response rate of 10% to 25% is typical when conducting employee surveys (Phillips & Phillips, 2004). Therefore, the response rate for this research study was found to be within expected.

The survey data set was reviewed for normality prior to further analysis. Histogram graphs were generated for each variable in the study to visually assess the distribution shapes. None of the distributions appeared to have a uniform bell-curve shape. Statistical testing was then performed using Kolmogorov-Smirnov and Shapiro-Wilk's normality tests. All three dependent variables of top management commitment, project selection, and training were found

to be statistically significant at $p < .05$ for both tests. Statistical significance for both tests implied a non-normal distribution. The data was transformed to logarithmic and re-tested for normality. All three variables were still statistically significant thus confirming a non-normal distribution.

Parametric testing is used for data with normal distributions and non-parametric testing is used for data with non-normal distributions. The two common tests for correlation analysis are Pearson's r and Spearman's Rho. Parametric tests such as Pearson's r cannot be used if the normality assumption is violated (Leedy et al., 2019). The study data violated the assumption of normality therefore Spearman's Rho test was selected. Spearman's Rho is used to calculate the degree of correlation between two variables that is ranked between -1 to 1.

Correlation analysis using Spearman's Rho was used to answer the first three research questions for the study. Ordinal regression analysis was used to answer research question 4. An alpha level of $p < .05$ was selected to analyze the correlation between the independent and dependent variables. The SPSS output table also identified any variables that had significance at $p < .01$. The independent variables were tested against each dependent variable and an aggregate of all three dependent variables was labeled as total LSS implementation. This approach allowed total LSS implementation score to be tested against each leadership style while also providing results for each individual dependent variable.

Validity and Reliability

The two types of validity are internal or external. Leedy and Ormrod (2015) defined internal validity as "the extent to which its (research) design and the data it yields allow the researcher to draw defensible conclusions about cause-and-effect and other relationships within

the data" (p. 194). Calder, Phillips, and Tybout (1982) defined external validity as "whether or not an observed causal relationship should be generalized to and across different measures, persons, settings, and times" (p. 240). The MLQ has demonstrated strong construct validation up through the current 5X form (Bass & Avolio, 2004). Muenjohn and Armstrong (2008) evaluated the MLQ's structural validity using confirmatory factor analysis (CFA) over 138 cases. The authors reported a Cronbach's alpha coefficient of 0.86 when verifying reliability. The authors concluded that the MLQ was the most adequate instrument for measuring transformational and transactional leadership (Muenjohn and Armstrong, 2008). Cronbach's alpha is a measure of internal reliability for questionnaires, with a value of 0.70 or higher as acceptable (Taber, 2018). The Cronbach's alpha for the MLQ survey was 0.83 and it was 0.91 for the LSS survey.

External validity is measured by the adoption and application across multiple fields of study. The external validity of the current 5X form is confirmed through its use in worldwide research programs, graduate studies, and having been translated to thirteen different languages (Bass & Avolio, 2004). To measure convergent validity, Rowold (2005) administered both the MLQ-5X and Transformational Leadership Inventory (TLI) assessments to a study of 267 government employees. The MLQ-5X transformational leadership scale and the TLI's transformational leadership scale were found to have convergent validity. Antonakis et al. (2003) concluded that "Our results indicate that the current version of the MLQ (Form 5X) is a valid and reliable instrument that can adequately measure the nine components comprising the full-range theory of leadership" (p. 286). These findings validate the use of the MLQ in this research study.

Study Assumptions

The assumptions of the research study were as follows:

- The sampled black belt participants would be representative of the black belt population across XYZ.
- The findings of this study would have a degree of relevance to other large manufacturing A&D corporations located within the United States.
- The MLQ-5X questionnaire would be adequate for assessing the three identified leadership styles.
- The LSS survey would be adequate for assessing the three LSS CSFs.
- Survey response rates would be high enough to support sound statistical analysis on the collected data.
- Participants would read and answer each survey question honestly.
- Incomplete surveys beyond five questions would be discarded from the research study.

Ethical Assurances

The inclusion of human subjects in this research prioritized participant rights and privacy during study planning. The researcher was first required to complete the Collaborative Institutional Training Initiative (CITI) 'Human Subjects Research' training course. The researcher was then required to submit the proposed search study to the University of Central Florida's IRB for review and approval. The IRB approval letter can be referenced in Appendix F. The submission process included providing multiple artifacts regarding the study and the extent to which human subjects were involved. The primary objective of the IRB is to ensure human subjects are protected with minimal risk.

Beyond IRB approval, the research study also required consent from Corporation XYZ's legal department. The same artifacts provided to IRB were provided to the legal department to ensure the study materials did not violate the confidentiality or interests of the participating employees. Internal restrictions that were imposed included complete anonymity and no employee identifiers within the data set. The organizational department team mediated the data transfer to the researcher to comply with the legal department's conditions. Using an electronic survey format allowed the participants to take the survey remotely and privately.

The introductory email included an explanation of the research study. The informed consent form can be referenced in Appendix E. The survey was completely voluntary and therefore participants had the choice to participate or not with no penalty. The survey was designed to be non-intrusive by minimizing personal questions that could make the participant feel uncomfortable or want to cease involvement in the study. These measures and considerations provided ethical assurances with minimal amounts of risk for the study participants.

Summary

The purpose of this quantitative correlation study was to understand the relationship between black belt leadership styles and LSS CSFs within A&D corporation XYZ. Four research questions were hypothesized to answer the original problem statement. The research study included a sample of 112 trained black belts that work across multiple manufacturing facilities within the United States. An online survey was used to collect the data to answer the four research questions. The survey included demographics, self-rated leadership styles, and evaluation of three LSS CSFs.

The survey materials were reviewed and assessed for validity and reliability to ensure meaningful results could be concluded from the findings. Underlying assumptions of the research study were presented and summarized. The inclusion of human subjects required IRB approval to ensure the highest degrees of ethical assurances were taken. The University of Central Florida's IRB approved the researcher to conduct this study. Collected data was processed in a manner to ensure the researcher could perform proper analysis while also complying with XYZ's legal department. Data analysis for answering the research questions was performed using descriptive statistics and Spearman's Rho correlation test.

CHAPTER FOUR: FINDINGS AND ANALYSIS OF RESULTS

This chapter presents the findings from analyzing the study data using statistical techniques. This chapter will also provide the answers to the four proposed research questions. The purpose of this quantitative correlation study was to understand if there was any relationship between trained black belts leadership styles (laissez-faire, transactional, and transformational) and the three LSS CSFs (management commitment, project selection, and training) within A&D Corporation XYZ. The following sections will summarize the descriptive and inferential statistical results from the study data. The demographic data of the sampled participants will be reviewed and discussed next.

Demographics Data

The sample in this research study consisted of black belt practitioners who work within A&D corporation XYZ. The sampled black belts directly or indirectly supported manufacturing operations across multiple locations within the United States. The surveyed black belts were active in the methodology and trained through XYZ's internal LSS curriculum. The number of years trained for each black belt ranged from 0 years to more than 15 years. Though some employees may have been trained externally, XYZ required every employee interested in being an active black belt to pass their internal training. This is likely due to XYZ having a unique work environment that requires various degrees of adaptation for the methodology to work as intended.

A total of 430 black belts were invited to participate in this research study via an electronic survey link. Of the 430 invites, 112 black belts participated and completed the online survey. The demographics section of the survey collected qualitative categorical data about the

participants. The six questions within the section included role, classification, work environment, years of training, and projects supported annually. This type of data is necessary for visualizing the distribution of responses from each question to have keen insight about the sample. The collected demographic data was analyzed using descriptive statistics. Table 2 provides an overview summary for each question identifier along with the respective response rates.

Table 2: Sample Demographics

Role	**N**	**%**
Management	42	37%
Engineering	42	37%
Non-Technical	13	12%
Other	13	12%
Finance	3	3%
Classification		
Individual Contributor	58	51%
Leader	55	49%
Work Environment		
Manufacturing	45	40%
Program	41	36%
Functional	23	20%
Facilities	3	3%
Human Resources	1	1%
Years Trained in Black Belt		
0-5	28	25%
6-10	27	24%
11-15	27	24%
More than 15 years	30	27%
Projects Supported Annually		
0	20	19%
1-3	65	58%
4-6	14	12%
More than 7	13	12%

The roles of Engineering (37%) and Management (37%) constituted about 74% of the black belt roles. This is an interesting observation as it highlights that most of the black belts at XYZ support manufacturing via engineering or management. The ‘Other’ category included a handful of different roles such as Quality Assurance, Information Technology, Production Planning, and Supply Chain.

The next important question identifier to discuss is the classification of the study participants. At XYZ, an individual contributor is an employee with no direct reports while a leader is an employee with direct reports. With respects to this research study, the word leader is synonymous with manager as not to confuse it with leadership styles. The data showed a close balance of individual contributors (51.3%) and leaders (48.7%) within the sample. Of the three LSS CSFs explored in the research study, top management commitment was number one on the list. About half of the sampled black belts being within management roles provided relative data that could more fairly assess the top management commitment CSF. It was noted earlier that management played a significant role in supporting projects as they are a primary means of how the LSS methodology is executed.

The demographic survey asked participants how many improvement projects they supported annually. This question was derived from the literature findings regarding the importance of organizations being able to select and execute projects for maximum value to customers. A common theme from the literature was the necessity for top management and black belt practitioners to be fully engaged and committed in selecting projects. Table 3 provides a breakdown of how many projects are supported annually by individual contributors and leaders.

Table 3: Leader and individual contributor support

		Projects Supported Annually			
		0	1-3	4-6	More than 7
Classification	Individual Contributor	12	31	5	10
	Leader	8	34	9	3
	Total	20	65	14	13

The key takeaway is that 65 black belts in both classifications support between 1 to 3 improvement projects per year. It's hard to distinguish if this is an adequate number of projects

per year for A&D organizations wanting to reap optimal gains from using LSS. A total of 20 black belts reported supporting 0 projects annually which raises a concern on if this is driven from lack of management support or low involvement in projects. A large responsibility of the Black Belt role is the ability to lead high value improvement projects that achieve results and benefit the organization (Pyzdek & Keller, 2003). Projects are essential pursuits to provide teams with the tools and knowledge to solve complex problems (Antony & Gupta, 2019).

Annual projects supported by working environment will now be examined. The working environments of Manufacturing (40%) and Program (36%) accounted for 76% of the environments that the black belts supported. Table 4 indicates that manufacturing and program working environments support the most improvement projects (63.3%).

Table 4: Annual projects by work environment

		Projects Supported Annually			
		0	1-3	4-6	More than 7
Environment	Manufacturing	2	27	8	8
	Program	13	23	4	1
	Functional	5	12	2	3
	Facilities	0	2	0	1
	Human Resources	0	1	0	0
Total		20	65	14	13

Most support levels fell into the 1 – 3 annual projects column. A note worth mentioning is that 13 black belts within the program working environment supported 0 annual projects. Cultural behaviors of low engagement may stem from lack of top management commitment or insufficiencies in training curriculums.

Descriptive Statistics

Descriptive statistics were performed against the variables from the study. The three independent variables in the study were the MLQ leadership styles of laissez-faire, transactional, and transformational. The dependent variables were management commitment, project selection, and training. Table 5 provides the results for both the independent and dependent variables.

Table 5: Descriptive Statistics of Study Variables

	Mean	Std. Deviation	Minimum	Maximum	N
Management Commitment	3.66	.867	1.00	5.00	110
Project Selection	3.58	.662	1.00	5.00	112
Training	3.60	.738	1.00	5.00	112
Total LSS CSF	3.61	.659	1.00	5.00	112
Transformational	4.17	.476	2.20	5.00	112
Transactional	3.45	.532	1.75	5.00	112
Laissez-Faire	1.57	.432	1.00	3.13	112

The LSS survey section consisted of fifteen total questions in which management commitment, project selection, and training, had five questions each. The response options for the participants were Strongly Disagree, Disagree, Neither Agree nor Disagree, Agree, and Strongly Agree.

Management commitment was found to have a mean response of 3.66 with a standard deviation of 0.87. Project Selection was found to have a mean response of 3.58 with a standard deviation of 0.66. Training was found to have a mean response of 3.60 with a standard deviation of 0.74. Total LSS effectiveness was the aggregate of the three dependent variables and had a mean response of 3.61 with a standard deviation of 0.66. The three individual CSFs had similar mean response scores with slight differences in the standard deviations. It can be observed from these results that the black belts perceived the three CSFs between Neither Agree nor Disagree and Agree.

The MLQ-5X section consisted of 45 questions with 36 measuring the three leadership styles. The MLQ-5X was a self-rater version in which each participant rated their perception of their own leadership styles. Though this approach did introduce opportunity for bias, it was an effective approach to understand the leadership styles of black belts that were not managers with direct reports that would normally rate them. The MLQ-5X had 9 questions that measured three criteria relating to outcomes of leadership. The results from the outcomes of leadership questions were not analyzed because they did not directly support answering the proposed research questions. The response options for the participants were Not at all, Once in a while, Sometimes, Fairly often, and Frequently, if not always.

Transformational leadership styles were found to have a mean response of 4.17 with a standard deviation of 0.48. Transactional leadership styles were found to have a mean response of 3.45 with a standard deviation of 0.53. Laissez-faire leadership styles were found to have a mean response of 1.57 with a standard deviation of 0.43. Of the three means, transformational leadership was the highest at 4.17 (fairly often) and laissez-faire leadership was the lowest at 1.57 (between once in a while to sometimes).

The black belts frequently used transformational styles of leadership and infrequently used laissez-faire styles of leadership within their roles. The mean response for transactional leadership styles implied that the black belts sometimes used it within their roles. These results aligned with Guo-yi and Jian-sheng's (2011) findings that transactional styles are necessary for driving results while transformational styles are necessary to empower and grow the culture. The literature identified that military based organizations tend to mostly use transactional styles of leadership. The findings contradict the transactional norm for A&D organizations. The primary

tendency towards transformational styles suggests that XYZ's black belts have the right balance of leadership qualities to innovate and capitalize on LSS implementation.

Normality Validation

Prior to statistical testing, the dependent variables were comprehensively analyzed for assumptions of normality. Each CSF was first analyzed through histograms to visualize the distributions. Normal probability plots for each CSF were also assessed to evaluate normality by how closely the data points followed a straight line path. Data that has a normal distribution will likely have a skewness value between -2 to +2 (George & Mallery, 2019) and a kurtosis value closer to 3. Larger deviations outside of these values may help identify when the data is non-normal.

Management commitment was found to have a slightly skewed distribution to the left (-0.98) and a positive kurtosis of 1.08. The distribution in Figure 7 appears to be non-normal as it lacks a bell curve shape and has outliers. A kurtosis value under 3 implies that a majority of the data is centered around the mean with the lower tails being stretched thinner. The probability plot in Figure 8 shows that all of the data points do not closely follow the straight line which is another indicator of non-normality.

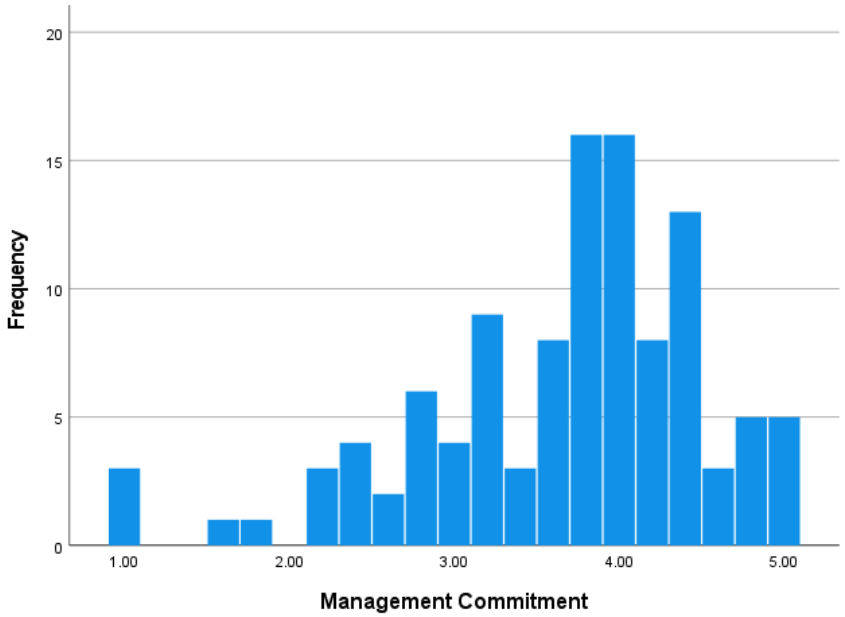

Figure 7: Histogram of Management Commitment

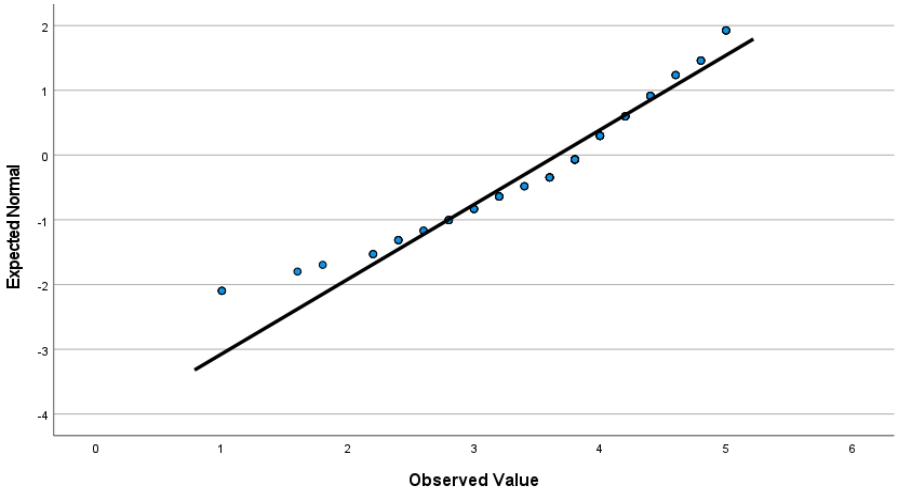

Figure 8: Normal Q-Q Plot of Management Commitment

Project selection was found to have a slightly skewed distribution to the left (-0.85) and a positive kurtosis of 1.79. Though the distribution in Figure 9 does appear to have a mostly bell curve shape, it is skewed left by outliers. A kurtosis value under 3 implies that a majority of the data is centered around the mean with the lower tails being stretched thinner. The probability plot

in Figure 10 shows that all of the data points do not closely follow the straight diagonal line which is another indicator of non-normality.

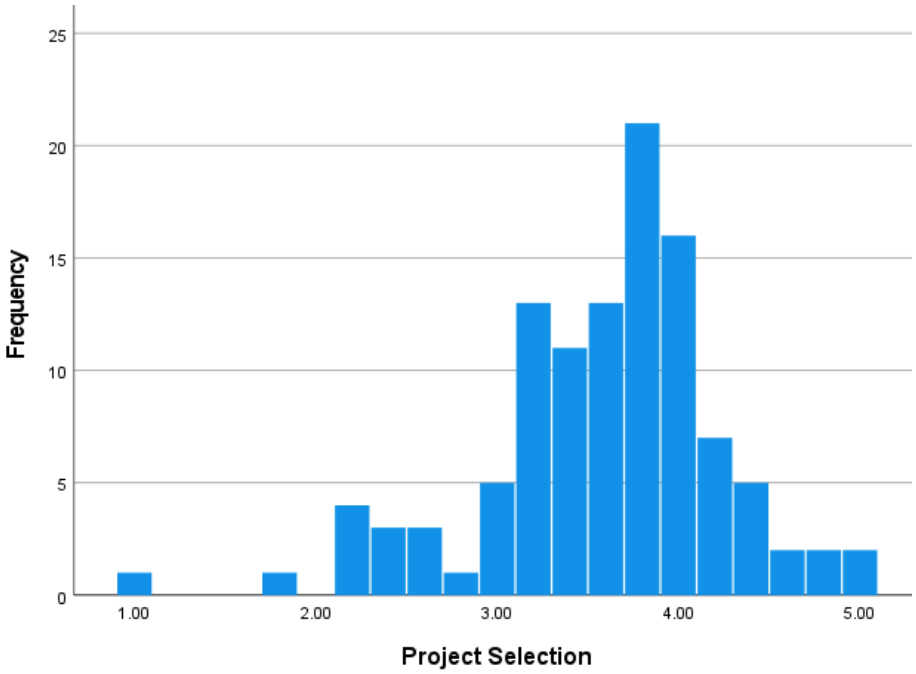

Figure 9: Histogram of Project Selection

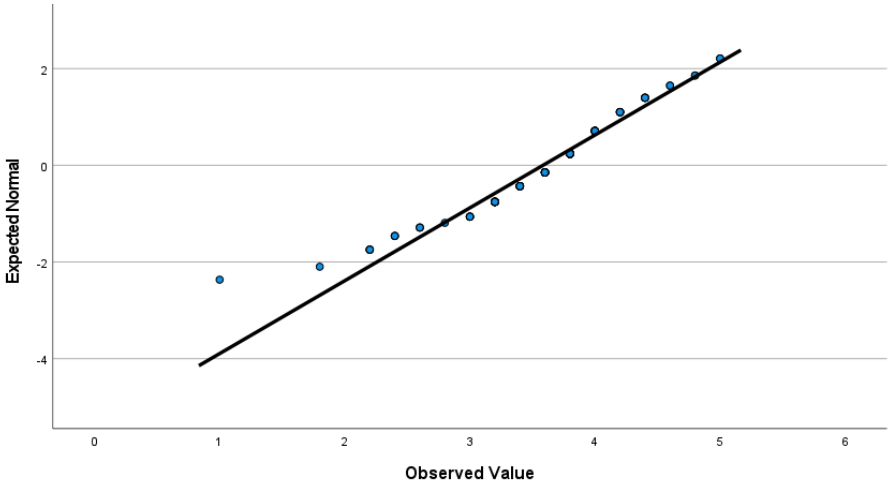

Figure 10: Normal Q-Q Plot of Project Selection

Training was found to have a slightly skewed distribution to the left (-0.34) and a positive kurtosis of 0.55. The skewness value of -0.34 is within an acceptable range close enough to 0 to

infer it is symmetric. The distribution in Figure 10 is influenced by outliers and does not visually appear to have a bell curve shape. Two outliers are visible on the left side of the distribution. A kurtosis value under 3 implies that a majority of the data is centered around the mean with the lower tails being stretched thinner. The probability plot in Figure 12 shows that most of the data points follow the straight diagonal line with the exception of one outlier.

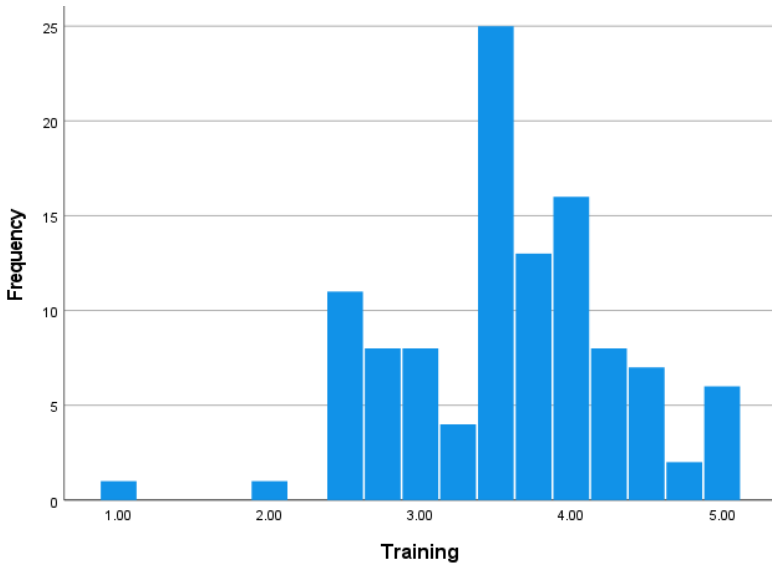

Figure 11: Histogram of Training

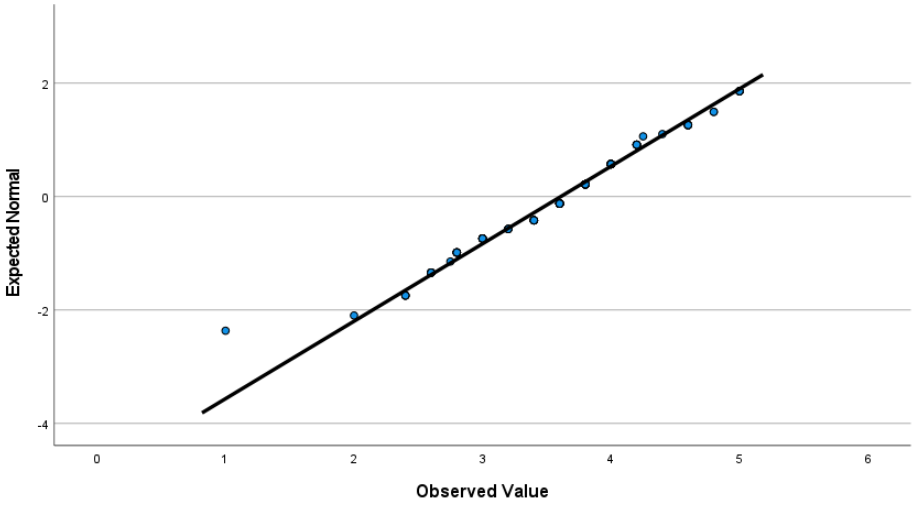

Figure 12: Normal Q-Q Plot of Training

Total LSS CSF was found to have a slightly skewed distribution to the left (-0.75) and a positive kurtosis of 1.64. Though the distribution in Figure 13 visually does appear to have a bell curve shape, it is slightly skewed left with an outlier. A kurtosis value under 3 implies that a majority of the data is centered around the mean with the lower tails being stretched thinner. The probability plot in Figure 14 shows that most of the data points follow the straight diagonal line with the exception of a few outliers. Aggregating the three dependent variables into Total LSS CSF provided a comprehensive view for the histogram distribution and probability plot for total LSS implementation.

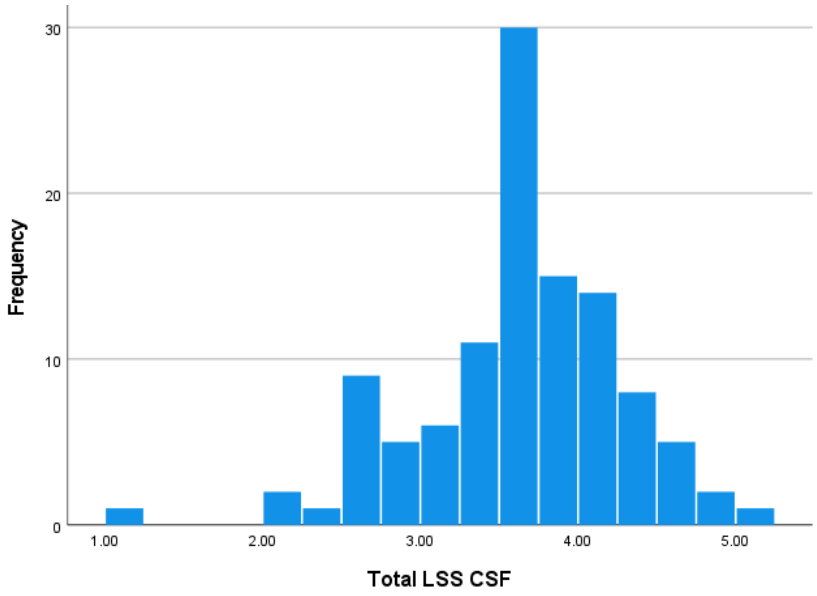

Figure 13: Histogram of Total LSS CSF

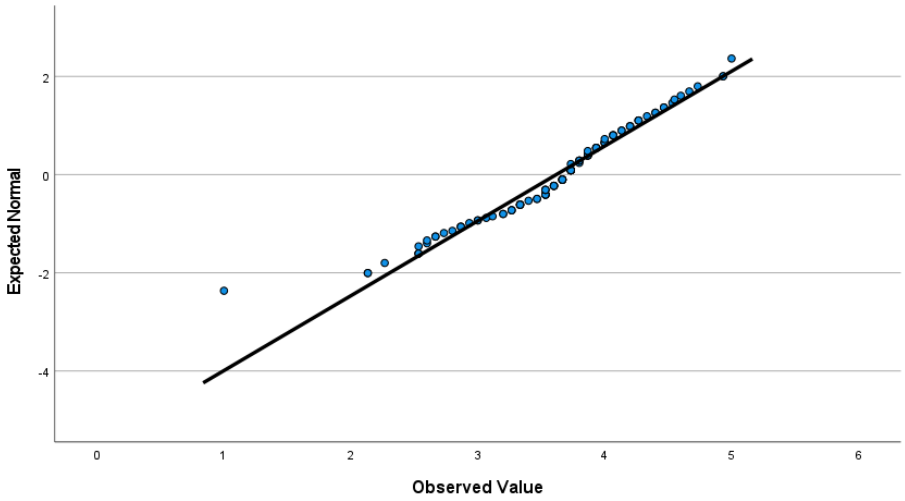

Figure 14: Normal Q-Q Plot of Total LSS CSF

Visualizing histograms and probability plots of the dependent variables allowed a first pass assessment for the assumption of normality. Based on the quantitative criteria for normality in respect to skewness, all of the CSFs were found to be within an accepted range thus implying a degree of symmetry. All three CSFs had probability plots with data point deviations and outliers from the straight diagonal line which implied potential degrees of non-normality. The

results from this approach were not finite enough to confidently determine if the data set violated the assumptions of normality or not. Additional testing methods were used to further analyze and verify if the data was normal or non-normal.

The data was next analyzed using Kolmogorov-Smirnov and Shapiro-Wilk's tests for normality. Both of these tests are grounded in hypothesis testing and determining if the p-values are statistically significant or not. A p-value above 0.05 implies the data is normally distributed and a p-value below 0.05 implies the data is non-normally distributed. Table 6 summarizes the results from conducting both tests.

Table 6: Normality Testing of CSFs

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Management Commitment	.163	110	<.001	.930	110	<.001
Project Selection	.128	110	<.001	.946	110	<.001
Training	.122	110	<.001	.970	110	.013
Total LSS CSF	.130	110	<.001	.961	110	.003

a. Lilliefors Significance Correction

The three CSFs and Total LSS CSF were all found to have p-values below 0.05 for both tests. The null hypothesis that the data was normally distributed was rejected as the p-values were found to be statistically significant. A logarithmic transformation was subsequently applied to the data to make it as normal as possible for normality testing. Table 7 summarizes the results from analyzing the transformed data.

Table 7: Normality Testing of Transformed CSFs

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Log Management Commitment	.200	110	<.001	.789	110	<.001
Log Project Selection	.176	110	<.001	.828	110	<.001
Log Training	.164	110	<.001	.886	110	<.001
Log Total LSS CSF	.175	110	<.001	.842	110	<.001

a. Lilliefors Significance Correction

The three logarithmic transformed CSFs and Total LSS CSF were all found to have p-values below 0.05 for both tests. The null hypothesis that the data was normally distributed was rejected again as the p-values were found to be statistically significant. The results from performing normality tests aided in determining that the data set had a non-normal distribution. Testing and verifying normality was a pivotal step in the analysis process to ensure applicable statistical tests were considered. Pearson's coefficient, regression analysis, and ANOVA were not considered due to violations of normality.

Research Question 1

Research Question 1 states: What is the relationship between a black belt's laissez-faire leadership style as defined by the MLQ and LSS CSFs (management commitment, project selection, and training)?

$H_0$1: There is no relationship between a black belt's laissez-faire leadership style as defined by the MLQ and LSS CSFs (management commitment, project selection, and training).

H_A1: There is a relationship between a black belt's laissez-faire leadership style as defined by the MLQ and LSS CSFs (management commitment, project selection, and training).

Spearman's Rho correlational analysis was utilized to evaluate the hypothesis in research question 1. Table 8 summarizes the Spearman's Rho correlation results for the laissez-faire leadership style and dependent variables. Management commitment (p = .007), training (p = .001), and total LSS CSF (.010) were found to be statistically significant at $\alpha = 0.05$. Project selection was found to be insignificant. The null hypothesis for research question 1 was rejected based on these significant correlations. It can be concluded that the laissez-faire leadership style negatively correlates with total LSS CSFs, management commitment, and training.

Table 8: Laissez-Faire Leadership Spearman Correlations

		Management Commitment	Project Selection	Training	Total LSS CSF
Laissez-Faire	Correlation Coefficient	-.256**	-.131	-.304**	-.241*
	Sig. (2-tailed)	.007	.168	.001	.010
	N	110	112	112	112

Management commitment was found to have a negative correlation coefficient value of r_s = -0.256. Training was found to have a negative correlation coefficient value of r_s = -0.304. Total LSS CSF was found to have a negative correlation coefficient value of r_s = -0.241. The values range within a moderate to weak negative correlation with laissez-faire leadership but are statistically significant. These results show that management commitment, training, and total LSS CSF are negatively associated with the laissez-faire leadership style. Therefore, laissez-faire leadership may be an ineffective style for black belts to use when implementing LSS in manufacturing environments.

Research Question 2

Research Question 2 states: What is the relationship between a black belt's transactional leadership style as defined by the MLQ and LSS CSFs (management commitment, project selection, and training)?

$H_0$2: There is no relationship between a black belt's transactional leadership style as defined by the MLQ and LSS CSFs (management commitment, project selection, and training).

H_A2: There is a relationship between a black belt's transactional leadership style as defined by the MLQ and LSS CSFs (management commitment, project selection, and training).

Spearman's Rho correlational analysis was utilized to evaluate the hypothesis in research question 2. Table 9 summarizes the Spearman's Rho correlation results for the transactional leadership style and dependent variables. Project selection (p = .032), training (p = .016), and total LSS CSF (.025) were found to be statistically significant at $\alpha = 0.05$. Management commitment was found to be insignificant. The null hypothesis for research question 2 was rejected based on these significant correlations. It can be concluded that the transactional leadership style positively correlates with total LSS CSF, project selection, and training.

Table 9: Transactional Leadership Spearman Correlations

		Management Commitment	Project Selection	Training	Total LSS CSF
Transactional	Correlation Coefficient	.145	.203*	.227*	.211*
	Sig. (2-tailed)	.130	.032	.016	.025
	N	110	112	112	112

Project selection was found to have a positive correlation coefficient value of $r_s = 0.203$. Training was found to have a positive correlation coefficient value of $r_s = 0.227$. Total LSS CSF was found to have a positive correlation coefficient value of $r_s = 0.211$. The values range within

a moderate to weak positive correlation with transactional leadership but are statistically significant. These results show that project selection, training, and total LSS CSF are positively associated with the transactional leadership style. Therefore, transactional leadership may be an effective style for black belts to use when implementing LSS in manufacturing environments.

Research Question 3

Research Question 3 states: What is the relationship between a black belt's transformational leadership style as defined by the MLQ and LSS CSFs (management commitment, project selection, and training)?

H_03: There is no relationship between a black belt's transformational leadership style as defined by the MLQ and LSS CSFs (management commitment, project selection, and training).

H_A3: There is no relationship between a black belt's transformational leadership style as defined by the MLQ and LSS CSFs (management commitment, project selection, and training).

Spearman's Rho correlational analysis was utilized to evaluate the hypothesis in research question 3. Table 10 summarizes the Spearman's Rho correlation results for the transformational leadership style and dependent variables. Management commitment (p = .004), project selection (p = .011), training (p = <.001), and total LSS CSF (.002) were found to be statistically significant at $\alpha = 0.05$. The null hypothesis for research question 3 was rejected based on these significant correlations. It can be concluded that the transformational leadership style positively correlates with total LSS CSF, management commitment, project selection, and training.

Table 10: Transformational Leadership Spearman Correlations

		Management Commitment	Project Selection	Training	Total LSS CSF
Transformational	Correlation Coefficient	.274**	.239*	.321**	.283**
	Sig. (2-tailed)	.004	.011	<.001	.002
	N	110	112	112	112

Management commitment was found to have a positive correlation coefficient value of r_s = 0.274. Project selection was found to have a positive correlation coefficient value of r_s = 0.239. Training was found to have a positive correlation coefficient value of r_s = 0.321. Total LSS CSF was found to have a positive correlation coefficient value of r_s = 0.283. The values range within a moderate to weak positive correlation with transformational leadership but are statistically significant. These results show that management commitment, project selection, training, and total LSS CSF are positively associated with the transformational leadership style. Therefore, transformational leadership may be an effective style for black belts to use when implementing LSS in manufacturing environments.

Research Question 4

Research Question 4 states: Does a black belt's laissez-faire leadership style, transactional leadership style, and transformational leadership style, as defined by the MLQ-5X, predict the success of LSS implementation (management commitment, project selection, and training)?

H04: There is no predictability between a black belt's laissez-faire leadership style, transactional leadership style, and transformational leadership style, as defined by the MLQ, and the success of LSS implementation (management commitment, project selection, and training).

H_A4: There is predictability between a black belt's laissez-faire leadership style, transactional leadership style, and transformational leadership style, as defined by the MLQ, and the success of LSS implementation (management commitment, project selection, and training).

Ordinal regression analysis was utilized to evaluate the hypothesis in research question 4. The dependent variable used for analysis with the total LSS CSF. Total LSS CSF was chosen to understand which black belt styles of leadership, if any, would be able to predict successful LSS implementation. The three independent variables used in the analysis were the three MLQ leadership styles. The control variables of role, classification, work environment, years trained, and annual projects were included as well. The assumptions from the ordinal regression model were reviewed first prior to analyzing the results.

Table 11 summarizes the results from fitting the ordinal model to the study data. The model fit was found to be statistically significant ($p = .002$). This implies the model is able to predict more accurate outcomes over a null model with no predictors. Table 12 summarizes the results from evaluating how well the model fit the data. The goodness-of-fit was found to be non-significant for both the Pearson ($p = .952$) and Deviance test ($p = 1.000$). Non-significance implies that the model had a good fit to the data.

Table 11: Ordinal Model Fitting

Model	-2 Log Likelihood	Chi-Square	df	Sig.
Intercept Only	808.079			
Final	784.147	23.932	8	.002

Table 12: Ordinal Model Goodness-of-Fit

	Chi-Square	df	Sig.
Pearson	5101.888	5272	.952
Deviance	784.147	5272	1.000

After both model assumption tests were validated, the results from the ordinal analysis were analyzed. Table 13 summarizes the results for how much each leadership style was able to be a predictor of successful LSS implementation. Of the control variables, annual projects supported (p = .001) was found to be statistically significant. The positive estimate value of 0.644 suggests that black belts who supported more projects annually had higher LSS implementation success scores. Laissez-Faire (p = .118), Transactional (p = .586), and Transformational (p = .126), were found to non-significant in the model at $\alpha = 0.05$. The null hypothesis failed to be rejected. This implies that the three leadership styles of laissez-faire, transactional, and transformational, are not predictors in the success of LSS implementation.

Table 13: Ordinal Model Leadership Styles as Predictors of Successful LSS Implementation

	Estimate	Std. Error	Wald	df	Sig.
Role	.054	.133	.162	1	.687
Classification	.098	.414	.057	1	.812
Work Environment	.076	.186	.168	1	.682
Years Trained	.117	.151	.596	1	.440
Annual Projects	.644	.202	10.135	1	.001
Laissez-Faire	-.662	.423	2.448	1	.118
Transactional	.197	.363	.296	1	.586
Transformational	.671	.438	2.340	1	.126

Results Evaluation

A quantitative correlational study was conducted to analyze the relationship between trained black belt's leadership styles and three LSS CSFs within A&D corporation XYZ. Study participants completed an electronic survey which determined their styles of leadership and perspective on LSS CSFs. A total of 430 total surveys were sent over a four week period to the study participants. The survey had three sections including demographics, FRLM leadership styles, and LSS CSFs. A total of 112 surveys were completed which provided a response rate of roughly 26%. The demographics of the participants were presented and discussed in great detail at the beginning of this chapter.

Statistical analysis was performed on the collected data using SPSS software. The collected data was tested for normality and found to have a non-normal distribution. Parametric testing could not be used because the assumption of normality was violated. Non-parametric testing using Spearman's Rho was chosen to test for correlations between the study variables. Non-parametric testing using Ordinal Regression was chosen to test which styles of leadership were predictors of total LSS implementation success.

The literature review conducted in Chapter 2 identified and shaped the basis of which this research was conducted. Four research questions were asked to understand if there were any relationships between black belt practitioner leadership styles and LSS CSFs:

Research Question 1: What is the relationship between a black belt's laissez-faire leadership style as defined by the MLQ and LSS CSFs (management commitment, project selection, and training)?

Research Question 2: What is the relationship between a black belt's transactional leadership style as defined by the MLQ and LSS CSFs (management commitment, project selection, and training)?

Research Question 3: What is the relationship between a black belt's transformational leadership style as defined by the MLQ and LSS CSFs (management commitment, project selection, and training)?

Research Question 4: Does a black belt's laissez-faire leadership style, transactional leadership style, and transformational leadership style, as defined by the MLQ-5X, predict the success of LSS implementation (management commitment, project selection, and training)?

According to the results based on Spearman Rho's testing of research question 1, the null hypothesis that no relationship existed between laissez-faire leadership and LSS CSFs was rejected. Statistical significance implies that there was correlation between the variables. A negative correlation was found for LSS implementation success, management commitment, and training. Project selection was found to be insignificant in relation to laissez-faire leadership. This style of leadership would be ineffective for black belt practitioners to use with the LSS methodology.

According to the results based on Spearman Rho's testing of research question 2, the null hypothesis that no relationship existed between transactional leadership and LSS CSFs was rejected. Statistical significance implies that there was correlation between the variables. A positive correlation was found for LSS implementation success, project selection, and training. Management commitment was found to be insignificant in relation to transactional leadership. This style of leadership would be effective for black belt practitioners to use with the LSS methodology.

According to the results based on Spearman Rho's testing of research question 3, the null hypothesis that no relationship existed between transformational leadership and LSS CSFs was rejected. Statistical significance implies that there was correlation between the variables. A positive correlation was found for LSS implementation success, management commitment, project selection, and training. No CSFs were found to be insignificant in relation to transformational leadership. This style of leadership would be highly effective for black belt practitioners to use with the LSS methodology.

According to the results based on ordinal regression testing of research question 4, the null hypothesis that no relationship existed between laissez-faire, transactional, and transformational leadership and LSS implementation failed to be rejected. Statistical insignificance implies that none of the three leadership styles were predictors of LSS implementation success. Annual projects supported was found to be statistically significant implying that annual projects supported did have a positive relationship with LSS implementation success.

Summary

This chapter presented the results from a quantitative correlational research study of black belt practitioners from A&D Corporation XYZ. Study participants completed an electronic survey which determined their styles of leadership and perspective on LSS CSFs. A total of 430 total surveys were sent over a four week period to the study participants. A total of 112 surveys were completed which provided a response rate of roughly 26%. Statistical analysis was completed using Spearman Rho's correlation analysis and ordinal regression analysis. The null hypothesis for research questions 1-3 was rejected, implying significant correlations exist between the three leadership styles and LSS CSFs. The null hypothesis for research question 4 failed to be rejected, implying the three leadership styles were not predictors of the success of LSS implementation. Chapter five will present an evaluation of the findings, conclusions, limitations, and future research recommendations.

CHAPTER FIVE: CONCLUSION

This research investigated how different black belt leadership styles may impact the success of LSS implementation within A&D manufacturing organizations. The research study was conducted within A&D organization XYZ. XYZ is a Fortune 500 company involved in developing and manufacturing military defense products. XYZ deploys LSS as its primary methodology to support continuous improvement projects. The study included 112 employees trained as black belt practitioners in LSS across multiple manufacturing locations within the United States.

LSS is a proven methodology that is deployed across multiple industries. The leadership aspects required to drive successful technical continuous improvement methodologies, such as LSS, is often under assessed. This research aimed to understand what correlations may exist between specific leadership styles and LSS CSFs. Understanding how leadership styles impact the LSS CSFs may be of high interest to organizations wanting to maximize the benefits from implementing the methodology. This research highlights the importance of black belt practitioner leadership styles that may not be prioritized in training curriculums primarily focused on the LSS methodology itself.

Evaluation of Results

This study has implications for organizations within the A&D industry who use the LSS methodology for continuous improvement initiatives. The findings showed a negative correlation between laissez-faire leadership and LSS implementation success, management commitment, and training. The findings showed a positive correlation between transactional leadership and LSS implementation success, project selection, and training. The findings showed a positive

correlation between transformational leadership and LSS implementation success, management commitment, project selection, and training. Black belt practitioners within XYZ using transactional and transformational styles of leadership were therefore found to have positive impacts on overall LSS implementation and the three CSFs.

The growing importance of leadership styles and LSS implementation in manufacturing served as the basis and focus of the implications between both topics. The research findings aligned with van Elp, Roemeling, and Aij's (2021) study results that a hybrid use of transactional and transformational leadership is necessary in continuous improvement initiatives. Other researchers also supported that transactional and transformational leadership should be treated as complementary styles that can be utilized in parallel (Hetland & Sandal, 2003; MacKenzie, Podsakoff, & Rich, 2001; Tejeda, Scandura, & Pillai, 2001). The findings of this study aligned with Prasertwattanakul and Chan's (2007) study which found that transactional and transformational leadership styles had positive relationships with six sigma performance. Prasertwattanakul and Chan (2007) also found a negative relationship with the laissez-faire leadership style and concluded it should be completely eliminated.

Annual projects supported was found to be a significant predictor of LSS implementation within XYZ. Black belt practitioners must drive project completions and alignment with stakeholders through their leadership styles when implementing LSS (Antony et al., 2018). Leadership was found to be a LSS CSF in determining how successful cross-functional projects would be (Näslund, 2013). Higher amounts of projects supported means more opportunities for leadership to influence the valuable benefits received from implementing LSS (Snee, 2010). This finding supported the importance of black belt leadership when implementing LSS through project support.

Kassotaki, Paroutis, and Morrell's (2019) study of an A&D organization found that project leaders carried the responsibility of driving task-oriented outcomes (exploitation) through the use of innovative (exploration) approaches. Ebrahimi et al.'s (2016) study in manufacturing organizations found a relationship between transformational leadership and exploratory innovation. The researchers also found a relationship between transactional leadership and exploitative innovation. The findings from this research study within XYZ thus corroborate with the findings of Kassotaki et al. (2019) and Ebrahimi et al. (2016). The necessity for black belts to utilize both styles of leadership is imperative to execute task-oriented activities while fostering exploratory pursuits of innovation for continuous improvement.

It was an unexpected finding from the study that laissez-faire, transactional, and transformational leadership styles were not predictors of LSS implementation success as hypothesized in research question 4. In other words, the black belt leadership styles had no relationship with the LSS CSFs. This finding contrasts Hilton and Sohal's (2012) conceptual model, which speculated that project leadership would be a predictor in successful LSS deployment based on preliminary evaluations. Though ordinal regression models are often most popular, they pose serious limitations as underlying assumptions may be violated along with varying interpretations of the same results (Williams, 2008). This finding also contradicts research that concluded lack of leadership was a critical barrier for successful LSS implementation (Albliwi et al., 2015; Antony & Gupta, 2019; McLean & Antony, 2014, Timans et al.,2012). Further research would be necessary to understand which variables or conditions would provide a more robust predictive model.

Limitations

The main limitation of this study is that it only analyzed one corporation within the A&D industry. Though much is to be gleaned from the LSS black belt culture of corporation XYZ, it limited the study from being able to assess other manufacturing corporations in the industry. The results might be limited in relevance to companies in other countries, as XYZ is in the United States. XYZ is considered a large organization which potentially limits the findings from being completely applicable to SMEs. Additional limitations from the study include:

1. Data was collected using an online survey which may have introduced the opportunity for response bias. Fear of being honest, lack of interest, or skipping questions, could have contributed to this bias. Perceived threat on surveys has historically led to underreporting from participants (Bradburn, Sudman, Blair, & Stocking, 1978). The study set parameters in place to mitigate these biases through voluntary participation, informed consent, and exclusion criteria, for survey responses.
2. Leadership styles determined by the MLQ-5X leadership questionnaire were self-rated by each participant. This creates a natural bias in the results as each participant rated themselves. If the participants were rated by their peers, the leadership style results may have varied. The self-rater form had to be used per XYZ's legal department. This was a requirement to protect the interests of the study participants.
3. The study's sample only included trained black belts within corporation XYZ. The LSS methodology includes other roles such as Champions and Sponsors. Both roles are usually significant in LSS and require leadership support for overall project success. Green belts were not considered as they seldom have a leadership role in improvement projects.

4. The study defined LSS implementation success through the three CSFs of management commitment, project selection, and training. Though the literature identified these as the top three CSFs, there are CSFs that were not considered. This limits understanding how black belt leadership styles may have correlated with other factors that could influence LSS implementation. The CSFs were also analyzed from the results of survey questions as opposed to actual financial results from LSS within XYZ.
5. The study only measured the three leadership styles identified by the FRLM. Though the MLQ-5X has been deemed a valid and reliable tool for measuring laissez-faire, transactional, and transformational leadership (Avolio, 2004), other leadership assessments were not considered. Depending on industry and organizational work culture, the MLQ-5X could potentially be limited at determining an accurate representation of black belt leadership styles. The results from this study could support the foundation for future research in continuing the exploration of leadership theories.

Contributions to the Body of Knowledge

This research contributes to the body of knowledge by providing empirical data to address gaps that were identified in the literature. An analysis of research themes in LSS from 2000 to 2016 found that empirical research was commonly conducted through case studies and surveys (Raval, Kant, & Shankar, 2018). To the knowledge of the researcher, this is the first study to examine the relationship between black belt practitioner leadership styles and LSS CSFs within an A&D organization. The research presents new findings for the A&D manufacturing industry and new findings for the academic literature for leadership and LSS.

Database reviews returned significantly less results for LSS leadership studies within the A&D industry when compared to the automotive and healthcare industries. According to Setijono et al. (2012), "The role of leadership styles in relation to LSS deployment appears to be more important to practitioners in the field than it was in the literature, where a relatively small number of sources identified it" (p. 280). Sing and Rathi's (2019) review of LSS implementation across various industries noted that the A&D manufacturing industry lacked awareness about using LSS for continuous improvement efforts. Albliwi et al.'s (2015) systematic review of LSS in the manufacturing industry identified gaps between LSS and innovation to help corporations to sustain competitiveness. The study findings bridge these gaps through how practitioner transactional and transformational leadership styles correlate with LSS CSFs.

Continuous improvement initiatives often fail in manufacturing environments due to inconsistent leadership commitments (McLean & Antony, 2014). The literature identified limited journals focused specifically on leadership and LSS, with an overemphasis on theoretical rather than empirical studies (Alnadi & McLaughlin, 2020). Suresh et al. (2012) identified a need for research to validate leadership variables that would enable successful deployment. There is a lack of empirical research that supports which leadership styles are most effective for successful LSS implementation (Laureani & Antony, 2018). This research therefore contributes quantitative results from an empirical study to further progress the current body of work within the academic literature.

The practical contribution of this research is for organizations wanting to comprehend how leadership styles can influence LSS CSFs during implementation. Top management leaders hoping to improve business value through LSS will have industry relevant findings to better assess their work culture and black belt leaders. The necessity for organizational innovation will

create high demands for leaders that can execute continuous improvement through LSS projects. Black belt practitioners will have applicable information on LSS CSFs and how they correlate with different styles of leadership within the FRLM. Insight into different leadership styles may improve current training programs or re-focus leadership initiatives to enhance organizational outcomes.

Conclusions

This study provides quantitative results for LSS implementation CSFs and leadership by directly examining an S&P 500 manufacturing corporation within the A&D industry. Subjection to DoD standards and military budgets provides limitations when attempting to improve (Papin & Kleiner, 1998). Steinbock (2014) noted that the A&D industry is subject to ongoing innovation challenges because of limited budgets and low-cost competition. A&D organizations face the challenge of needing to continuously improve their manufacturing processes at lower costs to remain competitive. This places a greater emphasis on being able to implement continuous improvement methodologies, such as LSS, to provide value to customers.

Today's fast-paced environment demands effective leadership to properly handle rapid change and complexity (Emmerling et al., 2015). One aspect of innovation in defense organizations and the military is the capability of leadership to shape the process improvement related activities (Cheung, Mahnken, & Ross, 2011). Black belt practitioners are responsible for leading LSS implementation at the middle-management project level. The findings of the study support that both transactional leadership and transformational leadership have positive correlations with LSS implementation within an A&D manufacturing context. The results

highlight that black belt practitioners may need to range between transactional leadership and transformational leadership for executing different elements of the LSS methodology.

The hierarchical organizational structure of the military is foundationally built on transactional leadership (Collazo, 2015), which can oft times be mirrored in A&D organizations. Transactional styles of leadership were found to be prevalent amongst top management in the A&D industry (Kassotaki, 2019). Based on the unique characteristics between both leadership styles, A&D organizations may be at a disadvantage by predominantly using transactional leadership only. Project leaders from three different A&D organizations reported that their leaders were mostly transactional with less focus on transformational activities (Kassotaki, 2019). The overreliance on transactional leadership may explain why lack of top management involvement is commonly cited as a failure factor during LSS implementation.

The results of this study identify two leadership styles as defined by the FRLM that positively impact the LSS CSFs of top management, project selection, and training. Employing both transactional leadership and transformational leadership together will positively impact successful LSS implementation. These findings present a compelling reason for specific organizations to evaluate if and how transformational leadership is part of their culture. Organizations implementing LSS should assess the leadership styles of their practitioners and provide resources to grow individual skillsets. The curriculums for leadership training and LSS training programs should be holistically assessed as well. Acknowledging that both transactional leadership and transformational leadership are pivotal for black belt practitioners will lead to greater success during LSS implementation.

Future Research Recommendations

The results of this research provide multiple avenues for new studies to expand upon the current literature for LSS and leadership styles within the A&D industry. The studied topic is one that is becoming more prevalent as organizations are tasked with meeting higher demands at lower costs. The narrowed focus from only analyzing XYZ provides researchers with a holistic representation of a large manufacturing organization within the A&D industry. Expanding upon the original proposed research questions in this study would lay the groundwork for new results and inferences. The following are future research recommendations based on the results from this study:

The first recommendation for future research is to conduct similar research studies at other large manufacturing organizations and then compare the results with the findings of this study. The specific results from XYZ provides a baseline research comparable to draw further inferences about the relationship between leadership styles and LSS CSFs. Studies that analyze multiple corporations via meta-analysis may infer broader observations that may miss the depth achieved from analyzing one corporation.

A second recommendation for future research would be to assess other LSS CSFs that were not part of the focus for this study. It would be fair to also consider using a different leadership model than the FRLM by Bass and Avolio (2004). The MLQ-5X met the needs of this study but that doesn't mean it would be the best choice for other industries or organizations performing different types of work. Evaluating how other CSFs interact with different leadership styles would further support growing the body of knowledge.

A third recommendation for future research would be to conduct a similar study with a broader population size including sponsors, champions, and top management executives. Having

data on their leadership styles and views of LSS CSFs would provide the ability to assess where discrepancies exist. Organizations could act on these findings by re-evaluating their training programs and elevating the right types of leaders into black belt roles.

A fourth recommendation for future research would be to employ a qualitative or mixed-mode study methodology. Quantitative results from using surveys provides data that can be readily analyzed via statistical testing procedures. A large portion of leadership is grounded in qualitative human-based traits that may make some aspects difficult to quantify. Qualitative methodologies include case studies, ethnography, phenomenology, grounded theory, and narrative inquiry (Leedy et al., 2019). The use of surveys with other qualitative methods would provide multiple new opportunities for analysis.

A fifth recommendation for future research would be to replicate this study in A&D SMEs to evaluate what differences or similarities exist with larger organizations, such as XYZ, in the market. Alexander et al.'s (2019) researched concluded there were knowledge gaps in the literature for LSS and SMEs. The authors discussed the constraints SMEs face with limited resources while trying to remain competitive. The results from a replicate study would fill knowledge gaps pertaining to LSS within the context of SMEs and large organizations in the A&D industry.

APPENDIX A: DEMOGRAPHICS SURVEY

Demographics

What is your current role?

- ○ Engineering
- ○ Finance
- ○ Non-Technical
- ○ Management
- ○ Other:

Please specify

Are you classified as a Leader or Individual Contributor?

- ○ Leader
- ○ Individual Contributor

What type of work environment do you support?

- ○ Manufacturing
- ○ Program
- ○ Functional
- ○ Human Resources
- ○ Facilities

How many years have you been trained in black belt?

- ○ 0-5
- ○ 6-10
- ○ 11-15
- ○ More than 15 years

How many Lean Six Sigma (LSS) improvement projects do you support annually?

- ○ 0
- ○ 1-3

- ○ 4-6
- ○ More than 7

APPENDIX B: MLQ-5X SELF-RATER SURVEY

Sample Items From the Multifactor Leadership Questionnaire (MLQ) Form 5X-Short

These questions provide examples of the items that are used to evaluate leadership style. The MLQ is provided in both Self and Rater forms. The Self form measures self-perception of leadership behaviors. The Rater form is used to measure leadership. By thinking about the leadership styles as exemplified below, you can get a sense of your own belief about your leadership.

Key: 0 = Not at all 1 = Once in a while 2 = Sometimes 3 = Fairly often 4 = Frequently, if not always

Transformational Leadership Styles

Idealized Influence (Attributes)	I go beyond self-interest for the good of the group.	0 1 2 3 4
Idealized Influence (Behaviors)	I consider the moral and ethical consequences of decisions.	0 1 2 3 4
Inspirational Motivation	I talk optimistically about the future.	0 1 2 3 4
Intellectual Stimulation	I reexamine critical assumptions to question whether they are appropriate.	0 1 2 3 4
Individualized Consideration	I help others to develop their strengths.	0 1 2 3 4

Transactional Leadership Styles

Contingent Reward	I make clear what one can expect to receive when performance goals are achieved.	0 1 2 3 4
Management by Exception: Active	I keep track of all mistakes.	0 1 2 3 4

Passive/Avoidant Leadership Styles

Management by Exception: Passive	I wait for things to go wrong before taking action.	0 1 2 3 4
Laissez-Faire	I avoid making decisions.	0 1 2 3 4

APPENDIX C: LSS SURVEY

Please select your level of agreement.

Management Commitment:

	Strongly Disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree
The Lean Six Sigma methodology is used for implementing continuous improvement initiatives across the enterprise.	○	○	○	○	○
Management actively takes a role in providing resources (finances, manpower, leadership support) for teams to achieve project objectives.	○	○	○	○	○
Management provides ongoing support to address cultural resistance during lean six sigma improvement initiatives.	○	○	○	○	○
Employees I interact with understand the benefits and customer value from utilizing the lean six sigma methodology.	○	○	○	○	○
My organization emphasizes creativity and innovation in addition to cost reduction goals within continuous improvement initiatives.	○	○	○	○	○

Project Selection:

	Strongly Disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree
Lean Six Sigma projects are selected **and** prioritized in alignment with organizational goals and objectives.	○	○	○	○	○
Employees are empowered to choose relevant improvement projects within their working environment.	○	○	○	○	○
Criteria for selecting improvement projects is grounded in objective data and customer requirements rather than a "gut feel" approach.	○	○	○	○	○
Project charters we use clearly communicate the problem and necessary scope of work required for the team to be successful.	○	○	○	○	○

Training:

	Strongly Disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree
The internal Lean Six Sigma training course requirements prepare employees to become practitioners within the organization.	○	○	○	○	○
Common problem-solving tools associated with lean six sigma are understood and applied regularly within the organization.	○	○	○	○	○
The organizational return on investment from training and certifying green belts and black belts is observable and/or quantifiable.	○	○	○	○	○
Black belts are often deployed across multiple functional teams to facilitate and provide problem solving techniques.	○	○	○	○	○
Knowledge learned from the lean six sigma methodology is shared within the community of practice.	○	○	○	○	○

APPENDIX D: MIND GARDEN INSTRUMENT APPROVAL

Approval for Remote Online Use of a Mind Garden Instrument

Effective date is September 1, 2020 for:

Corey Gellis

You submitted your Application for Remote Online Use at 3:44 pm EDT on August 31, 2020.

mind garden [v2]

APPENDIX E: INFORMED CONSENT FORM

UNIVERSITY OF CENTRAL FLORIDA

EXPLANATION OF RESEARCH

Title of Project: ASSESSMENT OF LEADERSHIP STYLES AND LEAN SIX SIGMA EFFECTIVENESS WITHIN AN AEROSPACE & DEFENSE CORPORATION

Principal Investigator: Corey Gellis, Doctoral Student, University of Central Florida, Orlando, FL.

Faculty Supervisor: Dr. Ahmad Elshennawy

You are being invited to take part in a research study. Whether you participate is completely voluntary.

Research Purpose? The purpose of this research is to understand if there is a statistical relationship between self-rated leaderships styles and lean six sigma critical success factors for trained black belts and master black belts within an Aerospace & Defense corporation.

What will be asked of me? You will be asked to complete an online survey that will gather information on your self-perceived leadership style and perspective of lean six sigma success factors. The expected time to complete this survey is 20 minutes.

Is this research study confidential? Yes. The data collected in this study is confidential.

How will the data from the research study be stored? The data will be stored in a secure encrypted location that will be locked and password protected. The data will only accessible by the investigator. The data will be stored for a minimum of 5 years after study closure.

Study contacts for questions about the study or to report a problem: If you have questions, concerns, or complaints please contact:

Corey Gellis, Doctoral Student, Industrial Engineering Program, College of Engineering and Computer Science at cgellis@knights.ucf.edu, or Dr. Elshennawy, Faculty Supervisor, Department of Industrial Engineering and Management Systems at (407) 823-5742 or by email at Ahmad.Elshennawy@ucf.edu.

IRB contact about your rights in this study or to report a complaint: If you have questions about your rights as a research participant, or have concerns about the conduct of this study, please contact Institutional Review Board (IRB), University of Central Florida, Office of Research, 12201 Research Parkway, Suite 501, Orlando, FL 32826-3246 or by telephone at (407) 823-2901, or email irb@ucf.edu.

APPENDIX F: IRB APPROVAL LETTER

UNIVERSITY OF CENTRAL FLORIDA

Institutional Review Board
FWA00000351
IRB00001138, IRB00012110
Office of Research
12201 Research Parkway
Orlando, FL 32826-3246

EXEMPTION DETERMINATION

August 7, 2020

Dear Corey Gellis:

On 8/7/2020, the IRB determined the following submission to be human subjects research that is exempt from regulation:

Type of Review:	Initial Study, Exempt Category 2
Title:	ASSESSMENT OF LEADERSHIP STYLES AND LEAN SIX SIGMA EFFECTIVENESS WITHIN AN AEROSPACE & DEFENSE CORPORATION
Investigator:	Corey Gellis
IRB ID:	STUDY00002044
Funding:	None
Grant ID:	None
Documents Reviewed:	• HRP 254 - Explanation of Research, Category: Consent Form; • HRP 255 Request for Exemption, Category: IRB Protocol; • Lean Six Sigma Survey, Category: Survey / Questionnaire; • MLQ Leadership Survey, Category: Survey / Questionnaire; • Survey Introduction Email, Category: Recruitment Materials;

This determination applies only to the activities described in the IRB submission and does not apply should any changes be made. If changes are made, and there are questions about whether these changes affect the exempt status of the human research, please submit a modification request to the IRB. Guidance on submitting Modifications and Administrative Check-in are detailed in the Investigator Manual (HRP-103), which can be found by navigating to the IRB Library within the IRB system. When you have completed your research, please submit a Study Closure request so that IRB records will be accurate.

If you have any questions, please contact the UCF IRB at 407-823-2901 or irb@ucf.edu. Please include your project title and IRB number in all correspondence with this office.

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