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An Assessment Of Leadership Traits And The Success Of Six Sigma Projects

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AN ASSESSMENT OF LEADERSHIP TRAITS AND THE
SUCCESS OF SIX SIGMA PROJECTS

by

David L. Chamblee Jr.

A dissertation submitted to the graduate faculty
in partial fulfillment of the requirements for the degree of
DOCTOR OF PHILOSOPHY

Department: Interdisciplinary Studies
Major: Leadership Studies
Major Professor: Dr. Forrest Toms

North Carolina A&T State University
Greensboro, North Carolina
2010

ABSTRACT

Chamblee, Jr., David L. AN ASSESSMENT OF LEADERSHIP TRAITS AND THE SUCCESS OF SIX SIGMA PROJECTS. (**Major Advisor: Dr. Forrest Toms**), North Carolina Agricultural and Technical State University.

This study identifies specific leadership traits for green and black belt Six Sigma leaders that have a statistical relationship with the success of Six Sigma projects. The study also tests the reliability of a scale created from the Leadership Trait Questionnaire items.

Approximately five hundred ($N = 500$) Six Sigma leaders were selected from a Tyco Electronics database called Tyco Electronics Business Improvement Tracking (TBIT). The criteria for participants were as follow: (a) They were master black belts, black belts, green belts or lean practitioners; (b) Their projects were related to Six Sigma; (c) Their projects had a hard cost savings; and (d) They work in North America, Asia or Europe, Middle East, Africa (EMEA). The Leadership Trait Questionnaire (LTQ) was used to measure personal characteristics or traits that are directly related to the nature and demands of leadership (Northouse, 2001). Participating leaders were asked to respond to each trait on a five-point scale ranging from Strongly Agree to Strongly Disagree (Northouse, 2001). The responses to the questionnaire were analyzed using Minitab software version 15.0. Statistical analysis included descriptive statistics, Cronbach's reliability of measures, one way ANOVA and Main Effects Plot analysis. In this study more effective green belt leaders rated themselves higher than less effective green belt leaders on the following traits: articulate, perceptive, self-confident, self-assured and

determined. Also, the more effective green belt leaders reported stronger upper management support than did less effective green belt leaders. In this study more effective black belt leaders rated themselves higher than less effective black belt leaders on the following traits: articulate, perceptive, self-confident, self-assured, determined, dependable and friendly. The more effective black belt leaders also reported stronger upper management support and project experience than did less effective black belt leaders. Clearly, in times of economic uncertainty and increasing global competiveness managers need to be able to recognize the individuals who possess the needed traits to make their companies profitable.

School of Graduate Studies
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This is to certify that the Doctoral Dissertation of

David L. Chamblee Jr.

has met the dissertation requirements of
North Carolina Agricultural and Technical State University

Greensboro, North Carolina
2010

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DEDICATION

This dissertation is dedicated to my sons David Joseph Chamblee and Ta'Shaun Marquise Davis. Also it is dedicated to all black male youth living in poverty. God did it for me and he will do it for you. I encourage you to live your life by the following motto:

Faith + Hard work + Dedication = Success

BIOGRAPHICAL SKETCH

David Lee Chamblee Jr. was born on February 17, 1970 in Elizabeth City, N.C. He graduated magna cum laude with a B.S. degree in Industrial Technology/ Manufacturing Systems from North Carolina Agricultural and Technical State University. He also earned a M.S. degree in Industrial Technology with a concentration in Quality Assurance from Bowling Green State University.

David has over seventeen years of engineering and leadership experience with various fortune 500 companies. David also has several years of experience as an adjunct professor. He taught technology and engineering courses at Bowling Green State University and North Carolina A & T State University. David is Six Sigma certified as a Green Belt and Black Belt.

Currently, David is a senior Quality Engineer for Tyco Electronics. He has traveled internationally over the past five years to Juarez, Mexico, Shenzhen, China and Evora, Portugal leading the implementation of Six Sigma projects that have saved millions of dollars to Tyco Electronics bottom line. He serves as the vice-president of the Manufacturing Systems Advisory Board for the School of Technology at North Carolina A & T State University. He serves as a deacon at Calvary Christian Center in Greensboro, N.C. Also David is a member of Omega Psi Phi fraternity. He has received several awards for uplifting mankind and serving as the vice-basileus.

ACKNOWLEDGMENTS

I would like to thank God, my family, committee members and friends who supported me throughout this educational journey!

I thank God for giving me the strength to persevere in accomplishing this educational goal.

I thank my children for being understanding and demonstrating patience during this process. Whitney, Cydney, DJ and Ta'Shaun I love you with all my heart!

I thank my wife for her support and not giving up on me during the dissertation phase.

I would like to thank all my committee members: Dr. Toms, Dr. Walker, Dr. Barber, Dr. McCauley and Dr. Bulls. I greatly appreciate the guidance and support throughout the doctoral process.

Finally, I would like to thank Dr. Erwin for giving me the opportunity to be in the program and believing in me.

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CHAPTER 1

Introduction: Effective Leadership, Six Sigma, and Trait Theory

Fuqua and Newman (2005) argue that systems theory is the most appropriate approach in the twenty-first century for achieving effective leadership in an organization. Systems theory defines leadership more broadly than the traditional bureaucratic models of leadership; it focuses on all members as leaders, rather than just one leader and a great many followers. The benefits of implementing systems theory are flexibility in leadership roles; increase sense of continuity within an organization over time; power and authority as relates to function and responsibility (those with specific expertise in a given area and who bear responsibility for outcomes in that area would be vested with power and authority over that arena of organizational functioning).

Chemers (2000) defined effective leadership as "a process of social influence in which one person is able to enlist the aid and support of others in the accomplishment of a common task." First he argued that the leader must be perceived as competent and trustworthy by her/his followers. Next, leaders must coach, guide, and support their followers in a way that allows followers to contribute to group goal attainment while satisfying their own personal needs and goals. Finally, effective leaders must use the skills and abilities possessed by themselves and their followers to accomplish the group's mission.

Hedricks and Weinstein (1999), in their analysis of a personality profile of a corporate leader, found effective leadership to interrelate with the following four

competency areas: Influencing and Directing; Building Relationships; Problem Solving and Decision Making; and Personal Organization and Time Management. With respect to Influencing and Directing, leaders possessed the motivation to assertively and persuasively present their ideas, to successfully complete projects. In the competency area of Building Relationships, leaders placed less emphasis on developing interpersonal relationships for the purpose of socializing, and leaders did not have a high need to be liked. Leaders excelled in the area of Problem Solving and Decision Making because of their above average risk-taking and sense of urgency. Finally, with respect to Personal Organization and Time Management, leaders appear to be focused on implementing their highly innovative ideas in such a way as to ensure their timely completion of projects.

Kilburg (2007) focused on reverence and temperance as the foundation of effective leadership. Ancient Chinese and Greek models of effective leadership were based on the assumption that individuals in these positions must first seek and practice virtuous behavior. Only when they were thought to have reasonably demonstrated that they understood and could consistently enact behavior that was reverent, temperate, courageous, just, and wise would such individuals be proposed for senior positions in state government.

Duff (2007) delivered a speech to graduates of the Professional Executive Leadership School in which he defined an effective leader. Captain Duff serves with the Lynchburg, Virginia, Police Department. According to Captain Duff , characteristics of effective leaders include the following: (a) Optimism—thinking positively all the time; (b) True north vision—must establish a vision thinking towards the future; (c) Relentless

preparation—must always be prepared by constantly analyzing strengths, weaknesses, opportunities, and threats; (d) Teamwork—must think in terms of "we" instead of "I"; (e) Communication—must have good verbal and written communication skills; and (f) Courage—must not be afraid to make the right decision.

As demonstrated above, effective leadership can be defined from many different perspectives. Effective leadership is the key to successfully implementing Six Sigma projects (ReVelle, 2004). An effective leader in the context of Six Sigma is a leader who has implemented projects that resulted in significant cost savings to the bottom line. Six Sigma is a process-focused, statistically based approach to business improvement that companies such as Motorola, General Electric, Tyco Electronics and American Express have used to produce millions of dollars in bottom-line improvements (Hoerl, Rodebaugh, & Snee, 2004).

Edward J. Zander, Motorola CEO, stated that Six Sigma has saved his company more than $16 billion to date. General Electric's CEO, Jack Welch, wrote in the annual report that from 1996 to 1998 Six Sigma tactics had saved his company more than $2 billion. Tyco Electronics' CEO, Tom Lynch, wrote in the annual report that from 2003 to 2008 his company has saved more than $700 million. American Express Vice President, Rick Irving, stated that Six Sigma programs have delivered approximately one billion dollars in benefits annually since the launch in 1999. The implementation of Six Sigma strategies has resulted in significant savings for various organizations (Hahn, Hill, Hoerl, & Zinkgraf, 1999). Clearly, in times of economic uncertainty upper management need to be able to recognize the individuals who possess the needed traits for effective leadership.

Champions, master black belts, black belts, green belts, and team members make up the core of Six Sigma (ReVelle, 2004). Champions and master black belts work behind the scenes to support people working on projects, as well as the overall initiative (Eckes, 2001). Without a strong and tireless black belt or green belt, Six Sigma teams are usually not effective (Goffnett, 2004). Black belts and green belts are characterized as "future business leaders" (Eckes, 2001) and "the backbone of Six Sigma culture" (Brue, 2002). The problem, then, resides in selecting a green belt or black belt with specific traits that relate to successfully implementing Six Sigma projects.

The black belt and green belt must possess strong problem solving, the ability to collect and analyze data, organizational savvy, leadership and coaching experience, and good administrative sense (Kumar, Wolfe, & Wolfe, 2008). Moreover s/he must be adept at project management, the art and science of getting things done on time through the effort of others (Goffnett, 2004). Black belt and green belt candidates are described as disciplined problem solvers who possess a significant amount of technical ability, are comfortable with basic statistics, and are not afraid to question conventional wisdom (Adams, Gupta, & Wilson, 2003; Hoerl, 2001). Black belts and green belts have also been described as open minded change agents and project managers able to communicate effectively at all levels (Brue, 2002).

Many experts have insisted that black belts and green belts be able to use a broad set of soft skills as well, such as meeting management and presentation methods (Brekyfogle, Cupello, & Meadows, 2001; Eckes, 2001; Hoerl, 2001; Pyzdek, 2000). As a chosen leader, the black belt or green belt will guide a team through the Six Sigma

process. The existing literature, however, does not explore the specific traits that black belts and green belts should possess to successfully implement Six Sigma projects. Selecting an effective green belt or black belt could save an organization millions of dollars in terms of their bottom line (Hoerl et al., 2004). This study addresses gaps in the literature, and its results can be used to help in developing future green belt and black belt Six Sigma leaders.

Theoretical Framework

Trait theory forms the theoretical framework for this study. Trait theory was developed from the "great man" theories, and was used to study effective leaders. Trait theory indicates that traits play a critical role in regard to effective leadership practices (Bass, 1990). This study employs trait theory by correlating leader traits (independent variables) such as: articulate, perceptive, self-confident, self-assured, persistent, determined, trustworthy, dependable, friendly, and outgoing; with hard cost savings (dependent variable) for the organization. Also, project experience, upper management support and skill set, which are the mediating variables, will be correlated with hard cost savings. Many Six Sigma practitioners believe the aforementioned mediating variables affect the success of completing Six Sigma projects.

Northouse (2004) notes that during the early part of the twentieth century, leadership traits were studied to determine what made certain people great leaders. Early studies of trait theory were known as "great man" theories because they focused on identifying the innate qualities and characteristics possessed by social, political and

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military leaders. It was believed that people were born with these traits and only the "great" people possessed them. During this time, research concentrated on determining the specific traits that clearly differentiated leaders from followers (Bass, 1990; Jago, 1982).

In the mid-twentieth century, the trait approach was challenged by research that questioned the universality of leadership traits. In a major review in 1948, Stogdill suggested that no consistent set of traits differentiated leaders from non-leaders across a variety of situations. An individual with leadership traits who was a leader in one situation might not be a leader in another situation. Rather than being understood as a quality that individuals possessed, leadership was re-conceptualized as a relationship built within a social situation (Stogdill, 1948). Personal factors related to leadership continued to be important, but researchers contended that these factors were to be considered as relative to the requirements of the situation (Northhouse, 2004).

In recent years, there has been resurgence in interest in the trait approach in explaining how traits influence leadership (Bryman, 1992). For example, based on a new analysis of previous trait research, Lord, DeVader, and Alliger (1986) found that personality traits were strongly associated with individuals' perceptions of leadership. Similarly, Kirkpatrick and Locke (1991) have gone so far as to claim that effective leaders are actually distinct types of people in several key respects. Further evidence of renewed interest in the trait approach can be seen in the current emphasis given by many researchers to visionary and charismatic leadership (Bass, 1990; Bennis & Nanus, 1985; Tushman, O'Reilly, & Nadler, 1989; Zaleznik, 1977).

In summary, the trait approach is alive and well. It began with an emphasis on identifying the qualities of great persons; next, it shifted to include the impact of situations on leadership; and most currently, it has shifted back to reemphasize the critical role of traits in effective leadership (Northouse, 2004).

Purpose of the Study

The purpose of this research is twofold. First, the research identifies specific leadership traits for green and black belt Six Sigma leaders that have a statistical relationship with the success of Six Sigma projects. Second, the study tests the reliability of a scale created from the Leadership Trait Questionnaire items. The LTQ, which is derived from the trait theory, will be used to assess black belt and green belt leadership traits. Independent variables in this study include the following:

1. Articulate: Communicates effectively with others;

2. Perceptive: Discerning and insightful;

3. Self-confident: Believes in self and one's ability;

4. Self-assured: Secure with self, free of doubts;

5. Persistent: Stays fixed on the goal(s), despite interference;

6. Determined: Takes a firm stand, acts with certainty;

7. Trustworthy: Acts believable inspires confidence;

8. Dependable: Is consistent and reliable;

9. Friendly: Shows kindness and warmth;

10. Outgoing: Talks freely, gets along well with others (Northouse, 2004).

11. Project Experience

12. Upper Management Support

13. Technical Skill Set

The dependent variable is the actual cost savings that will be self reported by Six Sigma leaders. The actual cost savings for green belt projects that are $50,000 or greater will be considered a successful project. The actual cost savings for black belt projects that are $250,000 or greater will be considered a successful project.

Hypotheses

The following hypotheses ground data analysis for this study. They are framed in terms of traditionally accepted null and alternative hypotheses.

1. Null Hypothesis: There is no statistical relationship between the traits of green belt leaders and the success of Six Sigma projects.

2. Alternative Hypothesis: There is a statistical relationship between the traits of green belt leaders and the success of Six Sigma projects.

3. Null Hypothesis: There is no statistical relationship between the traits of black belt leaders and the success of Six Sigma projects.

4. Alternative Hypothesis: There is a statistical relationship between the traits of black belt leaders and the success of Six Sigma projects.

5. Null Hypothesis: A scale created from the Leadership Trait Questionnaire items is not reliable.

6. Alternative Hypothesis: A scale created from the Leadership Trait Questionnaire items is reliable.

Definitions of Key Terms

Both Six Sigma and trait theory employ terms in unique ways. For clarification, the specialized vocabulary used in this study is defined below:

Black Belt is a process improvement project team leader who is trained and certified in the principles of Six Sigma methodology and tools, and who is responsible for the most complex Six Sigma projects (Pande & Holpp, 2002).

Green Belt is a process improvement project team leader who is trained and certified in the principles and practices of Six Sigma methodology and tools, and who is responsible for projects in which the cost savings are less and the time to complete the project is less than the black belt (Pande & Holpp, 2002).**Traits** are innate or learned characteristics, or both (Northouse, 2007).

Hard Cost Savings: (also known as Green Savings or Reduction Savings)—have a direct impact on the Profit/Loss (P&L) statement for the business and are usually the result of improvements which reduce costs (http://tebit.us.tycoelectroncis.com/Default.aspx).

Project Success is hard cost savings for green belt projects equal to or greater than $50,000 is successful. Black belt projects equal to or greater than $250,000 is successful (http://6sigma.us.tycoelectronics.com/Default.htm).

Six Sigma is a process-focused, statistically based approach to business improvement (Hoerl et al., 2004).

TEBIT (Tyco Electronics Business Improvement Tracking)—a software application utilized within Tyco Electronics to track, maintain, and report price reductions or cost savings for projects involving External Supplier spend reductions and avoidances or Internal cost improvements (http://tebit.us.tycoelectronics.com/Default.aspx).

Significance of Study

The existing literature does not explore the specific traits that black belts and green belts should possess to successfully implement Six Sigma projects. However, selecting an effective green belt or black belt could save an organization millions of dollars in terms of their bottom line (Hoerl et al., 2004). This study addresses gaps in the literature, and its results can be used to help in developing future green belt and black belt Six Sigma leaders. Finally, this study demonstrates that the Leadership Trait Questionnaire (LTQ) scale is reliable. Prior to this study the LTQ instrument developed by Peter Northouse had not been tested for reliability. The LTQ instrument offers another method of conceptualizing and operationalizing Six Sigma leaders' ability to assess their leadership traits.

Chapter 1 has introduced the research focus, theoretical framework, null and alternative hypotheses, and defined key terms. Chapter 2 provides a review of relevant literature, and Chapter 3 sets out the research methodology in detail.

CHAPTER 2

Literature Review: Trait Theory as a Theoretical Frame for Understanding Leadership Approaches and Six Sigma

Chapter 2 provides a review of the literature in the following areas which are foundational to this study. The first section focuses on major leadership approaches and the theoretical perspective of trait theories. The second section sets out a history of Six Sigma, and the third unpacks the leadership roles that exist within Six Sigma.

Major Leadership Approaches

Leadership is a topic that has been studied for centuries. It is perceived as a difficult phenomenon to understand because of its many facets. Many research practitioners and scholars in the field of leadership have accepted the challenge to better understand all the components that affect the leadership process. There are many ideologies surrounding leadership. However the following appear to be the core elements related to leadership: leadership is a process, leadership involves influence, leadership occurs in a group context, and leadership involves goal attainment (Northouse, 2007).

Leadership is a topic that traces back to early Biblical times. Despite an abundance of research on this topic, practitioners and scholars find it difficult to exactly quantify exactly leadership, and how one accomplishes the leadership role successfully (Bulls, 2008).

The primary argument in the field of leadership surrounds whether leadership is an inherited trait, or a set of qualities and skills that can be learned. Many scholars argue that an individual is born with certain traits that define her/him as a leader. Other scholars view leadership as a learning process, meaning an individual can learn to become a leader. The literature recognizes that leadership as a trait is quite different from describing leadership as a process (Northouse, 2007).

The ideology of leadership from the trait perspective emphasizes that leaders have varying degrees of traits with which they are born. The degree to which an individual possesses these traits determines how effective that person can be as a leader. The ideology that leadership is a learned process based on education, experience and exposure is an inclusive view; from this perspective, leadership is open to all people, not just a set few who were born with certain traits (Jago, 1982).

It is debatable whether leadership is a trait, process or both, however trait theory argues for the trait perspective. Leader traits are challenging to quantify, but there are numerous instruments such as the Myers-Briggs Type Indicator, Principles of Adult Learning Scale, Guglielmino, Leadership Trait Questionnaire, and the Campbell Leadership Instrument, that attempt to address and understand the characteristics of effective leaders (Bulls, 2008). Trait theory will be used as the foundation to address the hypotheses introduced in Chapter 1:

1. Null Hypothesis: The Leadership Trait Questionnaire scale is not reliable.

2. Alternative Hypothesis: The Leadership Trait Questionnaire scale is reliable.

3. Null Hypothesis: There is no relationship between the traits of green belt leaders and the success of Six Sigma projects. The traits will not predict the success of Six Sigma projects.

4. Alternative Hypothesis: There is a relationship between the traits of green belt leaders and the success of Six Sigma projects. The traits will predict the success of Six Sigma projects.

5. Null Hypothesis: There is no relationship between the traits of black belt leaders and the success of Six Sigma projects. The traits will not predict the success of Six Sigma projects.

6. Alternative Hypothesis: There is a relationship between the traits of black belt leaders and the success of Six Sigma projects. The traits will predict the success of Six Sigma projects.

Trait approach. Leadership traits were studied during the early twentieth century in an effort to determine what elements constituted effective leadership. The "great man" theories characterized the first research completed on leadership traits. These theories argue that individuals are born with certain traits that make them leaders, and that if an individual was not born with these traits, then s/he could not be a leader. Social leaders, political leaders and military leaders were perceived to possess these innate traits (Northouse, 2007). Research conducted during the early twentieth century demonstrated that leaders had certain traits that followers did not possess (Bass, 1990).

There were advocates and critics of trait theory. Researchers started to question the universal quality of leadership traits during the twentieth century. There were no

consistent set of traits that distinguished leaders from followers (Stogdill, 1948). Stogdill's research demonstrated that both the situation and the environment can contribute to the success or failure of a leader. Stogdill's researcher argues that rather than being an innate quality, a leadership trait evidences itself within the relationship that emerges between people and a social situation. Stogdill's (1948) perspective on trait theory argues that characteristics of individual leaders are evidenced in relationship to a given situation. The basis of this argument is that the leadership ability that is effective in one situation may not work in another.

The trait theory is still considered to be a valid construct as we enter the twenty-first century, and several researchers have focused on restoring trait theory. Bryman's (1992) research demonstrated that traits definitely influence leadership. Further, a person's perception of a leader has a lot to do with the perceived leader's personal characteristics (Lord et al., 1986). There are many self assessment tools for leaders; however, the Leadership Trait Questionnaire (LTQ) is one of the few that considers the perception of the follower when assessing the leader.

Several leadership traits have emerged into new theories. Charismatic leadership is one of the most prestigious theories that originated from the charisma trait (Bennis & Nanus, 1985). Findings from the research of Kirkpatrick and Lock (1991) supported the view that leaders possess traits that are different from followers.

In summary, the trait approached is still being studied by scholars and practitioners today. The "great man" theories were the first theories to state that leaders were born with certain traits that determined who was destined for success in leadership.

Social leaders, political leaders and military leaders were the individuals who were

perceived to possess a certain set of traits; therefore they were often research subjects in

the field of leadership (Bulls, 2008). Some scholars and practitioners were not advocates

of the "great man" theories. Stogdill was a scholar and practitioner who argued that a

person's leadership role depends on the environment. Stogdill's research supported the

theoretical perspective that the leadership role changes with the environment. As of today

the trait theory approach has shifted back to the perspective that traits play a critical role

in regard to effective leadership practices.

Study of Major Leadership Traits

Ralph Stogdill conducted two extensive studies on leadership traits. Based on his

findings effective leadership depends not only on an individual's traits, but also the

situation. Stogdill's research on traits has been the foundation for many other trait

research studies. Between 1904 and 1948 Stogdill reviewed and analyzed over 124 traits

during his first study. He was able to identify a set of traits that he argued all leaders

possessed in order to be effective (see Table 1). His research found that traits, as well as

the relationship with team members, determined a leader's effectiveness (Stogdill, 1948).

Stogdill reviewed and analyzed 163 traits during his second survey from 1948 to 1970.

He expanded the set of traits however; insight, responsibility, initiative, persistence, self-

confidence and sociability were common to the first study. Achievement,

cooperativeness, tolerance, and influence were the traits that differentiated the second

from the first study. This study was noted as being more balanced with regard to

describing the traits and their relationship to leadership.

Table 1. Research Traits and Characteristics

Researcher(s)	Traits/Characteristics
Stogdill (1948)	intelligence, alertness, insight, responsibility initiative, persistence, self-confidence, sociability
Mann (1959)	intelligence, masculinity, adjustment, dominance, extroversion, conservatism
Stogdill (1974)	achievement, persistence, insight, initiative, self-confidence, responsibility, cooperativeness, tolerance, influence, sociability
Lord et al. (1986)	intelligence, masculinity, dominance, cognitive ability, task knowledge
Kirkpatrick and Locke (1991)	drive, motivation, integrity

The synopsis of Stogdill's two extensive studies on traits is as follows (Stogdill, 1974):

The leader is characterized by a strong drive for responsibility and task

completion, vigor and persistence in pursuit of goals, venture-someness and

originality in problem solving, drive to exercise initiative in social situations, self-

confidence and sense of personal identity, willingness to accept consequences of

decision and action, readiness to absorb interpersonal stress, willingness to

tolerate frustration and delay, ability to influence other people's behavior, and

capacity to structure social interaction systems to the purpose at hand. (p. 175)

The trait studies conducted by Stogdill inspired other scholars and practitioners to

look at the leadership process from perspectives other than the "great man" theory. Mann

(1959) reviewed and analyzed over 1,400 personality traits as he focused on the

difference between those of leaders and those of non-leaders (see Table 1). Lord et al.

(1986) were advocates of Mann's research and conducted a meta-analysis on the over

1,400 traits (see Table 1). Lord and Mann argued that traits could be used to discriminate

between leaders and non-leaders (Bulls, 2008).

Kirkpatrick and Locke (1991) stated in their research that "it is unequivocally

clear that leaders are not like other people" (p. 59). Drive, motivation, integrity, cognitive

ability and task knowledge were the set of traits that they found were possessed by

leaders only (see Table 1). They did not argue that only leaders were born with these

traits; their perspective was that leadership traits could be innate, could be learned, or

both (Northouse, 2007). Bass (1990) stated, "There is no overall comprehensive theory of

the personality of leaders. Nonetheless, evidence abounds about particular patterns of

traits that are of consequence to leadership, such as determination, persistence, self-

confidence, and ego strength" (p. 87). Scholars of trait theories argued that leaders

portrayed certain personality traits that were linked to the overall leadership process

(Bulls, 2008).

The research on leadership traits does not list a common set of traits for all

situations. However it does provide a guide to the type of traits that most leaders in

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western societies possess. Intelligence, self-confidence, determination, integrity and sociability are the common set of traits that were identified throughout these studies (Bulls, 2008).

The intelligence trait is the ability of the leader to comprehend information. Zaccaro, Kemp, and Bader (2004) found that leaders tend to have higher intelligence than non-leaders. The self confidence trait includes both the self-esteem and self assurance principles of the leader. The determination trait is the desire to get a task done. The integrity trait is defined as the act of carrying out the task in an ethical manner. The trait of sociability describes the ability of the leader to be courteous, friendly, tactful, and diplomatic. More recent studies based upon the trait approach tend to be quantitative, rather than qualitative, in approach (Bulls, 2008)

One of the biggest problems in past research relating personality to leadership is the lack of a structure for describing personality, leading to a wide range of traits being investigated under different labels. In recent years Judge, Bono, Ilies, and Gerhardt (2002) conducted research on the taxonomic structure for classifying and organizing traits. This taxonomic structure was called the five-factor model. The five-factor model of personality, often termed the Big Five, can be used to describe the most salient aspects of personality (Hurtz & Donovn, 2000). Proponents argue that the Big Five are heritable and stable over time. The dimensions comprising the five-factor model include Neuroticism, Extraversion, Openness to Experience, Agreeableness, and Conscientiousness (Judge & Bono, 2004).

Neuroticism represents the tendency to exhibit poor emotional adjustment and experience negative affects such as anxiety, insecurity, and hostility (Judge et al., 2002). Individuals high in neuroticism tend to view the world through negative lens, score high in neuroticism, and tend to experience emotional distress, whereas those who score low on the trait are calm, even tempered, and relaxed (Judge & Bono, 2004). Recent work by Judge, Erez, Bono, and Thoresen (2002) revealed a strong association between neuroticism and low self-esteem and low general self-efficacy. It is unlikely individuals high in neuroticism will exhibit transformational leadership behaviors, such as idealized influence, inspirational motivation, or intellectual stimulation (Judge & Bono, 2004).

Extraversion represents the tendency to be sociable, assertive, active, and to experience positive affects such as energy and zeal. Positive emotionality is at the core of extraversion (Judge et al., 2002). Extraverts tend to exhibit inspirational leadership (e.g., have an optimistic view of the future). They are capable of generating confidence and enthusiasm among followers because of their positive ambitious and influential character. Extraverts also may score high on intellectual stimulation, as they tend to seek out and enjoy change (Judge & Bono, 2004).

Openness to Experience is the disposition to be imaginative, nonconforming, unconventional, and autonomous (Judge et al., 2002). Individuals high in this trait are emotionally responsive and intellectually curious. They tend to have flexible attitudes and engage in divergent thinking. Openness to Experience is associated with transformational leadership because individuals with this trait are creative and are likely to score high in intellectual stimulation. Also, individuals high in openness to experience may exhibit

inspirational leadership behaviors because they are imaginative and insightful. They are likely to be able to see a vision for an organization's future (Judge & Bono, 2004).

Agreeableness is the tendency to be trusting, compliant, caring, and gentle (Judge et al., 2002). Individuals high in agreeableness value affiliation and avoid conflict. They are modest, altruistic, and tend to be both trusting and trustworthy. There are several leadership behaviors that may be exhibited by individuals high in agreeableness. They are likely to be concerned with individuals' growth and development needs and are likely to be sure that individuals are rewarded appropriately and praised for work well done. They may score high in idealized influence and be seen as role models because of their trustworthiness and consideration for others. Finally, agreeable leaders are likely to be available when needed, leading to low scores on passive leadership (Judge & Bono, 2004).

Conscientiousness is comprised of two related facets: achievement and dependability (Judge et al., 2002). Conscientiousness has been one of the most commonly studied traits in the work of psychology. Conscientious individuals tend to have a strong sense of direction and work hard to achieve goals. They are also cautious, deliberate, self-disciplined, and tend to be neat and well organized, which suggests a link between conscientiousness and contingent reward. They may be more likely to engage in management by exception-active, which involves both setting and monitoring goals. Also, because they are dependable and unlikely to neglect their work responsibilities, conscientious individuals are unlikely to exhibit passive leadership behaviors, which

involve lack of self discipline and the default of leadership responsibilities (Judge & Bono, 2004).

The Big Five traits have been found to be relevant to many aspects of life, such as subjective well-being and even longevity. One of the most popular applications of the five-factor model has been to the area of job performance, in which eight meta-analyses have been conducted. The meta-analysis conducted by the authors of *Personality and Leadership: A Qualitative and Quantitative Review* concluded that the five-factor model has a multiple correlation of .48 with leadership, indicating strong support for the leader trait perspective when traits are organized according to the five-factor model (Judge et al., 2002).

Six Sigma Overview

Some scholars and practitioners have attempted to describe Six Sigma in one or two definitions (Breyfogle, Cupello, & Meadows, 2001; Dambolena & Rao, 1994). However, many have concluded that there are at least three definitions (Adams, Gupta, & Wilson, 2003; Brue, 2002; Eckes, 2001; Pande & Holpp, 2002). Six Sigma can be viewed as a metric, a mindset, and a methodology. The first logical and commonly heard definition for Six Sigma is that it is a statistical expression—a metric (Breyfogle et al., 2001; Brue, 2002; Dambolena & Rao, 1994; Harry, 1998; Pande & Holpp, 2002). The lowercase Greek symbol (sigma) is the metric or fundamental statistical concept that denotes a population's standard deviation and is a measure of variation or dispersion about a mathematical mean. Harry (1998) and Breyfogle et al. (2001), among others,

explained how Six Sigma can be defined as a term for process performance that produces a mere 3.4 defects per million opportunities (DPMO). In layperson terms, Six Sigma is a metric representing a process that is performing virtually free of all defects.

As a second definition, Six Sigma is considered an organizational mindset that emphasizes customer focus and creative process improvement (Brue, 2002; Dambolena & Rao, 1994; Harry, 1998; Pande & Holpp, 2002). As Harry (1998) aptly stated, "The philosophy of Six Sigma recognizes there is a direct correlation between the number of product defects, wasted operating costs, and the level of customer satisfaction" (p. 60). With this mindset, individuals are prepared to work in teams in order to achieve Six Sigma and its ultimate goal of reducing process variation to no more than 3.4 defects per million opportunities. Adams, Gupta, and Wilson (2003) maintained that "Five sigma will not meet customer requirements, and seven will not add significant value." Six Sigma's 3.4 parts per million is close to perfection, and that makes it more attainable. Interestingly, the vast majority of processes found in U. S. companies are said to linger near four sigma or less (Breyfogle et al., 2001; Harry, 1998).

As a third definition, Six Sigma is viewed as a strategic improvement methodology termed DMAIC (Breyfogle et al., 2001; Brue, 2002; Eckes, 2001; Harry, 1998; Pande & Holpp, 2002; Pande, Neuman, & Cavanagh, 2002). DMAIC is an abbreviation of the five systematic steps in the Six Sigma methodology. The steps used for breakthrough thinking and improvement are: define, measure, analyze, improve, and control (Hoerl et al., 2004). This methodology is used to carry out the structured philosophy of Six Sigma in places that include but are not limited to manufacturing,

design, engineering, human resources, purchasing, and customer service (Benedetto, 2003; Zu, Fredendall, & Douglas, 2008).

The implementation of Six Sigma strategies has resulted in some significant savings for various organizations (Hahn et al., 1999). The CEO of Motorola stated that Six Sigma has saved his company more than $16 billion to date. General Electric's CEO, Jack Welch, wrote in the company's annual report that from 1996 to 1998, Six Sigma had saved his company more than $2 billion. Tyco Electronics' CEO, Tom Lynch, wrote in his annual report that from 2003 to 2008 his company saved more than $700 million. The Vice President of American Express stated that Six Sigma programs have delivered approximately one billion dollars in benefits annually since its launch in 1999.

Effective leadership is the key to successfully implementing Six Sigma methodologies. Champions, master black belts, black belts, green belts, and team members make up the core of Six Sigma (ReVelle, 2004). Champions and master black belts work behind the scenes to support people working on projects and the overall initiative (Eckes, 2001). Black belt and green belt candidates are described as disciplined problem solvers who possess a significant amount of technical ability, are comfortable with basic statistics, and are not afraid to question conventional wisdom (Hoerl, 2001; Adams et al., 2003). A black belt and green belt have also been described as open-minded change agents and project managers able to communicate effectively at all levels (Brue, 2002). Many experts have insisted that black belts and green belts use a broad set of soft skills such as meeting management and presentation methods (Brekyfogle et al., 2001:

Eckes, 2001; Hoerl, 2001; Pyzdek, 2000). As a chosen leader, the black belt or green belt will guide a team through the DMAIC process.

Black belts and green belts are "future business leaders" (Eckes, 2001) and "the backbone of Six Sigma culture" (Brue, 2002). Adams et al. (2003) insisted that black and green belts should be selected based on management potential. They make up on average roughly 2% of an organization's workforce. Without a strong and tireless black belt or green belt Six Sigma teams are usually not effective. The black belt and green belt must possess many skills, including strong problem solving, the ability to collect and analyze data, organizational savvy, leadership and coaching experience, and good administrative sense (Kumar et al., 2008). Moreover s/he must be adept at project management, and the art and science of getting things done on time through the effort of others (Goffnett, 2004).

Brief History of Six Sigma

Six Sigma was first conceived by experts at Motorola in the early 1980's. Bob Galvin, who was chairperson of Motorola at the time, presented an incredibly demanding quality goal to his employees in 1981, which may have been the stimulus for Six Sigma. Around 1985 engineer Bill Smith's research regarding process capability and defect reduction became the basis for Six Sigma innovation. Leadership at Motorola later asked Mikel J. Harry, then part of Motorola's technical staff, to pioneer the strategic methodology that would soon become Six Sigma. Harry and his colleagues refined the Six Sigma strategy by decade's end (Goffnett, 2004).

Six Sigma activities and achievements, seen mainly in large manufacturing operations, are also becoming more prevalent in small businesses, transactional business processes (e.g., human resources and purchasing), and in the service sector (Gnibus & Krull, 2003; Goh, 2002; Hammer & Goding, 2001; Harry, 1998; Smith, 2003). Smaller companies have had similar financial success compared to larger companies but on a smaller scale (Brue, 2002; Gnibus & Krull, 2003; Harry, 1998). From a financial perspective, Six Sigma has had a considerable impact on numerous organizations across a variety of industries.

Several comparable systems preceded Six Sigma, such as Statistical Process Control (SPC); and Lean, Kaizen, and Total Quality Management (TQM), which are utilized in industry and taught in academia. Statistical Process Control has been in use for decades, is an essential device integrated into Six Sigma (Goh, 2002), and can function independently of the aforementioned systems. Six Sigma, however, functions using many aspects of lean and quality control (Burton, n. d.; Drickhamer, 2002; Pyzdek, 2000), which indicates its ability to complement, or run parallel to, other initiatives and create cohesion between business processes (Bisgaard, Hoerl, & Snee, 2002).

The primary differences between Six Sigma and the aforementioned quality systems are as follows (Antony, 2004):

1. Six Sigma strategy places a clear focus on achieving measurable and quantifiable financial returns to the bottom line of an organization. No Six Sigma project is approved unless the bottom line impact has been clearly identified and defined.

2. Six Sigma places an unprecedented importance on strong and passionate leadership and the support required for its successful deployment.

3. The Six Sigma methodology of problem solving integrates the human elements (culture change, customer focus, belt system infrastructure, etc.) and process elements (process management, statistical analysis of process data, measurement system analysis, etc.) of improvement.

4. Six Sigma methodology utilizes the tools and techniques for fixing problems in business processes in a sequential and disciplined fashion.

5. Six Sigma creates an infrastructure of champions, master black belts, black belts, and green belts that lead, deploy, and implement the approach.

6. Six Sigma emphasizes the importance of data and decision-making based on facts and data rather than assumptions and hunches.

7. Six Sigma utilizes the concept of statistical thinking and encourages the application of well-proven statistical tools and techniques for defect reduction through process variability reduction methods (e.g. statistical process control and design of experiments).

Six Sigma's DMAIC Methodology

DMAIC methodology is the systematic approach to implementing Six Sigma (Goffnett, 2004). Define (D) is the first step of the Six Sigma methodology in which leaders are expected to select projects, set initial goals or targets, and develop a project charter or statement of work (SOW). Costs of poor quality associated with the new or

existing process being analyzed, are estimated. Improvement targets are set, often in terms of sigma and cost (Pande et al., 2002). Leadership selects the appropriate team members. The team then determines more precisely the criteria that are critical to the customer. Run chats, interviews or surveys, for example, are utilized to obtain leads and useable figures (Eckes, 2001). A high level process map of the existing process is to be developed with start and end points clearly illustrated. Strategic deliverables include a process map, a working project charter, a team roster, and the costs of poor quality. A progress report to leadership normally concludes each step (Eckes, 2001; Pande et al., 2002).

Measure is the second step of the Six Sigma methodology denoted by the capital letter M. In this step a baseline measure is taken using actual data (Eckes, 2001; Pande et al., 2002; Snee, 2003). The measure then becomes the origin from which the team can gauge improvement. The team develops measures or utilizes existing ones, such as Statistical Process Control data or database information, and pairs them according to critical customer criteria. Pareto diagrams and control charts, as well as methods mentioned above in the "define" step, are possible data sources for baseline measures. Testing repeatability and reproducibility (R&R) of a measurement system is recommended throughout a Six Sigma project wherever critical measures are taken. A data gathering plan or sampling plan can be followed for greater accuracy (Eckes, 2001; Pande et al., 2002). The project charter should be refined based on the data gathered in the measure step. The process map can be revised based on new discoveries of value added or non-value added steps in the existing process. Strategic deliverables for the

measure step are baseline figures, R&R results, process capability, an improvement goal, a refined process map, and a refined project charter (Eckes, 2001; Pande et al., 2002).

The third step, A, is analyze. Here, teams identify several possible causes (X's) of variation or defects that are affecting the outputs (Y's) of the process. One of the most frequently used tools in the analyze step is the cause and effect diagram (Eckes, 2001; Snee, 2003). A Six Sigma team explores possible causes that might originate from sources such as people, machinery, equipment, environment, materials, and methods. Another highly effective technique to explore root cause is asking "why" to a possible cause at least five times (Eckes, 2001). Team member suggestions may need to be clarified before proceeding further, so each and every team member has a clear understanding of the cause being presented. The resulting list should be reduced to the most probable root causes. Causes can be validated using new or existing data and applicable statistical tools, such as scatter plots, hypothesis testing, ANOVA, regression, or design of experiments (DOE). Experts warn not to assume causation or causal relationships unless there is clear evidence. Furthermore, validating root causes can help teams avoid implementing ineffective "improvements" and wasting valuable resources (Eckes, 2001). Root cause is the number one team deliverable coming out of the analyze step (Eckes, 2001; Pande et al., 2002).

The team then enters the improve (I) stage. Here a team would brainstorm to come up with corrective actions that address validated root causes. The tool most preferred for this process is the affinity diagram, which is a brainstorming technique in which a topic or issue is presented to a small team who then quickly list ideas or solutions

(Eckes, 2001). The team should narrow the list to one or two potential improvements that are step deliverables for small scale implementation. Improvements should be selected based on probability of success, time to execute, impact on resources, and cost (Eckes, 2001; Pande et al., 2002). If newly-gathered data indicate the small-scale implementation is a legitimate success, teams should proceed to full-scale implementation (Pande et al., 2002).

The final component for the Six Sigma leader is control, signified by the capital letter C. At this point devices should be put in place to give early signals as to when a process is heading out of control. Teams may develop poke-yokes or mistake-proof devices that utilize light sound, logic programming, or no-go design to help control a process (Breyfogle et al., 2001). The ultimate goal for this step is to reduce variation by controlling X's and monitoring Y's (Pande et al., 2002).

In approximately three to six months, the sigma levels or process capability figures that should be routinely measured and documented by workers are then checked by the process owner to make certain that the installed improvements are lasting. All documentation and project reports should be finalized. With a control plan in place, the project is delivered to the rightful owner who is usually the project champion or a sponsor from leadership. It is the owner's duty to then manage the new improved process (Eckes, 2001; Pande et al., 2002). If Six Sigma was not achieved, a separate project can be kicked off in the future to address any residual root cause.

Six Sigma Leadership Roles

Effective leadership is the key to successfully implementing Six Sigma methodologies. Champions, master black belts, black belts, green belts, and team members make up the core of Six Sigma (ReVelle, 2004). Champions and master black belts work behind the scenes to support people working on projects and the overall initiative (Eckes, 2001).

The black belt is the fulltime person dedicated to handling critical change opportunities and driving them to achieve bottom line cost savings. The black belt leads, inspires, delegates, and manages the team to improve processes. The primary responsibility of the black belt is to keep the project moving to completion (Pande & Holpp, 2002). Black belts are typically chosen from the middle management ranking. They are removed from their full time position for 18 months to two years to work on a black belt Six Sigma project. They typically complete four to six projects during this time frame. Once their duration terminates they have an option to go back to their original position or take a position doing Six Sigma activities fulltime (Pande & Holpp, 2002). Master black belts (MBB) serve as coaches or mentors to black belts who work on a variety of projects. In most cases, MBBs are the experts in applying the Six Sigma tools. They often provide training to the other Six Sigma leaders (Pande & Holpp, 2002).

A green belt is a leader trained in Six Sigma skills, often to the same level as a black belt leader. However, the green belt works on her/his project part-time versus fulltime, and remains responsible for the activities of the permanent position as well. Green belt projects are typically less complex than black belts' because of the amount of

time allotted to work on them. The role of the green belt is to bring the new concepts and tools of Six Sigma to the day-to-day activities of the business (Pande & Holpp, 2002).

A champion is an executive or key manager who initiates and supports the Six Sigma project. S/he is key because this person typically belongs to senior management. The champion is responsible for making sure the project stays aligned with the overall business objectives, and providing direction when it doesn't. The champion also ensures that the project team has all the necessary resources such as money, time, people, etc. to complete the project (Pande & Holpp, 2002).

Summary

Trait research has come full circle because there is a renewed interest in focusing directly on the critical traits of leaders. There are several advantages to viewing Six Sigma leadership from the trait approach. First, it is intuitively appealing because it fits clearly into the popular idea that leaders are special people who are out front, leading the way. Second, there is a century's worth of research that validates the basis of this perspective. Third, by focusing exclusively on the leader, the trait approach provides an in-depth understanding of the leader component in the leadership process. Last, the trait approach has provided some benchmarks against which individuals can evaluate their own personal leadership attributes (Northouse, 2004).

Chapter 2 has reviewed the literature that provides grounding for this study. Chapter 3 sets out the research methods used.

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CHAPTER 3

Methodology

Chapter 1 introduced the research focus, and Chapter 2 provided a comprehensive review of the literature on both trait theory and Six Sigma. This chapter sets out the strategies that will be used to study possible relationships between trait theory and Six Sigma leaders at the black and green belt levels.

Purpose

There were primarily two purposes of this study. First, this study identified specific leadership traits for green and black belt Six Sigma leaders that have a statistical relationship with the success of Six Sigma projects. Second, the purpose was to test the reliability of a scale created from the Leadership Trait Questionnaire items. The reliability of the LTQ scale had never been tested until this study. It was hypothesized that within the sample population there would be a statistical relationship between the traits of green and black belt Six Sigma leaders, and the success of Six Sigma projects. The following hypotheses ground data analysis for this study. They were framed in terms of traditionally accepted null and alternative hypotheses:

1. Null Hypothesis: There is no statistical relationship between the traits of green belt leaders and the success of Six Sigma projects.

2. Alternative Hypothesis: There is a statistical relationship between the traits of green belt leaders and the success of Six Sigma projects.

3. Null Hypothesis: There is no statistical relationship between the traits of black belt leaders and the success of Six Sigma projects.

4. Alternative Hypothesis: There is a statistical relationship between the traits of black belt leaders and the success of Six Sigma projects.

5. Null Hypothesis: A scale created from the Leadership Trait Questionnaire items is not reliable.

6. Alternative Hypothesis: A scale created from the Leadership Trait Questionnaire items is reliable.

Procedure

A sample population of Tyco Electronics Six Sigma leaders involved with completing green and black belt Six Sigma projects was asked to rate ten traits for their individual positions of leadership using the Leadership Trait Questionnaire (LTQ) instrument. The researcher did not ask team members to evaluate the Six Sigma leaders. Only the ratings from the Six Sigma leaders were utilized in this study. These ratings were used to examine whether the successful implementation of Six Sigma projects is affected by the Six Sigma leader's traits or characteristics.

Sample Description

Approximately 500 potential participants of Six Sigma leaders were selected from a Tyco Electronics database called Tyco Electronics Business Improvement Tracking (TBIT). The criteria for selecting the potential participants were as follows:

1. They were master black belts, black belts, green belts or lean practitioners;

2. Their projects were related to Six Sigma;

3. Their projects had a hard cost savings; and

4. They worked in North America, Asia or Europe, Middle East and Africa.

The researcher utilized Tyco Electronics' TBIT system to retrieve the potential participants' email addresses. Tyco Electronics' email system was used to invite each to participate in a study on leadership. The email included a cover letter and a Weblink to the survey which was hosted by SurveyMonkey.com (2008). The cover letter and the Web-based survey, version 1.5 hosted by SurveyMonkey.com, was approved by the Institutional Review Board (IRB) at North Carolina Agricultural and Technical State University. The cover letter included an explanation of the study and the importance of the participants' contribution to leadership research (see Appendix A).

Ethical Considerations

The researcher was granted access to the Tyco Electronics Business Improvement Tracking database and permission to send emails to Six Sigma leaders globally by Tom England, Global Director of Six Sigma Operations (see Appendix B). The researcher provided a participant letter within each email. The participant letter was approved by the

Institutional Review Board (IRB) at North Carolina Agricultural and Technical State University (see Appendix C). It was communicated to all participants the purpose of the survey, the approximate time it would take to complete, their rights as participants, and with whom the data would be shared.

Instrumentation

This study used the Leadership Trait Questionnaire (LTQ) (see Appendix D). The instrument's design reflects the nature and demands of leadership, and measures related to personal characteristics or traits. The LTQ defines leadership as actions which focus resources to create desirable opportunities (Northouse, 2007). The researcher requested permission from Peter Northouse via email to use the LTQ instrument (see Appendix E).

Northouse (2004) developed a quantitative survey using ten traits he found to be common to all leaders in any situation. The primary purpose of the LTQ survey was to allow the leaders to do a self assessment and to allow the followers to do an assessment of their leader from a leadership process perspective (Northouse, 2004). Only the leaders in this study rated themselves on the ten traits on a five-point scale ranging from *Strongly Agree* to *Strongly Disagree* (Northouse, 2001). The instrument allows leaders to assess their strengths and weaknesses. According to Northouse (2007), the following are the ten traits that all effective leaders possessed in any situation:

- Articulate—communicates effectively with others
- Perceptive—discerning and insightful
- Self-confident—believes in oneself and one's ability

- Outgoing—talks freely, gets along with others

- Self-assured—secure with self, free of doubts

- Persistent—stays fixed on the goals despite interference

- Determined—takes a firm stand, act with certainty

- Trustworthy—takes believably, inspires confidence

- Dependable—is consistent and reliable

- Friendly—shows kindness and warmth. (p. 33)

The researcher, who is a Six Sigma practitioner, saw the comprehensive ten traits of the LTQ as most applicable in the Six Sigma field. The researcher used the LTQ for participants to conduct a self assessment of the traits for black belt and green belt leaders only. The team members did not assess the black belt and green belt leaders of their teams. The application of the LTQ in this manner allowed the researcher to establish the reliability of the LTQ scale as a measure of leadership traits for future research. It also allowed the researcher to examine the traits of the LTQ as predictive measures of actual cost savings in Six Sigma projects.

Summary of Variables

A summary of variables is presented in Table 2. The first group of variables, independent variables I, are the ten leadership traits that are measured using the LTQ instrument. The LTQ instrument allows leaders to assess their strengths and weaknesses. The leaders rate the ten leadership traits on a five-point Likert scale ranging from

Strongly Agree to *Strongly Disagree*. The ten traits are articulate, perceptive, self-confident, outgoing, self-assured, persistent, determined, trustworthy, dependable, and friendly.

Table 2. Summary of Variables

Variable	Traits/Characteristics
Independent Variables I	articulate, perceptive, self-confident, self-assured, persistent, determined, trustworthy, dependable, friendly, outgoing
Independent Variables II	project experience, upper management support, skill set
Dependent Variable	hard cost savings

The second group of variables, independent variables II, include project experience, upper management support, and technical skill set. Project experience is measured based on the number of projects completed. Upper management support is measured using a three-point Likert scale ranging from *Strong Support* to *Weak Support*. Technical skill set is measured on a three-point Likert scale ranging from *Strong Technical Skill Set* to *Weak Technical Skill Set*. Six Sigma practitioners argue that the most successful projects will be impacted by these variables.

The third group of variables included only one, which is the dependent variable. The dependent variable is the actual cost savings self reported by the Six Sigma leaders.

Green belt projects equal to or greater than $50,000 are considered successful. Black belt projects equal to or greater than $250,000 are considered successful.

Validity and Reliability

Peter Northouse developed the Leadership Trait Questionnaire instrument to be used as a self assessment tool. Northouse is the author of several books and many publications in professional journals. Some of the most recent books include: (a) *Introduction to Leadership Concepts and Practice*; (b) *Leadership, Fifth Edition: Theory and Practice*; (c) *Meeting the Ethical Challenges of Leadership, Third Edition*; and (d) *Cases in Leadership, Second Edition*. Respected as a scholar and practitioner of leadership, Northouse has taught and provided consultant services for more than 20 years in the areas of leadership development, leadership education, conflict management, and health communication.

The LTQ instrument developed by Northouse has been used by many, even though it has not been tested for reliability and validity. Northouse argues that the LTQ is a quality instrument for the self assessment of leadership traits. This current research project evaluates the LTQ instrument using Cronbach's alpha analysis to determine whether a scale created from the LTQ items is reliable.

Data Analysis

The Web-based version of the LTQ instrument was downloaded anonymously to the researcher from SurveyMonkey.com. The researcher obtained actual responses, without knowing the identity of the participants, and was in no way able to identify who responded and who did not. The responses to the questionnaire were analyzed using Minitab software version 15.0. The statistical analysis included Cronbach's reliability of measures, descriptive statistics, One-Way ANOVA, and Main Effects Plot analysis.

First, the study determined whether a statistical relationship exists between the independent variables (see Figure 1) and the success of Six Sigma projects, which is measured by the dependent variable hard cost savings (see Figure 2). Second, the study determined whether a scale created from LTQ items was reliable.

Strengths and Limitations of the Design

The strengths of the current study include hard data to measure project success; the positive relationship the researcher has with participants, and the participants' extreme interest in the research findings. Most of the participants are in positions to hire green and black belt leaders. The major limitation of this design is the self ratings of leadership traits. Chapter 3 has set out the research methodology. Chapter 4 provides findings, and Chapter 5, discussion and implications of these for practice and further research.

Figure 1. Independent Variables

**Hard Cost
Savings**

**Project
Success**

Green Belt

= or > 50K

Successful

Black Belt

= or > 250K

Successful

Figure 2. Dependent Variable

CHAPTER 4

Results

There were five hypotheses employed to determine the reliability of measures and examine specific leadership traits that have a statistical relationship with the success of Six Sigma projects. Data were analyzed using descriptive statistics, Cronbach's reliability of measures, one way ANOVA, and Main Effects Plot analysis. Analyses of findings for each hypothesis are presented in this chapter.

Alpha Reliability Scores

While the Leadership Trait Questionnaire (LTQ) instrument was noted as being a quality instrument by its developer, Peter Northouse, it had not been tested for reliability until this study. The researcher used Cronbach Reliability to determine the reliability of a scale created from the LTQ items. Based on Cronbach an instrument's scale is reliable if the alpha is .70 or higher. The researcher conducted the reliability test separately for green and black belt leaders. For green belt leaders Cronbach's Alpha was .825. For black belt leaders Cronbach's Alpha was .766. Therefore, the researcher rejected the null hypothesis that a scale created from the Leadership Trait Questionnaire items is not reliable. The alternative hypothesis was accepted which states that a scale created from the Leadership Trait Questionnaire items is reliable. These findings allow scholars or/and practitioners to be confident in using this LTQ scale in assessing leadership traits for

future research. The primary purpose of this study was to determine whether there are specific leadership traits for green and black leaders, therefore the analysis was conducted using individual LTQ items rather than the LTQ scale.

Descriptive Statistics of Sample

The Leadership Trait Questionnaire was sent to 500 hundred Six Sigma leaders globally within Tyco Electronics. A total of 165 participants responded for an overall response rate of 33%. There were 82 green belts (49.7% of the sample) and 83 black belts (50.3% of the sample) who completed the survey.

In terms of the racial make-up of the sample, 121 were White (73.8%), 23 were African Americans (14%), 8 were Hispanic (4.9%), 6 were Asian (3.7%), 1 was Native American (0.6%), and 5 were other (3.0%). Males accounted for 89% (n=146) of the sample, with females representing 11% (n=18).

The majority 77.2% (n=129) of the respondents were located in the Americas, 20.4% (n=34) were from Europe, Middle East, and Africa (EMEA), and 2.4% (n=4) were from Asia. Thirty-eight percent 38.2% (n=63) of the Six Sigma leaders completing projects were between the ages of 40-49, with 37% (n=61) between the ages of 30-39. Black belts and green belts were equally represented in the sample, with black belts accounting for 49.7% (n=82), and green belts 50.3% (n=83). Appendix G gives a detailed descriptive breakdown of the sample.

Analysis of Leadership Traits and Six Sigma Leaders

  Green belt leaders. Descriptive statistics, One-Way ANOVA, and Main Effects Plot were conducted on the data to investigate the following hypotheses for green belt leaders:

1. Null Hypothesis: There is no statistical relationship between the traits of green belt leaders and the success of Six Sigma projects.

2. Alternative Hypothesis: There is a statistical relationship between the traits of green belt leaders and the success of Six Sigma projects.

  Descriptive statistics for green belt. The survey was sent to 300 green belt leaders, of which 83 responded yielding a 28% response rate. LTQ item means and standard deviations for this sample are shown in Table 3. The mean of the actual cost savings was 97,641. The standard deviation was 127,572. These data are reflected in Figure 3.

  Analysis of green belt leadership traits. The researcher analyzed each independent variable to determine if it had a statistical relationship with the dependent variable. The independent variables (I) were articulate, perceptive, self-confident, self-assured, persistent, determined, trustworthy, dependable, friendly and outgoing. The independent variables (II) were project experience, upper management support and technical skill set. Green belt projects equal to or greater than $50,000 is considered successfully. Black belt projects equal to or greater than $250,000 is considered successfully.

Table 3. LTQ Item Means and Standard Deviations for Green Belts

Traits	Mean	Standard Deviation
Articulate	4.39	.583
Perceptive	4.13	.665
Self-confident	4.29	.687
Self-assured	4.13	.640
Persistent	4.27	.682
Determined	4.19	.721
Trustworthy	4.48	.593
Dependable	4.42	.615
Friendly	4.26	.676
Outgoing	4.32	.647

A One-Way Analysis of Variance was used to evaluate the relationship between the independent variables and hard cost savings for green belt leaders. The independent variables: articulate, perceptive, self-confident, self-assured, determined, and upper management support were significantly related to hard cost saving ($p < .05$). Therefore the researcher rejected the null hypothesis, and accepted the alternative hypothesis that these independent variables have a statistical relationship with the traits of green belt leaders and the success of Six Sigma projects.
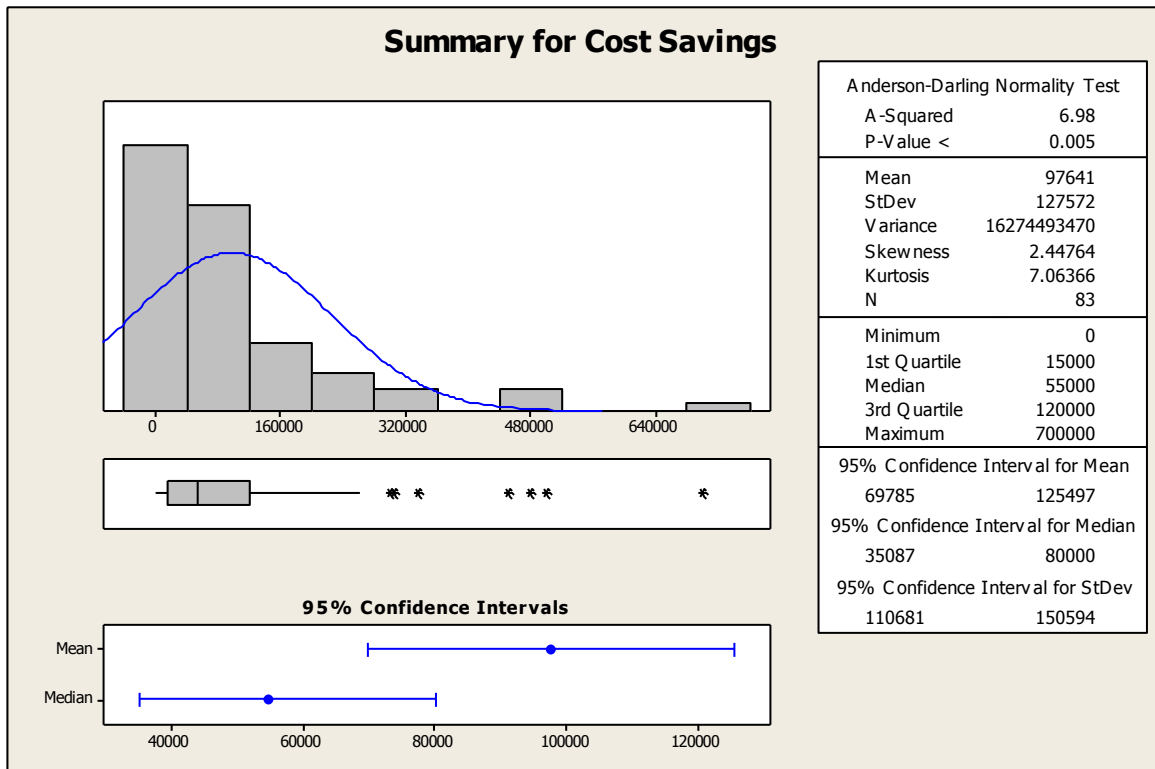
Figure 3. Green Belt Descriptive Data

There were no significant statistical findings for the following independent variables: persistent, trustworthy, dependable, friendly, outgoing, technical skill set, and project experience. For these variables the researcher accepted the null hypothesis. These independent variables had no statistical relationship with the success of Six Sigma projects. Table 4 summarizes these findings.

The researcher conducted further analysis on the independent variables that were significantly related to hard cost savings. The researcher used the Main Effects Plot to compare the actual cost savings mean of the various groups of these independent variables. Based on the findings from the Main Effects Plot analysis, green belt leaders

Table 4. One-Way ANOVA Summary

Source	df	ss	ms	F	R^2	p
Articulate	2	1.10990E+11	55495012699	3.39	7.80%	.04*
Perceptive	2	2.29482E+11	1.14741E+11	7.85	18.99%	<.01*
Self-confident	2	1.75865E+11	87932563494	5.70	14.55%	.01*
Self-assured	2	2.36587E+11	1.18294E+11	8.15	19.58%	<.01*
Determined	2	1.73919E+11	86959514259	4.87	13.22%	<.01*
Upper management support	2	2.62890E+11	1.31445E+11	9.47	21.54%	<.01*
Persistent	3	93613147548	31204382516	1.78	7.80%	.16
Trustworthy	2	73221803430	36610901715	1.81	5.59%	.17
Dependable	2	73952641042	36976320521	2.10	6.17%	.13
Friendly	2	1.15049E+11	57524295039	3.24	9.74%	.05
Outgoing	2	51813110471	25906555236	1.50	4.29%	.23
Technical skill set	2	45803919033	22901959517	1.35	3.75%	.27
Project Experience	7	1.05737E+11	15105267115	.086	8.68%	.55

Note: $p < .05$* is significant

who self reported the highest trait ratings also had the highest cost savings projects. The findings are summarized in Table 5 and Table 6.

These findings are significant because now managers know that articulate, perceptive, self-confident, self-assured, and determined, are the traits associated with a green belt leader's successful completion of projects. Further, the study found that

Table 5. Main Effects Plot Summary for Actual Cost Savings

Independent variables I	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
Articulate	149,305	77,752	21,797	-	-
Perceptive	184,302	72,633	28,348	-	-
Self-confident	161,550	73,239	24,006	-	-
Self-assured	183,418	70,329	28,509	-	-
Determined	167,323	74,360	32,226	-	-

Table 6. Main Effects Plot Summary for Actual Cost Savings

Independent variables II	Strong	Moderate	Weak
Upper Management Support	173,021	73,443	18,506

participants rated upper management support as critical to their successful project completion, as well.

Black belt leaders. Descriptive statistics, One-Way ANOVA, and Main Effects Plot were conducted on the data as the researcher investigated the following hypotheses for black belt leaders:

1. Null Hypothesis: There is no statistical relationship between the traits of black belt leaders and the success of Six Sigma projects.

2. Alternative Hypothesis: There is a statistical relationship between the traits of black belt leaders and the success of Six Sigma projects.

Descriptive statistics for black belt. The survey was sent to 200 black belt leaders, of which 81 responded, yielding a 41% response rate. LTQ item means and standard deviations for this sample are shown in Table 7. The mean of the actual cost savings was 1,493,198. The standard deviation was 4,905,343. These data are reflected in Figure 4.

Table 7. LTQ Item Means and Standard Deviations for Black Belts

Traits	Mean	Standard Deviation	
Articulate	4.47	.534	
Perceptive	4.28	.654	
Self-confident	4.17	.680	
Self-assured	4.11	.693	
Persistent	4.34	.695	
Determined	4.17	.680	
Trustworthy	4.44	.560	
Dependable	4.39	.657	
Friendly	4.09	.750	
Outgoing	4.23	.792	

Summary for Actual Cost Savings

Anderson-Darling Normality Test	
A-Squared	20.50
P-Value <	0.005
Mean	1493198
StDev	4905343
Variance	2.40624E+13
Skewness	5.5790
Kurtosis	33.4799
N	81
Minimum	0
1st Quartile	55000
Median	266000
3rd Quartile	740000
Maximum	35000000

95% Confidence Interval for Mean	
408537	2577858

95% Confidence Interval for Median	
150000	382033

95% Confidence Interval for StDev	
4248910	5803556

Histogram x-axis: 0, 8000000, 16000000, 24000000, 32000000

95% Confidence Intervals

Mean, Median — x-axis: 0, 500000, 1000000, 1500000, 2000000, 2500000

Figure 4. Black Belt Descriptive Data

Analysis of black belt leadership traits. The researcher analyzed each independent variable to determine if there was a statistical relationship with the dependent variable. The independent variables (I) include articulate, perceptive, self-confident, self-assured, persistent, determined, trustworthy, dependable, friendly and outgoing. The independent variables (II) were project experience, upper management support and technical skill set. Black belt projects equal to or greater than $250,000 are considered successfully.

A One-Way Analysis of Variance was used to evaluate the relationship between independent variables and hard cost savings for black belt leaders. The independent variables articulate, perceptive, self-confident, self-assured, determined, dependable, friendly, upper management support, and project experience were significantly related to hard cost savings ($p < .05$). Therefore the researcher rejected the null hypothesis and accepted the alternative hypothesis that these independent variables had an impact on black belt leaders' successfully completing their Six Sigma projects. There were no significant statistical findings for the following independent variables: persistent, trustworthy, outgoing, and technical skill set. Therefore the researcher accepted the null hypothesis: these independent variables had no impact on black belt leaders' completing their projects successfully. Table 8 summarizes these findings.

The researcher conducted further analysis on the independent variables that were significantly related to hard cost savings. The researcher used the Main Effects Plot to compare the actual cost savings mean of the various groups of these independent variables. Based on the findings from the Main Effects Plot analysis, black belt leaders who self reported the highest rating also had the highest cost savings projects. The findings are summarized in Table 9 and Table 10. Project experience was found to be statistically significant; however, the Main Effects Plot does not show a correlation in reference to the more projects a leader completed the higher the cost savings. Refer to Figure 5.

Table 8. One-Way ANOVA Summary

Source	df	ss	ms	F	R^2	p
Articulate	2	2.81671E+13	1.40836E+13	3.44	10.44%	.04*
Perceptive	3	3.77744E+13	1.25915E+13	3.15	14.01%	.03*
Self-confident	3	4.55090E+13	1.51697E+13	3.92	16.87%	.01*
Self-assured	2	4.34266E+13	2.17133E+13	5.66	16.10%	.01*
Determined	2	4.52519E+13	2.26259E+13	5.95	16.78%	<.01*
Dependable	2	2.83553E+13	1.41776E+13	3.47	10.51%	.04*
Friendly	2	3.31394E+13	1.65697E+13	4.13	12.29%	.02*
Upper Management Support	2	6.94751E+13	3.47376E+13	5.09	14.11%	.01*
Project Experience	17	2.17882E+14	1.28166E+13	2.19	44.25%	.02*
Persistent	2	1.05193E+13	5.25966E+12	1.20	3.90%	.31
Trustworthy	2	2.08441E+13	1.04220E+13	2.47	7.73%	.09
Outgoing	2	2.50504E+13	1.25252E+13	3.02	9.29%	.06
Technical Skill Set	2	1.46785E+13	7.33926E+12	0.95	2.98%	.39

Note: $p < .05*$ is significant

These findings are significant because now managers know that articulate, perceptive, self-confident, self-assured, determined, dependable and friendly are the traits associated with a black belt leader's successful completion of projects. Further, the study found upper management support and project experience to be critical in successfully completing Six Sigma projects, as well. Chapter 4 has provided the findings. Chapter 5 sets out discussion of these, along with implications for practice and future research.

Table 9. Main Effects Plot Summary for Actual Cost Savings

Independent variables I	Strongly agree	Agree	Neutral	Disagree	Strongly disagree
Articulate	1,660,554	239,814	170,000	-	-
Perceptive	1,908,510	375,367	156,667	214,000	-
Self-confident	2,007,554	299,529	285,000	150,000	-
Self-assured	2,041,157	390,630	162,000	-	-
Determined	2,031,032	348,821	106,667	-	-
Dependable	1,696,289	329686	100,000	-	-
Friendly	1,796,735	380,327	126,667	-	-

Table 10. Main Effects Plot Summary for Actual Cost Savings

Independent variables II	Strong	Moderate	Weak
Upper Management Support	2,428,646	341,743	65,000
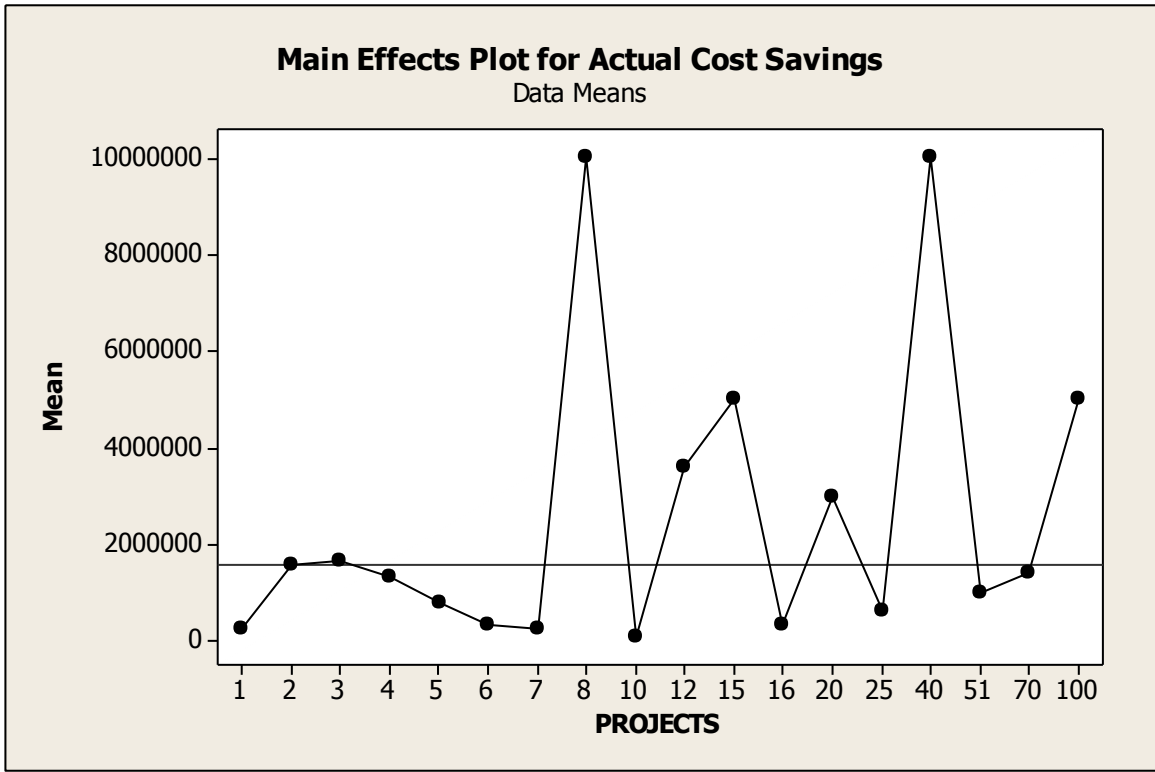
Figure 5. Mean Comparison of Completed Projects

CHAPTER 5

Discussion

This chapter compares the findings from Chapter 4 to the literature. Then, implications of the study, limitations of the study, and the directions for future research are discussed.

Interpretation of Findings

The findings from this study suggest that self-reported traits are associated with effective leadership for green and black belt Six Sigma leaders. Also, a scale created from the LTQ items was found to be reliable in this study. These findings support the most recent research on leadership traits. Trait theory is still considered to be a valid construct as we enter the twenty-first century, and several researchers have focused on restoring the theory. Bryman (1992) discovered during his research that traits definitely influence leadership. The findings of Kirkpatrick and Lock (1991) supported the notion that leaders possessed traits that were different from followers. Northouse (2004) argues that the ten comprehensive traits used in his Leadership Trait Questionnaire play a critical role in effective leadership. This study found that a subset of the LTQ self-rated traits are significantly related to self-reported cost savings. Green belt leaders who rated themselves high on "perceptive" had the highest cost savings mean of $184,302. Black belt leaders who rated themselves high on "self-assured" had the highest cost savings

mean of $2,041,157. These actual cost savings are significant as well as the examples

cited in the research. Tyco Electronics' CEO, Tom Lynch, wrote in the annual report that

from 2003 to 2008, his company saved more than $700 million. Edward J. Zander,

Motorola CEO, stated that Six Sigma has saved his company more than $16 billion to

date. General Electric's CEO, Jack Welch, wrote in the annual report that from 1996 to

1998 Six Sigma tactics had saved his company more than $2 billion.

This study also suggests from a practical perspective that a green and black belt

technical skill set may affect the actual cost savings of Six Sigma projects. Green belt

leaders in this study who self-reported as having a moderate to strong technical skill set

had a total mean of $343,433 in actual cost savings. Black belt leaders in this study who

self-reported as having a moderate to strong technical skill set had a total mean of

$3,255,151 in actual cost savings. Six Sigma research agrees that having a significant

amount of technical ability is important. The black belt and green belt must possess many

skills including strong problem solving, the ability to collect and analyze data,

organizational savvy, leadership and coaching experience, and good administrative sense

(Kumar et al., 2008). Moreover, s/he must be adept at project management, the art and

science of getting things done on time through the effort of others (Goffnett, 2004). Black

belt and green belt candidates are described as disciplined problem solvers who possess a

significant amount of technical ability, are comfortable with basic statistics, and are not

afraid to question conventional wisdom (Hoerl, 2001; Adams, Gupta, & Wilson, 2003).

Black belts and green belts have also been described as open-minded change agents and

project managers who must be able to communicate effectively at all levels (Brue, 2002).

Finally, this study suggests that self-reports of upper management support towards green and black belt projects is associated with actual cost savings as well. Green belt leaders who reported receiving moderate to strong support from upper management had a total cost savings mean of $246,464. Black belt leaders who reported receiving moderate to strong support from upper management had a total cost savings mean of $2,770,389. Six Sigma research supports this finding. A champion is an executive or key manager who initiates and supports the Six Sigma project. S/he is key because this person typically belongs to senior management. The champion is responsible for making sure the project stays aligned with the overall business objectives and providing direction when it doesn't. Also, the champion's job is to ensure that the project team has all the necessary resources such as money, time, people, etc. to complete the project (Pande & Holpp, 2002).

This study found that black belt leaders had more independent variables related to the success of their Six Sigma projects than did green belt leaders. Dependable, friendly, and project experience were significantly related to project success for black belt leaders but not for green belt leaders. This difference in findings for green belt and black belt leaders may be due to black belt leaders' projects being more complex than green belt leaders' projects. Black belt leaders are removed from their fulltime position for 18 months to two years to work on a black belt Six Sigma project. They typically complete four to six projects during this time frame. Green belt leaders are not removed from their fulltime position; they have to work on their project part-time. Therefore, green belt leaders aren't expected to complete as many projects as black belt leaders. Black belt

leaders have to be dependable and friendly because their responsibilities are greater. They are responsible for training green belt leaders and they interact with more people across various departments in an effort to successfully complete their projects. The number of projects black belt leaders complete is pertinent because of the complexity of their projects. The more projects they have under their belt the more effective and efficient they can be in completing future projects.

Implications of the Research

This study's findings can inform managers in hiring and developing green and black belt Six Sigma leaders. It is important to have an effective Six Sigma leader because of the millions of dollars in bottom-line improvements they lead teams to achieve. This study found a statistical relationship with specific leadership traits self-reported by green and black belt leaders that are associated with the successful completion of Six Sigma projects. Now that specific traits have been identified, managers can hire green and black belt leaders based on this information, as well as develop potential leaders to have these specific traits that correlate to successful completion of Six Sigma projects. An effective leader in the Six Sigma field relates to successfully completing projects that yield significant hard cost savings to the organization's bottom line.

This study addressed a gap in the Six Sigma literature. The literature did not discuss traits needed by Six Sigma leaders in order for them to successfully implement projects. The pre-existing literature discussed only the technical skill set that is needed.

Finally, this study demonstrated that a scale created from the Leadership Trait Questionnaire (LTQ) items is a reliable. Prior to this study the LTQ instrument developed by Peter Northouse was not tested for reliability. The LTQ instrument offers another method of conceptualizing and operationalizing a leader's ability to assess their leadership traits.

Limitations of this Study

In terms of limitations, this study has several that should be noted. First, all participants are from the researcher's company, Tyco Electronics. Therefore the researcher could only generalize about Six Sigma leaders within Tyco Electronics.

Second, cost savings was the only output measure for success. However, there are other factors that could determine the success of a project when hard cost savings aren't obtainable, such as downtime reductions, quality improvements (especially customer issues), working capital improvements, waste reductions, cost avoidances, etc.

Third, the non-leaders weren't asked to assess their leader using the Leadership Trait Questionnaire instrument. The researcher used the LTQ instrument primarily because of its 10 comprehensive traits which appeared to be very applicable in the context of Six Sigma leadership. The primary purpose of the LTQ is to assess the strengths and weaknesses of the leader.

A fourth limitation is the response rate for green belt leaders, which was 28%, and the small sample size within the groups of each independent variable. These two factors potentially affected the statistical significance and analysis of this study.

The fifth limitation is the large variation in cost savings data. This large variation may have statistically affected the outcome of this study's results. The researcher did remove self-reports of zero cost savings and outliers; however, there was no difference in the statistical significance of the findings. Finally, the sixth limitation is that 89% of the sample was males.

Future Research

Now that the LTQ has been tested to have a reliable scale, other studies related to the trait theories and Six Sigma leadership can be explored. One of the biggest problems in past research relating personality to leadership is the lack of a structure for describing personality, leading to a wide range of traits being investigated under different labels. Judge, Bono, et al. (2002) conducted recent research on the taxonomic structure for classifying and organizing traits. This taxonomic structure was called the five-factor model. The five-factor model of personality, often termed the Big Five, can be used to describe the most salient aspects of personality (Hurtz & Donovn, 2000). The Big Five are heritable and stable over time. The dimensions comprising the five-factor model are Neuroticism, Extraversion, Openness to Experience, Agreeableness, and Conscientiousness (Judge & Bono, 2004). The LTQ instrument may be utilized with the five-factor model in an effort to better understand traits and its effect on Six Sigma leadership.

Also, future research addressing the following factors could improve on this study to increase statistical and practical significance: (a) administer the survey to green and

60

black belt Six Sigma leaders from various companies; (b) define more than one output variable to determine a successful Six Sigma project; (c) decrease the number of levels from 5 to 3 in an effort to increase sample sizes for each level; and (d) restate the cost savings question in an effort to reduce variability in reporting.

Concluding Remarks

As global competitiveness continues to increase, companies are seeking initiatives that will give them an edge. Six Sigma strategies have been at the forefront of these initiatives. Six Sigma strategies led by effective green and black belt leaders have produced millions of dollars in bottom-line improvements. In this study, effective green belt leaders self-identified as having the following traits: articulate, perceptive, self-confident, self-assured, and determined. They also reported that strong upper management support mattered, and this was found to be associated with their effectiveness as leaders of projects. In this study black belt leaders self-identified as having the following traits: articulate, perceptive, self-confident, self-assured, determined, dependable, and friendly. They, too, reported that strong upper management support and project experience mattered, and this was found to be associated with their effectiveness as project leaders. Clearly, in times of economic uncertainty and increasing global competiveness, managers need to be able to recognize the individuals who possess the needed traits to make their companies profitable.

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APPENDIX A

Survey Cover Letter

Dear Respondent,

I am inviting you to participate in a research project to examine whether there are specific leadership traits for green and black belt Six Sigma leaders that correlate and predict the success of Six Sigma projects. Along with this letter is a short questionnaire. The purpose of the questionnaire is to measure personal characteristics of leadership. I am asking you to look over the questionnaire and, if you choose to do so, complete it and send it back to me. It should take you no more than 10 minutes to complete.

The results of this project will be used to meet the partial requirements for the degree of Doctor of Philosophy for the Leadership Studies Program at North Carolina A & T State University. Through your participation I hope to understand the leadership traits in regard to completing successful Six Sigma projects.

I do not know of any risks to you if you decide to participate in this survey and I guarantee that your responses will not be identified with you personally. I promise not to share any information that identifies you with anyone outside my dissertation committee chair Dr. Forrest Toms.

I hope you will take the time to complete this questionnaire and return it. Your participation is voluntary [and there is no penalty if you do not participate]. Regardless of whether you choose to participate, please let me know if you would like a summary of my findings.

If you have any questions or concerns about completing the questionnaire or about being in this study, you may contact me at 336-727-5719 or david.chamblee@tycoelectronics.com. This project has been approved by the Institutional Review Board (IRB) at North Carolina A&T State University.

If you have any questions about your rights as a research study participant, you may contact the chair of the IRB through Compliance Office at (336) 334-7995 or rescomp@ncat.edu.

You must be at least 18 years old in order to participate.
If you agree to participate, you may keep this form and complete the survey.
If you wish, you may stop at any time.
You do not have to place your name on the survey.

Sincerely,
David Lee Chamblee Jr.

APPENDIX B

Permission to Send Email to Leaders at Tyco Electronics

From: England, Tom
Sent: Tuesday, October 06, 2009 4:04 PM
To: Chamblee, David L.
Subject: RE: Green & Black Belt Database

Permission granted – good luck.

Best regards,

Tom

_____

From: Chamblee, David L.
Sent: Tuesday, October 06, 2009 3:00 PM
To: England, Tom
Subject: FW: Green & Black Belt Database
Importance: High

Hello Tom,

I searched TEBIT data base using the criteria of DMAIC green and black belt implemented projects, EBIT hard cost savings and North America locations only. There are 107 DMAIC green belts and 52 DMAIC black belts I would like to send a Leadership Trait Questionnaire to via email. The purpose of this questionnaire is to measure personal characteristics of leadership. The following are the 10 characteristics each leader will be asked to rate themselves on a scale of 1 Strongly disagree to 5 Strongly agree: Articulate, Perceptive, Self-confident, Self-assured, Persistent, Determined, Trustworthy, Dependable, Friendly, and Outgoing.

Tom, the purpose of my research study is to examine whether there are specific leadership traits for green and black belt Six Sigma leaders that correlate and predict the success of Six Sigma projects. **Please grant me permission to send the Leadership Trait Questionnaire via email to the aforementioned population.** The questionnaire will take less than 5 minutes to complete.

Regards,

David Chamblee
Quality Engineer, Relay Products Group
Tyco Electronics
RPG North America
3700 Reidsville Road, MS 177-57
Winston-Salem, NC 27101-2165
336-727-5719 tel

_____

From: England, Tom
Sent: Thursday, September 24, 2009 7:00 AM
To: Chamblee, David L.
Cc: Maley, Bonnie
Subject: RE: Green & Black Belt Database

Hello David,

I have been traveling the last 2 weeks and will be out of the office next week on Tuesday and Wednesday.

Please contact Bonnie Maley and set up a teleconference for either Monday or Thursday of next week.

Best regards,

Tom

_____

From: Chamblee, David L.
Sent: Wednesday, September 23, 2009 9:22 AM
To: England, Tom
Subject: FW: Green & Black Belt Database
Importance: High

Hello Tom,

How are you doing? I believe you were the director over the Engineering Rotation Program when I was in the IE program. Tom do we have a database for completed Six Sigma projects? A database that shows cost savings, completion times, who, type of project, etc. I would like to converse with you about some Six Sigma research I am currently doing in an effort to complete some graduate level work.

Regards,

David Chamblee
Quality Engineer, Relay Products Group
Tyco Electronics
RPG North America
3700 Reidsville Road, MS 177-57
Winston-Salem, NC 27101-2165
336-727-5719 tel

_____

From: Chamblee, David L.
Sent: Thursday, September 17, 2009 12:14 PM
To: England, Tom
Subject: Green & Black Belt Database
Importance: High

Hello Tom,

How are you doing? I believe you were the director over the Engineering Rotation Program when I was in the IE program. Tom do we have a database for completed Six Sigma projects? A database that shows cost savings, completion times, who, type of project, etc. I would like to converse with you about some Six Sigma research I am currently doing in an effort to complete some graduate level work.

Regards,

David Chamblee
Quality Engineer, Relay Products Group
Tyco Electronics
RPG North America
3700 Reidsville Road, MS 177-57
Winston-Salem, NC 27101-2165
336-727-5719 tel
336-727-5207 fax

APPENDIX C

IRB Approval Letter

NC A&T DIVISION OF RESEARCH AND ECONOMIC DEVELOPMENT
1601 East Market Street
Greensboro, NC 27411
(336) 334-7314
Web site: http://www.ncat.edu/~divofres/compliance/irb/index.php
Federalwide Assurance (FWA) #00000013

To: David Chamblee

From: Behavioral IRB

Date: 11/04/2009

RE: Notice of IRB Exemption
Exemption Category: 2.Survey, interview, public observation
Study #: 09-0145

Study Title: An Assessment of Leadership Traits on the Success of Six Sigma Projects

This submission has been reviewed by the above IRB and was determined to be exempt from further review according to the regulatory category cited above under 45 CFR 46.101(b).

Study Description:

The purpose of this study is to examine whether there are specific leadership traits for green and black belt Six Sigma leaders that correlate and predict the success of Six Sigma projects. The Leadership Trait Questionnaire (LTQ) will be disseminated to 400 participants using Survey Monkey.

Investigator's Responsibilities:

If your study protocol changes in such a way that exempt status would no longer apply, you should contact the above IRB before making the changes. The IRB will maintain records for this study for 3 years, at which time you will be contacted about the status of the study.

CC:
Forrest Toms, Leadership Studies

APPENDIX D

Leadership Trait Questionnaire

1. PURPOSE

Dear Respondent,

I am inviting you to participate in a research project to examine whether there are specific leadership traits for green and black belt Six Sigma leaders that correlate and predict the success of Six Sigma projects. Along with this letter is a short questionnaire. The purpose of the questionnaire is to measure personal characteristics of leadership. It should take you no more than 10 minutes to complete.

The results of this project will be used to complete a graduate level research project. Through your participation I hope to understand the leadership traits in regard to completing successful Six Sigma projects.

I guarantee that your responses will not be identified with you personally. I promise not to share any information that identifies you with anyone.

Your participation is voluntary. You may end your participation at any time by clicking the link to exit the survey. The researcher may choose not to use your survey responses if you choose to skip too many questions.

If you have any questions or concerns about completing the questionnaire or about being in this study, you may contact me at 336-727-5719 or david.chamblee@tycoelectronics.com. This project has been approved by the Institutional Review Board (IRB) at North Carolina A&T State University.

If you have any questions about your rights as a research study participant, you may contact the chair,Donna Eaton, of the IRB through Compliance Office at (336) 334-7995 or dheaton@ncat.edu.

If you agree to participate, you may print this form and then complete the survey.
If you wish, you may stop at any time.
You do not have to place your name on the survey.

Sincerely,

David L. Chamblee Jr.
Tyco Electronics
Quality Engineer

2. INSTRUCTIONS

Instructions:
Please fill out the Position Identification portion of the instrument.

Next please fill out the Demographic Information portion of the instrument.

For the final portion, please complete the LTQ Instrument for each of the ten traits listed. Please indicate the degree to which you think the trait describes you during the successful completion of your Six Sigma project.

3. POSITION IDENTIFICATION - SIX SIGMA

Fill out the position identification portion of the instrument

1. What is your highest Six Sigma classification?

◯ Black Belt

◯ Green Belt

2. How many Six Sigma projects have you completed based on your response to question #1?

[   ]

3. Based on your response to question #2 what was your highest cost savings project in dollars?

[   ]

4. Please indicate the degree to which you think upper management supported your project from a time, people and financial perspective.

	Strong Support	Moderate Support	Weak Support
1	◯	◯	◯

5. Please rate your technical skillset at the time you completed your Six Sigma project.

	Strong Skillset	Moderate Skillset	Weak Skillset
1	◯	◯	◯

4. DEMOGRAPHIC INFORMATION

Fill out the demographic information portion of the instrument

6. Race

○ African American

○ Asian

○ Hispanic

○ Native American

○ White

○ Other (please specify)

[   ]

7. Gender

○ Female

○ Male

8. Age (at time you completed project)

○ 18-29

○ 30-39

○ 40-49

○ 50-59

○ 60-older

9. Geographic Location (at the time you completed your project)

○ Americas

○ EMEA

○ Asia

5. LTQ INSTRUMENT

LTQ INSTRUMENT:

Please complete the LTQ Instrument for each of the ten traits listed. Please indicate the degree to which you think the trait describes you during the successful completion of your highest cost savings Six Sigma project.

10. Articulate - Communicates effectively with others

- ◯ Strongly Agree
- ◯ Agree
- ◯ Neutral
- ◯ Disagree
- ◯ Strongly Disagree

11. Perceptive - Discerning and insightful

- ◯ Strongly Agree
- ◯ Agree
- ◯ Neutral
- ◯ Disagree
- ◯ Strongly Disagree

12. Self-confident - Believes in oneself and one's ability

- ◯ Strongly Agree
- ◯ Agree
- ◯ Neutral
- ◯ Disagree
- ◯ Strongly Disagree

13. Self-assured - Secure with self, free of doubts

- ◯ Strongly Agree
- ◯ Agree
- ◯ Neutral
- ◯ Disagree
- ◯ Strongly Disagree

14. Persistent - Stays fixed on the goals despite interference

- ◯ Strongly Agree
- ◯ Agree
- ◯ Neutral
- ◯ Disagree
- ◯ Strongly Disagree

15. Determined - Takes a firm stand, acts with certainty

- ◯ Strongly Agree
- ◯ Agree
- ◯ Neutral
- ◯ Disagree
- ◯ Strongly Disagree

16. Trustworthy - Acts believably, inspires confidence

- ◯ Strongly Agree
- ◯ Agree
- ◯ Neutral
- ◯ Disagree
- ◯ Strongly Disagree

17. Dependable - Is consistent and reliable

- ◯ Strongly Agree
- ◯ Agree
- ◯ Neutral
- ◯ Disagree
- ◯ Strongly Disagree

18. Friendly - Shows kindness and warmth

- ◯ Strongly Agree
- ◯ Agree
- ◯ Neutral
- ◯ Disagree
- ◯ Strongly Disagree

19. Outgoing - Talks freely, gets along with others

◯ Strongly Agree

◯ Agree

◯ Neutral

◯ Disagree

◯ Strongly Disagree

6. THANK YOU!!!

THANK YOU!!! If you have any questions or concerns about completing the questionnaire or want to receive a summary you may contact me at (336) 727-5719 or david.chamblee@tycoelectronics.com. This project has been approved by the Institutional Review Board (IRB) at North Carolina A&T State University.

If you have any questions about your rights as a research study participant, you may contact the chair of the IRB through Compliance Office at (336) 334-7995 or dheaton@ncat.edu.

Thank you for participating!

Sincerely,

David L. Chamblee Jr.
Tyco Electronics
Quality Engineer

APPENDIX E

Permission to Use Leadership Trait Questionnaire

From: peter.northouse@wmich.edu on behalf of Peter Northouse
[peter.northouse@wmich.edu]
Sent: Wednesday, October 07, 2009 10:00 AM
To: Chamblee, David L.
Subject: Re: Permission to use LTQ Instrument

Importance: High

David,

Thank you for the inquiry regarding use of the LTQ.   You have my
permission to use the questionnaire.

Best of luck in your research.

Regards,
Peter Northouse, Ph.D.

On Oct 5, 2009, at 3:45 PM, Chamblee, David L. wrote:

> <Methodology093009.xls>

APPENDIX F

Cronbach's Reliability Test Results for Green and Black Belt Leaders

Reliability

Notes

Output Created		02-Mar-2010 08:24:10
Comments		
Input	Data	F:\Leadership Training\David Data\Green Belt Data.sav
	Active Dataset	DataSet0
	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	70
	Matrix Input	
Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
	Cases Used	Statistics are based on all cases with valid data for all variables in the procedure.

Syntax		RELIABILITY
		  /VARIABLES=art_rtg perc_rtg slfc_rtg slfa_rtg pers_rtg det_rtg trus_rtg dep_rtg frd_rtg out_rtg
		  /SCALE('Green Belt Reliability') ALL
		  /MODEL=ALPHA
		  /STATISTICS=DESCRIPTIVE SCALE
		  /SUMMARY=TOTAL.

Resources	Processor Time	0:00:00.031
	Elapsed Time	0:00:00.094

Scale: Green Belt Reliability

Case Processing Summary

		N	%
Cases	Valid	62	88.6
	Excluded[a]	8	11.4
	Total	70	100.0

a. Listwise deletion based on all variables in the

procedure.

Reliability Statistics

Cronbach's Alpha	N of Items
.825	10

Item Statistics

	Mean	Std. Deviation	N
art_rtg	4.39	.583	62
perc_rtg	4.13	.665	62
slfc_rtg	4.29	.687	62
slfa_rtg	4.13	.640	62
pers_rtg	4.27	.682	62
det_rtg	4.19	.721	62
trus_rtg	4.48	.593	62
dep_rtg	4.42	.615	62
frd_rtg	4.26	.676	62
out_rtg	4.32	.647	62

Item-Total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
art_rtg	38.50	13.697	.570	.804
perc_rtg	38.76	14.186	.373	.823
slfc_rtg	38.60	13.130	.581	.801
slfa_rtg	38.76	13.498	.551	.805
pers_rtg	38.61	13.782	.444	.816
det_rtg	38.69	13.593	.448	.816
trus_rtg	38.40	13.720	.551	.805
dep_rtg	38.47	13.401	.603	.800
frd_rtg	38.63	13.713	.465	.814
out_rtg	38.56	13.496	.543	.805

Scale Statistics

Mean	Variance	Std. Deviation	N of Items
42.89	16.495	4.061	10

Scale: Black Belt Reliability

Case Processing Summary

		N	%
Cases	Valid	64	82.1
	Excluded[a]	14	17.9
	Total	78	100.0

a. Listwise deletion based on all variables in the

procedure.

Reliability

Reliability Statistics

Cronbach's Alpha	N of Items
.766	10

Item Statistics

	Mean	Std. Deviation	N
art_rtg	4.47	.534	64
perc_rtg	4.28	.654	64
slfc_rtg	4.17	.680	64
slfa_rtg	4.11	.693	64
pers_rtg	4.34	.695	64
det_rtg	4.17	.680	64
trus_rtg	4.44	.560	64
dep_rtg	4.39	.657	64
frd_rtg	4.09	.750	64
out_rtg	4.23	.792	64

Item-Total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
art_rtg	38.23	13.579	.185	.773
perc_rtg	38.42	11.899	.503	.737
slfc_rtg	38.53	11.523	.565	.727
slfa_rtg	38.59	11.832	.479	.739
pers_rtg	38.36	11.472	.560	.728
det_rtg	38.53	12.031	.445	.744
trus_rtg	38.27	12.262	.515	.738
dep_rtg	38.31	11.996	.475	.740
frd_rtg	38.61	12.686	.252	.773
out_rtg	38.47	11.999	.359	.759

Scale Statistics

Mean	Variance	Std. Deviation	N of Items
42.70	14.593	3.820	10

APPENDIX G

Leadership Trait Questionnaire Responses for Six Sigma Leaders

Leadership Trait Questionnaire (LTQ) for Six Sigma Leaders

What is your highest Six Sigma classification?		
Answer Options	**Response Percent**	**Response Count**
Black Belt	49.7%	82
Green Belt	50.3%	83
	answered question	**165**
	skipped question	**9**

What is your highest Six Sigma classification?
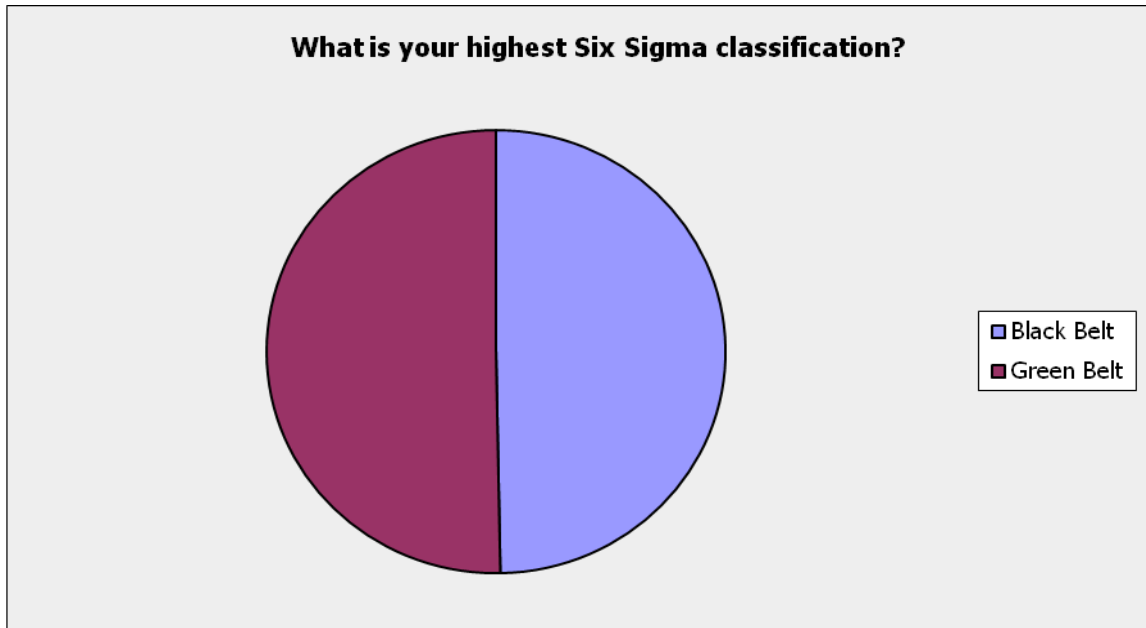
Leadership Trait Questionnaire (LTQ) for Six Sigma Leaders

How many Six Sigma projects have you completed based on your response to question #1?	
Answer Options	**Response Count**
	166
answered question	**166**
skipped question	**8**

Number	Response Date	Response Text
1	Nov 24, 2009 5:11 PM	1
2	Nov 25, 2009 2:00 AM	12
3	Dec 1, 2009 1:47 PM	Four
4	Dec 1, 2009 8:19 PM	2
5	Dec 1, 2009 8:26 PM	Two
6	Dec 1, 2009 8:27 PM	2
7	Dec 1, 2009 8:38 PM	4
8	Dec 1, 2009 8:39 PM	6
9	Dec 1, 2009 8:53 PM	1
10	Dec 1, 2009 9:51 PM	3
11	Dec 1, 2009 10:27 PM	1
12	Dec 2, 2009 12:08 PM	zero-helped on 7 black belt projects
13	Dec 2, 2009 3:33 PM	2
14	Dec 2, 2009 3:51 PM	4
15	Dec 2, 2009 7:54 PM	6
16	Dec 2, 2009 7:56 PM	20
17	Dec 2, 2009 8:04 PM	1
18	Dec 2, 2009 8:08 PM	1
19	Dec 2, 2009 8:18 PM	3
20	Dec 2, 2009 9:01 PM	5
21	Dec 2, 2009 9:03 PM	0
22	Dec 2, 2009 11:38 PM	2
23	Dec 3, 2009 12:59 AM	16
24	Dec 3, 2009 12:52 PM	12
25	Dec 3, 2009 2:06 PM	1
26	Dec 3, 2009 2:32 PM	2
27	Dec 3, 2009 2:41 PM	5
28	Dec 3, 2009 7:22 PM	1
29	Dec 3, 2009 8:12 PM	1
30	Dec 3, 2009 9:47 PM	one
31	Dec 3, 2009 10:26 PM	3
32	Dec 3, 2009 11:04 PM	One
33	Dec 4, 2009 1:07 AM	25
34	Dec 4, 2009 8:11 AM	3

Number	Response Date	Response Text	
35	Dec 4, 2009 11:20 AM	3	
36	Dec 4, 2009 12:02 PM	1	
37	Dec 4, 2009 12:14 PM	2	
38	Dec 4, 2009 1:11 PM	2	
39	Dec 4, 2009 1:12 PM	5	
40	Dec 4, 2009 2:02 PM	2	
41	Dec 4, 2009 2:12 PM	1	
42	Dec 4, 2009 2:51 PM	1	
43	Dec 4, 2009 3:39 PM	25	
44	Dec 4, 2009 3:49 PM	6	
45	Dec 4, 2009 9:52 PM	2	
46	Dec 7, 2009 8:52 AM	3	
47	Dec 7, 2009 11:37 AM	3	
48	Dec 7, 2009 12:59 PM	5	
49	Dec 7, 2009 4:20 PM	one	
50	Dec 7, 2009 6:01 PM	3	
51	Dec 7, 2009 6:02 PM	2	
52	Dec 7, 2009 6:41 PM	Five	
53	Dec 7, 2009 7:16 PM	2	
54	Dec 7, 2009 7:41 PM	one	
55	Dec 7, 2009 8:00 PM	0	
56	Dec 7, 2009 8:33 PM	1	
57	Dec 7, 2009 8:37 PM	5	
58	Dec 7, 2009 8:37 PM	3	
59	Dec 7, 2009 9:37 PM	1	
60	Dec 7, 2009 9:44 PM	2	
61	Dec 8, 2009 1:14 AM	3	
62	Dec 8, 2009 3:19 AM	3	
63	Dec 8, 2009 2:35 PM	1	
64	Dec 8, 2009 6:18 PM	one	
65	Dec 8, 2009 8:10 PM	six projects	
66	Dec 8, 2009 10:52 PM		1
67	Dec 9, 2009 10:44 AM		2
68	Dec 9, 2009 3:06 PM		1
69	Dec 9, 2009 8:04 PM		40
70	Dec 9, 2009 9:55 PM		5
71	Dec 9, 2009 11:16 PM		3
72	Dec 10, 2009 12:05 AM	Over 20 projects	
73	Dec 10, 2009 1:34 AM		2
74	Dec 10, 2009 6:18 AM		3
75	Dec 10, 2009 6:25 AM		70
76	Dec 10, 2009 6:57 AM		2
77	Dec 10, 2009 7:38 AM		5
78	Dec 10, 2009 7:40 AM	six	
79	Dec 10, 2009 7:45 AM		3
80	Dec 10, 2009 7:50 AM		2

Number	Response Date	Response Text
81	Dec 10, 2009 8:44 AM	four
82	Dec 10, 2009 9:02 AM	3
83	Dec 10, 2009 9:05 AM	3
84	Dec 10, 2009 9:19 AM	5
85	Dec 10, 2009 10:15 AM	2
86	Dec 10, 2009 10:20 AM	10
87	Dec 10, 2009 10:38 AM	about 10 projects
88	Dec 10, 2009 12:56 PM	1
89	Dec 10, 2009 2:04 PM	1
90	Dec 10, 2009 2:18 PM	1
91	Dec 10, 2009 3:36 PM	1
92	Dec 10, 2009 3:52 PM	3
93	Dec 10, 2009 5:57 PM	One
94	Dec 10, 2009 6:16 PM	1
95	Dec 10, 2009 6:38 PM	2
96	Dec 10, 2009 6:40 PM	2
97	Dec 10, 2009 6:47 PM	4
98	Dec 10, 2009 6:49 PM	Four
99	Dec 10, 2009 6:53 PM	4
100	Dec 10, 2009 6:53 PM	1
101	Dec 10, 2009 6:54 PM	3
102	Dec 10, 2009 6:56 PM	2
103	Dec 10, 2009 7:12 PM	1
104	Dec 10, 2009 8:01 PM	1
105	Dec 10, 2009 8:02 PM	3
106	Dec 10, 2009 8:26 PM	2
107	Dec 10, 2009 8:49 PM	3
108	Dec 10, 2009 9:00 PM	8
109	Dec 10, 2009 9:21 PM	2
110	Dec 10, 2009 10:14 PM	three
111	Dec 10, 2009 11:06 PM	2
112	Dec 11, 2009 2:42 AM	3
113	Dec 11, 2009 4:41 AM	3
114	Dec 11, 2009 7:58 AM	3
115	Dec 11, 2009 8:52 AM	1
116	Dec 11, 2009 9:10 AM	2
117	Dec 11, 2009 9:13 AM	2
118	Dec 11, 2009 11:11 AM	3
119	Dec 11, 2009 11:41 AM	2
120	Dec 11, 2009 12:07 PM	1
121	Dec 11, 2009 12:42 PM	1
122	Dec 11, 2009 1:13 PM	4
123	Dec 11, 2009 1:47 PM	2
124	Dec 11, 2009 2:27 PM	two
125	Dec 11, 2009 2:45 PM	4
126	Dec 11, 2009 6:25 PM	1

Number	Response Date	Response Text
127	Dec 11, 2009 7:59 PM	3
128	Dec 11, 2009 8:13 PM	3
129	Dec 11, 2009 8:42 PM	Two
130	Dec 12, 2009 8:31 PM	In my career (25+ years), I haven't really tracked. Estimate >50.
131	Dec 13, 2009 3:32 PM	1
132	Dec 14, 2009 12:17 PM	3
133	Dec 14, 2009 1:05 PM	6
134	Dec 14, 2009 2:09 PM	3
135	Dec 14, 2009 3:40 PM	2
136	Dec 14, 2009 3:44 PM	2
137	Dec 14, 2009 6:50 PM	5
138	Dec 14, 2009 9:24 PM	1
139	Dec 15, 2009 2:26 PM	1
140	Dec 15, 2009 3:20 PM	Two
141	Dec 15, 2009 3:38 PM	0
142	Dec 15, 2009 6:04 PM	2
143	Dec 16, 2009 8:15 AM	2
144	Dec 16, 2009 12:35 PM	12
145	Dec 16, 2009 7:50 PM	2
146	Dec 17, 2009 3:31 PM	3
147	Dec 18, 2009 8:10 AM	1
148	Dec 18, 2009 2:21 PM	3
149	Dec 18, 2009 5:32 PM	3
150	Dec 18, 2009 7:15 PM	Led 5, Coached 10+
151	Dec 18, 2009 9:17 PM	2
152	Dec 18, 2009 9:20 PM	20
153	Dec 20, 2009 3:04 PM	2
154	Dec 21, 2009 4:33 PM	Two
155	Dec 21, 2009 6:52 PM	2
156	Dec 22, 2009 8:03 AM	2
157	Dec 23, 2009 9:44 AM	100
158	Dec 23, 2009 12:33 PM	3
159	Dec 29, 2009 3:05 PM	7
160	Jan 4, 2010 7:38 PM	1
161	Jan 5, 2010 5:16 PM	1
162	Jan 6, 2010 6:57 AM	2
163	Jan 11, 2010 4:50 PM	1
164	Jan 12, 2010 4:40 PM	1.5
165	Jan 13, 2010 5:53 PM	15
166	Jan 14, 2010 6:00 PM	3

Leadership Trait Questionnaire (LTQ) for Six Sigma Leaders

Based on your response to question #2 what was your highest cost savings project in dollars?	
Answer Options	**Response Count**
	159
answered question	**159**
skipped question	**15**

Number	Response Date	Response Text	
1	Nov 23, 2009 5:57 PM		35000
2	Nov 24, 2009 5:11 PM		15000
3	Nov 25, 2009 2:00 AM	35 million	
4	Dec 1, 2009 1:47 PM	Plating Line Vision System - $350,000	
5	Dec 1, 2009 8:19 PM		111000
6	Dec 1, 2009 8:26 PM		480000
7	Dec 1, 2009 8:27 PM		550000
8	Dec 1, 2009 8:38 PM	do not remember	
9	Dec 1, 2009 8:39 PM		170000
10	Dec 1, 2009 8:53 PM		388000
11	Dec 1, 2009 9:51 PM		25000
12	Dec 1, 2009 10:27 PM		214000
13	Dec 2, 2009 12:08 PM		158000
14	Dec 2, 2009 3:33 PM	Nearly $ 500,000	
15	Dec 2, 2009 3:51 PM		12500
16	Dec 2, 2009 7:54 PM		450000
17	Dec 2, 2009 7:56 PM	100k	
18	Dec 2, 2009 8:04 PM		13000
19	Dec 2, 2009 8:08 PM	$25K hard and $50K soft	
20	Dec 2, 2009 8:18 PM		30000
21	Dec 2, 2009 9:01 PM		250000
22	Dec 2, 2009 9:03 PM		0
23	Dec 2, 2009 11:38 PM		48000
24	Dec 3, 2009 12:59 AM		286822
25	Dec 3, 2009 12:52 PM	$100K per Year	
26	Dec 3, 2009 2:06 PM	Approx. $25k	
27	Dec 3, 2009 2:32 PM		20000
28	Dec 3, 2009 2:41 PM		254000
29	Dec 3, 2009 7:22 PM		25000
30	Dec 3, 2009 8:12 PM		15000
31	Dec 3, 2009 9:47 PM		100000
32	Dec 3, 2009 11:04 PM		96000
33	Dec 4, 2009 1:07 AM	100k	
34	Dec 4, 2009 8:11 AM	484 557,00	

Number	Response Date	Response Text
35	Dec 4, 2009 11:20 AM	146466
36	Dec 4, 2009 12:02 PM	300K
37	Dec 4, 2009 12:14 PM	$100k
38	Dec 4, 2009 1:11 PM	80000
39	Dec 4, 2009 1:12 PM	100k
40	Dec 4, 2009 2:02 PM	35000
41	Dec 4, 2009 2:12 PM	600
42	Dec 4, 2009 2:51 PM	8000
43	Dec 4, 2009 3:39 PM	500000
44	Dec 4, 2009 3:49 PM	156000
45	Dec 4, 2009 9:52 PM	80000
46	Dec 7, 2009 8:52 AM	100000
47	Dec 7, 2009 11:37 AM	5000
48	Dec 7, 2009 12:59 PM	150000
49	Dec 7, 2009 4:20 PM	48000
50	Dec 7, 2009 6:01 PM	140000
51	Dec 7, 2009 6:02 PM	110000
52	Dec 7, 2009 6:41 PM	166000
53	Dec 7, 2009 7:16 PM	450000
54	Dec 7, 2009 7:41 PM	Unknown
55	Dec 7, 2009 8:37 PM	40000
56	Dec 7, 2009 8:37 PM	1 mil
57	Dec 7, 2009 9:37 PM	80000
58	Dec 7, 2009 9:44 PM	2000
59	Dec 8, 2009 1:14 AM	80000
60	Dec 8, 2009 3:19 AM	63000
61	Dec 8, 2009 2:35 PM	100000
62	Dec 8, 2009 6:18 PM	??
63	Dec 8, 2009 8:10 PM	27035 Dlls (aprox)
64	Dec 8, 2009 10:52 PM	0
65	Dec 9, 2009 10:44 AM	150k
66	Dec 9, 2009 3:06 PM	8357
67	Dec 9, 2009 8:04 PM	10 million Dollars over a 12 month period
68	Dec 9, 2009 9:55 PM	936900
69	Dec 9, 2009 11:16 PM	600000
70	Dec 10, 2009 12:05 AM	200,000 USD/year
71	Dec 10, 2009 1:34 AM	1000000
72	Dec 10, 2009 6:18 AM	85000
73	Dec 10, 2009 6:25 AM	1million USD
74	Dec 10, 2009 6:57 AM	620.000USD
75	Dec 10, 2009 7:38 AM	$266 000
76	Dec 10, 2009 7:40 AM	300
77	Dec 10, 2009 7:45 AM	273
78	Dec 10, 2009 7:50 AM	30000
79	Dec 10, 2009 8:44 AM	1.4 million USD
80	Dec 10, 2009 9:02 AM	680000

Number	Response Date	Response Text	
81	Dec 10, 2009 9:05 AM		400000
82	Dec 10, 2009 9:19 AM		360000
83	Dec 10, 2009 10:15 AM		60000
84	Dec 10, 2009 10:38 AM	150 k$	
85	Dec 10, 2009 12:56 PM		100000
86	Dec 10, 2009 2:04 PM	N/A	
87	Dec 10, 2009 2:18 PM		60000
88	Dec 10, 2009 3:36 PM	$120K	
89	Dec 10, 2009 3:52 PM		350000
90	Dec 10, 2009 5:57 PM	NA - Development program	
91	Dec 10, 2009 6:16 PM	new product, no history	
92	Dec 10, 2009 6:38 PM	25K	
93	Dec 10, 2009 6:40 PM		150000
94	Dec 10, 2009 6:47 PM		69000
95	Dec 10, 2009 6:49 PM		246000
96	Dec 10, 2009 6:53 PM		900000
97	Dec 10, 2009 6:54 PM	aprox 200K usd a year.	
98	Dec 10, 2009 6:56 PM		335267
99	Dec 10, 2009 7:12 PM	N/A	
100	Dec 10, 2009 8:01 PM	N/A - Was a LDFSS project	
101	Dec 10, 2009 8:02 PM		37000
102	Dec 10, 2009 8:49 PM	$30k	
103	Dec 10, 2009 9:00 PM	7 million dollars	
104	Dec 10, 2009 9:21 PM	300K	
105	Dec 10, 2009 10:14 PM		304000
106	Dec 10, 2009 11:06 PM		25000
107	Dec 11, 2009 2:42 AM		74000
108	Dec 11, 2009 4:41 AM	unknown- DFSSBB, primarily lean design activities	
109	Dec 11, 2009 7:58 AM		82719
110	Dec 11, 2009 8:52 AM	141k	
111	Dec 11, 2009 9:10 AM		66433
112	Dec 11, 2009 9:13 AM		262
113	Dec 11, 2009 11:41 AM		170000
114	Dec 11, 2009 12:07 PM	$300,000/yr	
115	Dec 11, 2009 12:42 PM		500000
116	Dec 11, 2009 1:13 PM	$650K	
117	Dec 11, 2009 1:47 PM	N/A LDFSS	
118	Dec 11, 2009 2:27 PM	Machine startup waste reduction by 43%	
119	Dec 11, 2009 2:45 PM		20000
120	Dec 11, 2009 6:25 PM		46174
121	Dec 11, 2009 7:59 PM		181000
122	Dec 11, 2009 8:13 PM	50K	
123	Dec 11, 2009 8:42 PM		900000
124	Dec 12, 2009 8:31 PM	1 million	
125	Dec 13, 2009 3:32 PM		50000
126	Dec 14, 2009 12:17 PM		800000

Number	Response Date	Response Text
127	Dec 14, 2009 1:05 PM	180K
128	Dec 14, 2009 2:09 PM	20000
129	Dec 14, 2009 3:40 PM	5000000
130	Dec 14, 2009 3:44 PM	Project for low cost design product acceptance
131	Dec 14, 2009 6:50 PM	several million
132	Dec 14, 2009 9:24 PM	65,000 annually
133	Dec 15, 2009 2:26 PM	3000
134	Dec 15, 2009 3:20 PM	No savings identified
135	Dec 15, 2009 6:04 PM	36000
136	Dec 16, 2009 8:15 AM	80000
137	Dec 16, 2009 12:35 PM	600000
138	Dec 16, 2009 7:50 PM	projects involved cost avoidance
139	Dec 17, 2009 3:31 PM	N/A - new product development
140	Dec 18, 2009 8:10 AM	lean design project (development, no operations)
141	Dec 18, 2009 2:21 PM	$25MM over 3 years
142	Dec 18, 2009 5:32 PM	ongoing savings - $200,000 for first year
143	Dec 18, 2009 7:15 PM	100000
144	Dec 18, 2009 9:17 PM	55000
145	Dec 18, 2009 9:20 PM	$5MM
146	Dec 20, 2009 3:04 PM	20k per quarter
147	Dec 21, 2009 4:33 PM	$2mm +
148	Dec 21, 2009 6:52 PM	250000
149	Dec 22, 2009 8:03 AM	50
150	Dec 23, 2009 9:44 AM	1.9 million $US
151	Dec 23, 2009 12:33 PM	12000
152	Dec 29, 2009 3:05 PM	245000
153	Jan 4, 2010 7:38 PM	0
154	Jan 5, 2010 5:16 PM	0
155	Jan 6, 2010 6:57 AM	-
156	Jan 11, 2010 4:50 PM	don't remember
157	Jan 12, 2010 4:40 PM	80k...company does not count avoidance(>200k)
158	Jan 13, 2010 5:53 PM	$5MM
159	Jan 14, 2010 6:00 PM	approximately $1 million

Leadership Trait Questionnaire (LTQ) for Six Sigma Leaders

Please indicate the degree to which you think upper management supported your project from a time, people and financial perspective.

Answer Options	Strong Support	Moderate Support	Weak Support	Rating Average	Response Count
1	69	74	21	2.29	164
				answered question	**164**
				skipped question	**10**

Please indicate the degree to which you think upper management supported your project from a time, people and financial perspective.
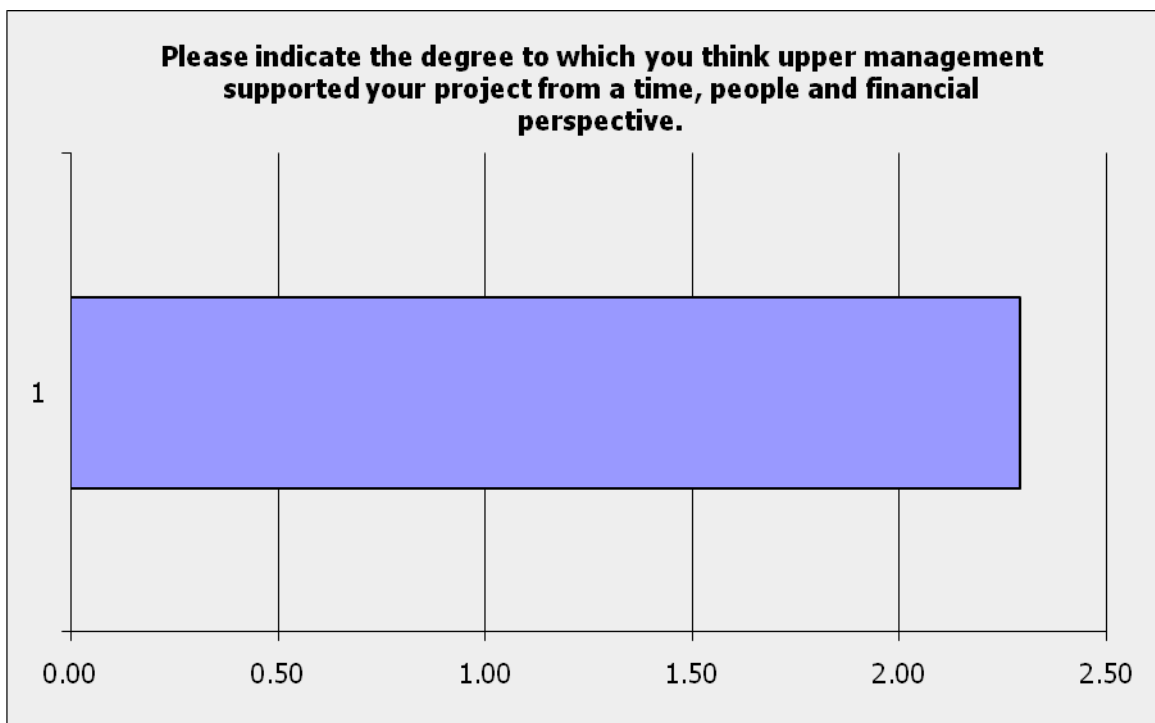
Leadership Trait Questionnaire (LTQ) for Six Sigma Leaders

| **Please rate your technical skillset at the time you completed your Six Sigma project.**					
Answer Options	**Strong Skillset**	**Moderate Skillset**	**Weak Skillset**	**Rating Average**	**Response Count**
1	65	98	1	2.39	164
				answered question	**164**
				skipped question	**10**

Please rate your technical skillset at the time you completed your Six Sigma project.
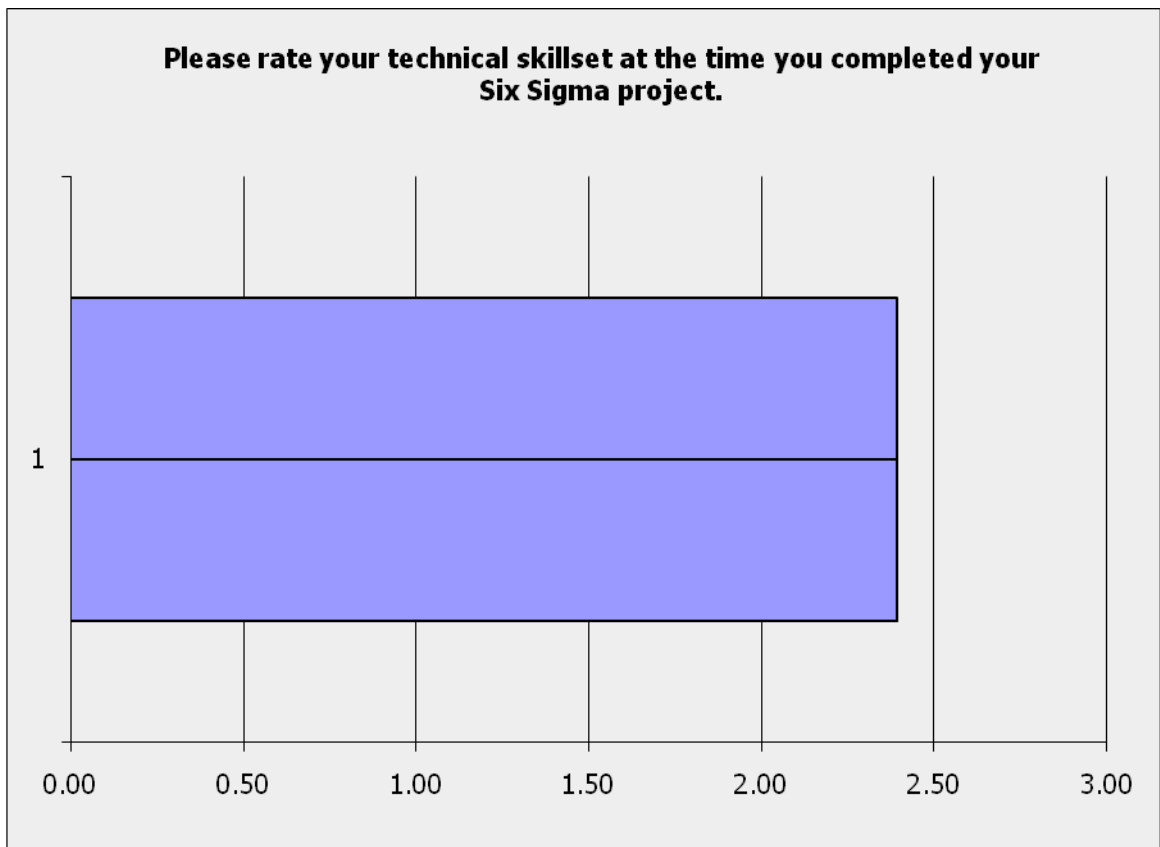
Leadership Trait Questionnaire (LTQ) for Six Sigma Leaders

Race		
Answer Options	**Response Percent**	**Response Count**
African American	14.0%	23
Asian	3.7%	6
Hispanic	4.9%	8
Native American	0.6%	1
White	73.8%	121
Other (please specify)	3.0%	5
	answered question	**164**
	skipped question	**10**

Number	Response Date	Other (please specify)
1	Dec 7, 2009 8:54 AM	EMEA
2	Dec 7, 2009 1:00 PM	German
3	Dec 10, 2009 9:01 PM	Pacific Islander
4	Dec 21, 2009 4:33 PM	Scot Irish
5	Dec 22, 2009 8:04 AM	German
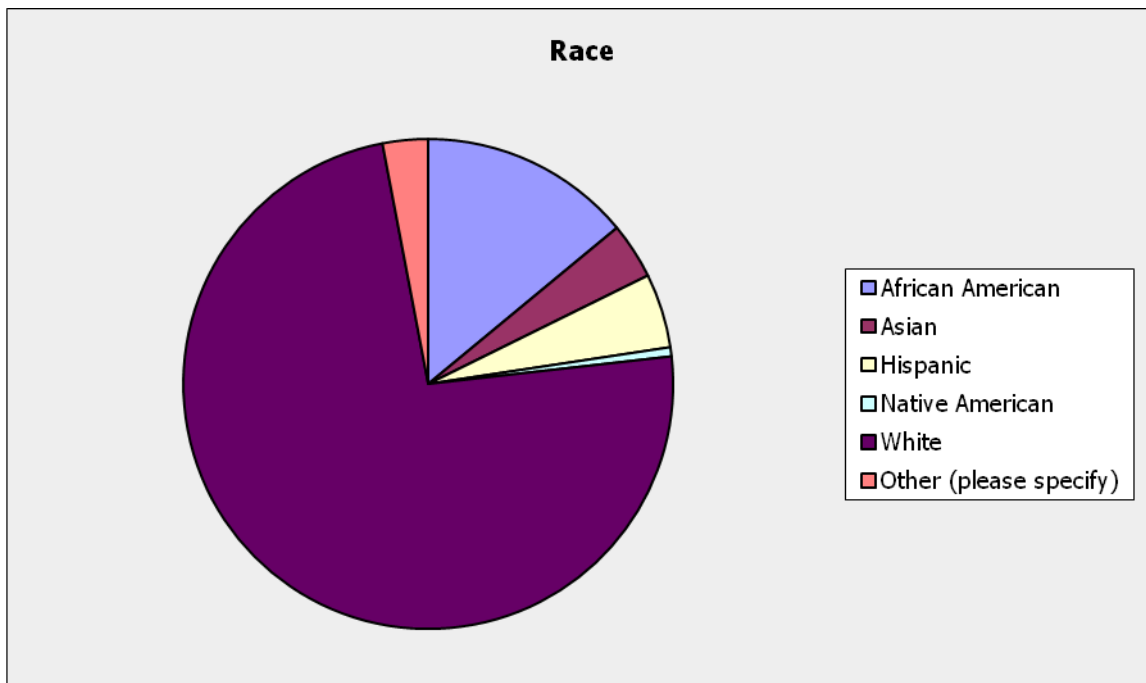
Leadership Trait Questionnaire (LTQ) for Six Sigma Leaders

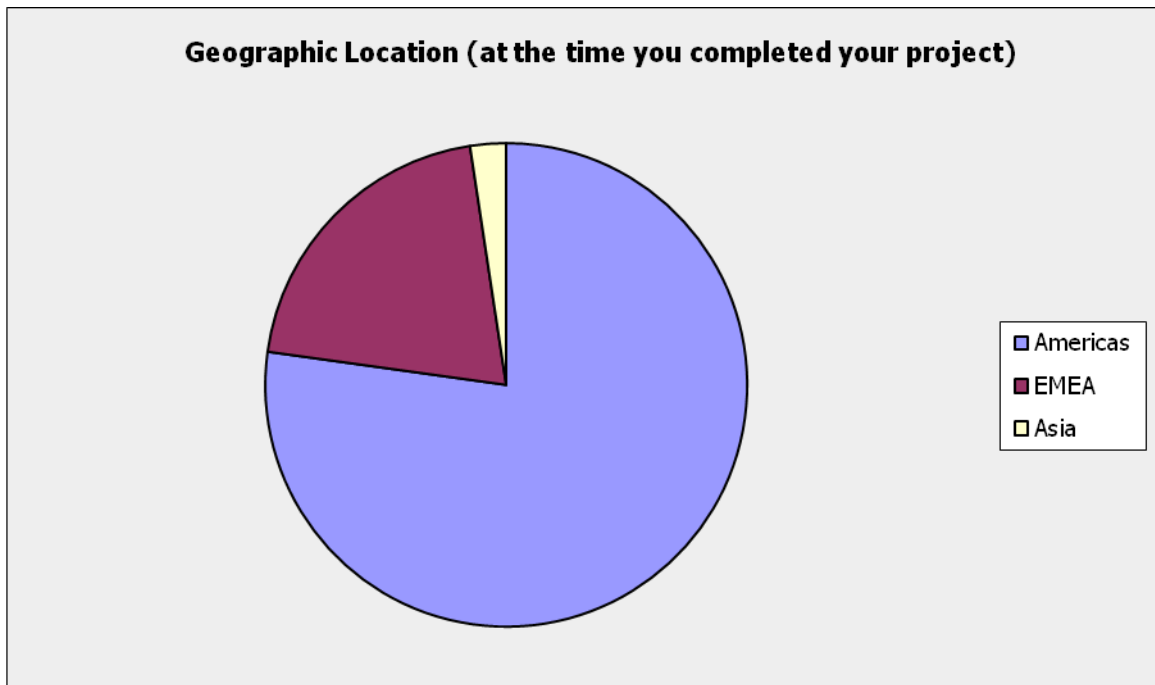| Gender		
Answer Options	**Response Percent**	**Response Count**
Female	11.0%	18
Male	89.0%	146
	answered question	**164**
	skipped question	**10**
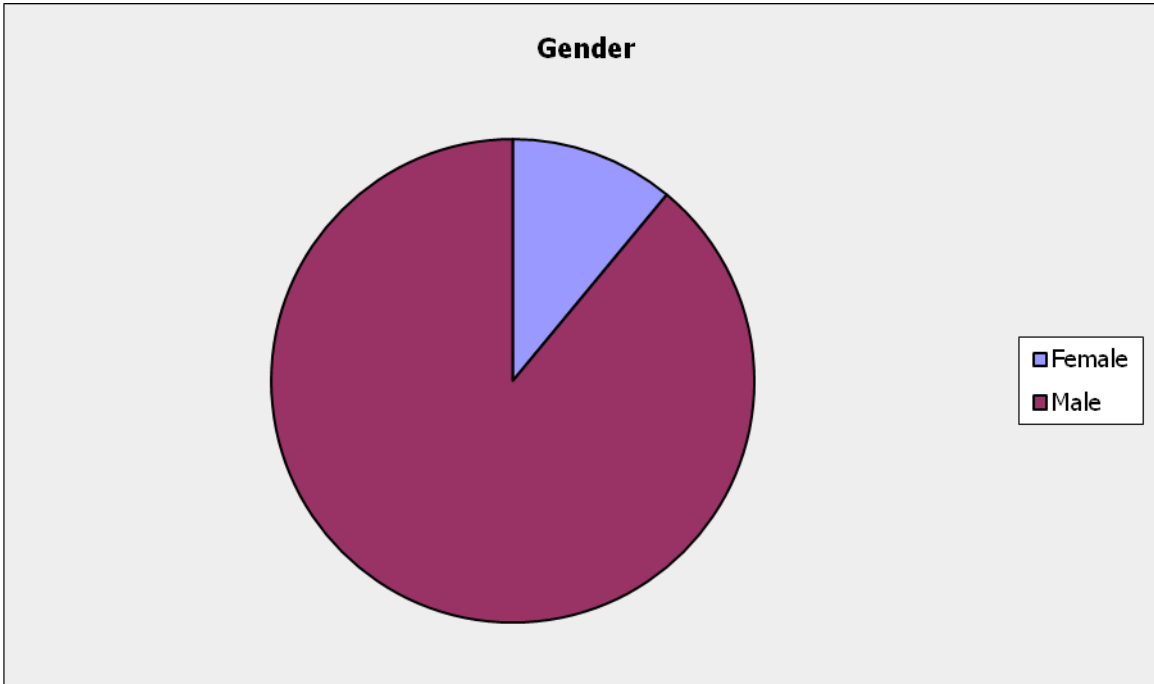
Leadership Trait Questionnaire (LTQ) for Six Sigma Leaders

Age (at time you completed project)

Answer Options	Response Percent	Response Count
18-29	7.3%	12
30-39	37.0%	61
40-49	38.2%	63
50-59	15.2%	25
60-older	2.4%	4
	answered question	165
	skipped question	9



Age (at time you completed project)
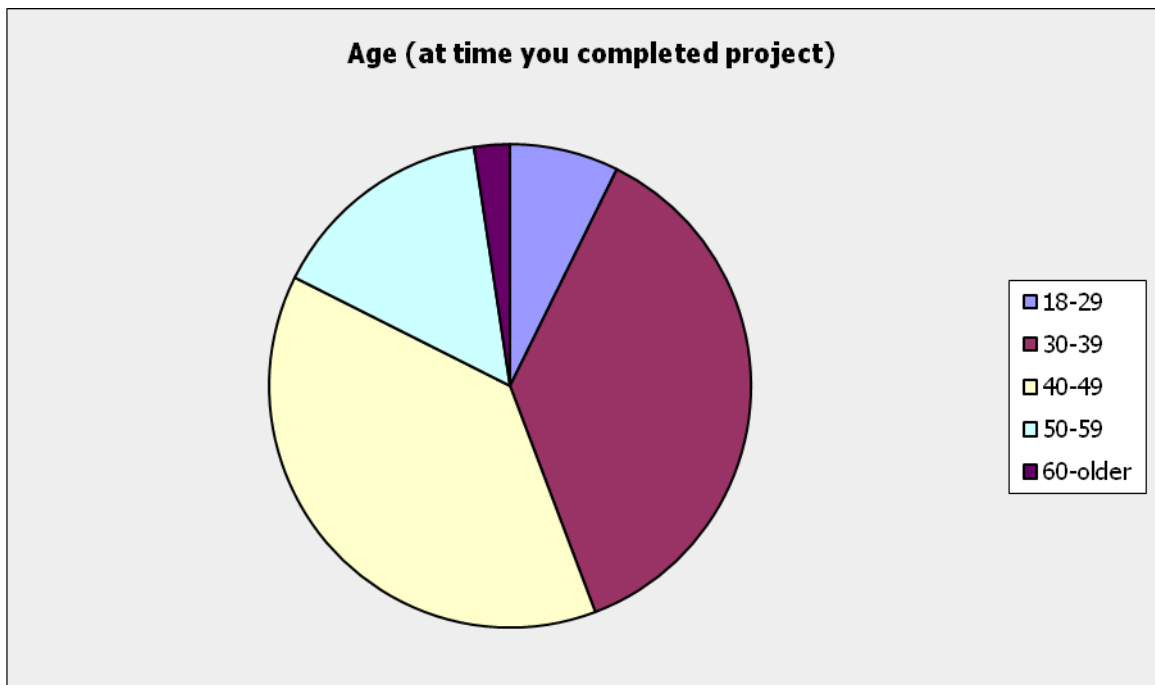
Leadership Trait Questionnaire (LTQ) for Six Sigma Leaders

Geographic Location (at the time you completed your project)

Answer Options	Response Percent	Response Count
Americas	77.2%	129
EMEA	20.4%	34
Asia	2.4%	4
	answered question	167
	skipped question	7

Geographic Location (at the time you completed your project)

Leadership Trait Questionnaire (LTQ) for Six Sigma Leaders

Articulate - Communicates effectively with others

Answer Options	Response Percent	Response Count
Strongly Agree	44.4%	72
Agree	51.9%	84
Neutral	3.7%	6
Disagree	0.0%	0
Strongly Disagree	0.0%	0
	answered question	162
	skipped question	12
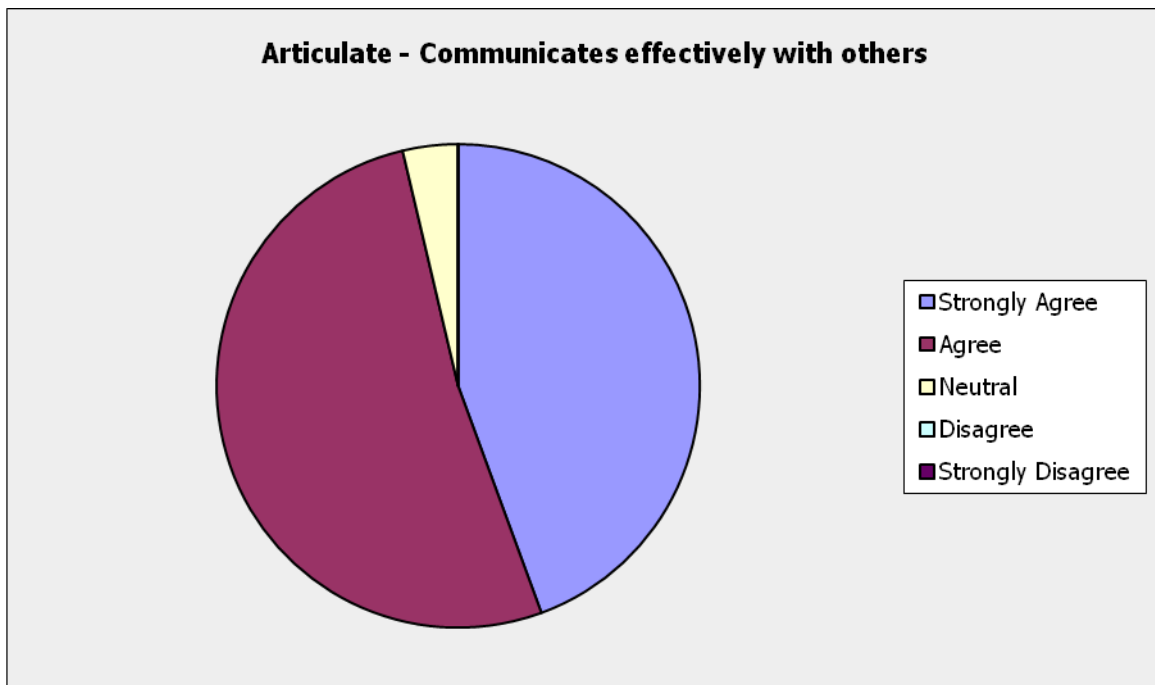
Leadership Trait Questionnaire (LTQ) for Six Sigma Leaders

Perceptive - Discerning and insightful

Answer Options	Response Percent	Response Count
Strongly Agree	34.4%	56
Agree	55.8%	91
Neutral	8.6%	14
Disagree	1.2%	2
Strongly Disagree	0.0%	0
	answered question	**163**
	skipped question	**11**
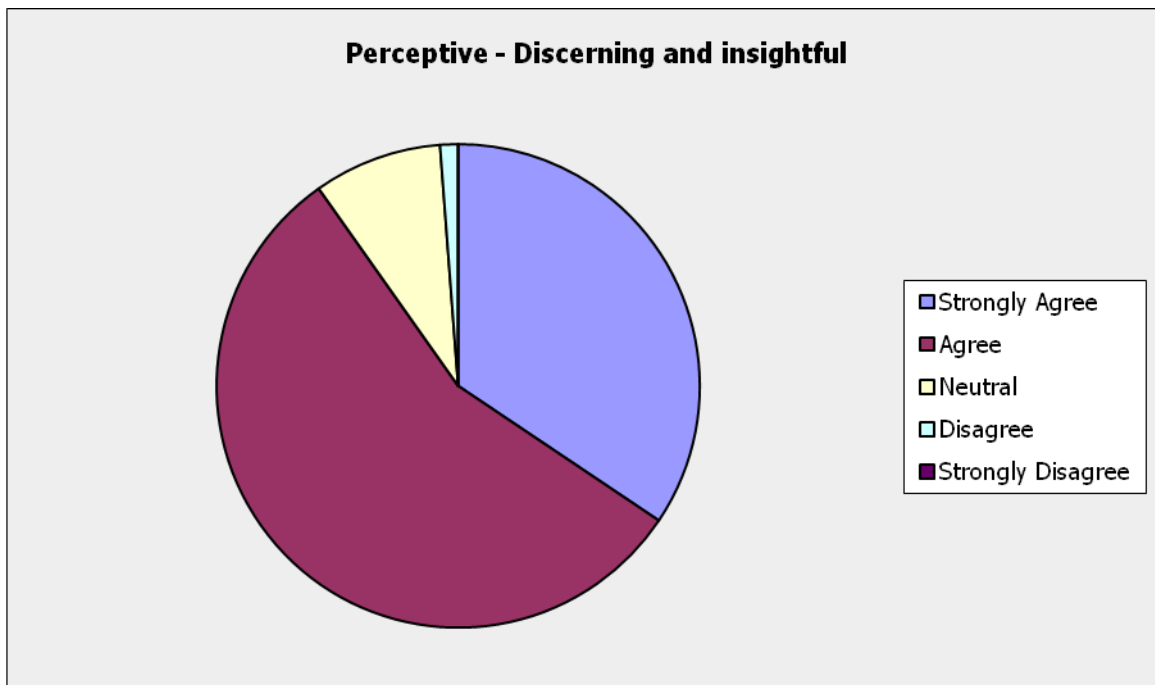
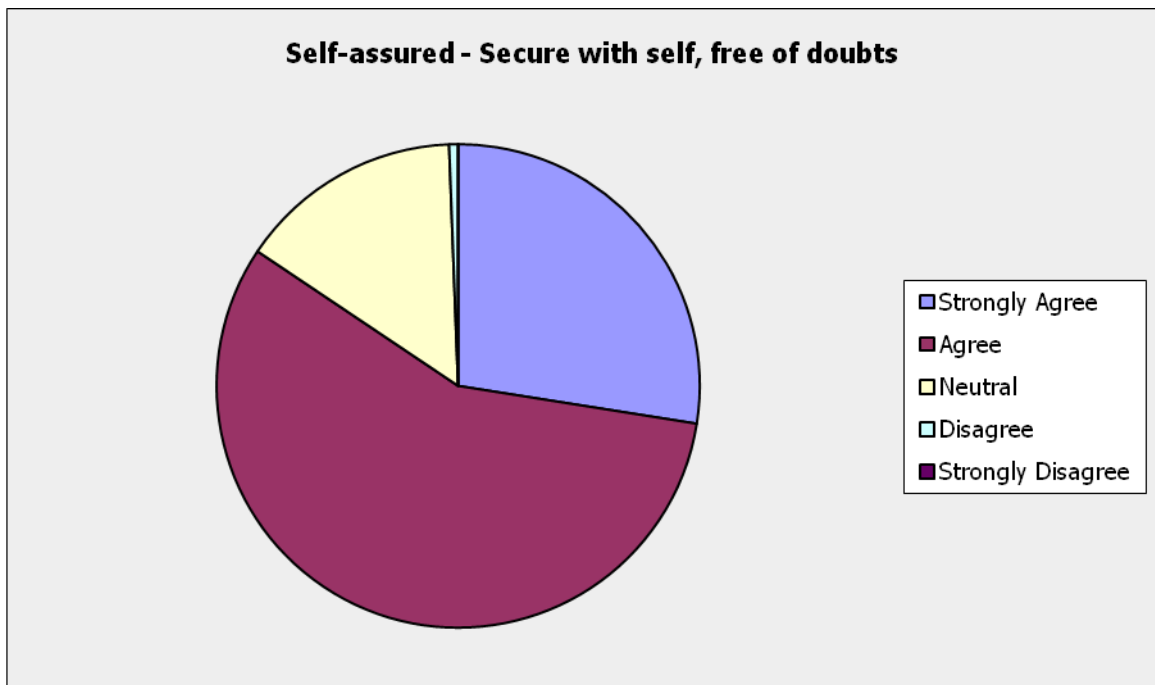# Leadership Trait Questionnaire (LTQ) for Six Sigma Leaders

Self-confident - Believes in oneself and one's ability		
Answer Options	**Response Percent**	**Response Count**
Strongly Agree	38.4%	61
Agree	50.3%	80
Neutral	10.1%	16
Disagree	1.3%	2
Strongly Disagree	0.0%	0
	answered question	**159**
	skipped question	**15**

Self-confident - Believes in oneself and one's ability

- Strongly Agree
- Agree
- Neutral
- Disagree
- Strongly Disagree

Leadership Trait Questionnaire (LTQ) for Six Sigma Leaders

Self-assured - Secure with self, free of doubts

Answer Options	Response Percent	Response Count
Strongly Agree	27.5%	44
Agree	56.9%	91
Neutral	15.0%	24
Disagree	0.6%	1
Strongly Disagree	0.0%	0
	answered question	160
	skipped question	14

Leadership Trait Questionnaire (LTQ) for Six Sigma Leaders

**Persistent - Stays fixed on the goals despite interference**

Answer Options	Response Percent	Response Count
Strongly Agree	44.5%	69
Agree	44.5%	69
Neutral	9.7%	15
Disagree	1.3%	2
Strongly Disagree	0.0%	0
	answered question	155
	skipped question	19

Persistent – Stays fixed on the goals despite interference

□ Strongly Agree
■ Agree
□ Neutral
□ Disagree
■ Strongly Disagree
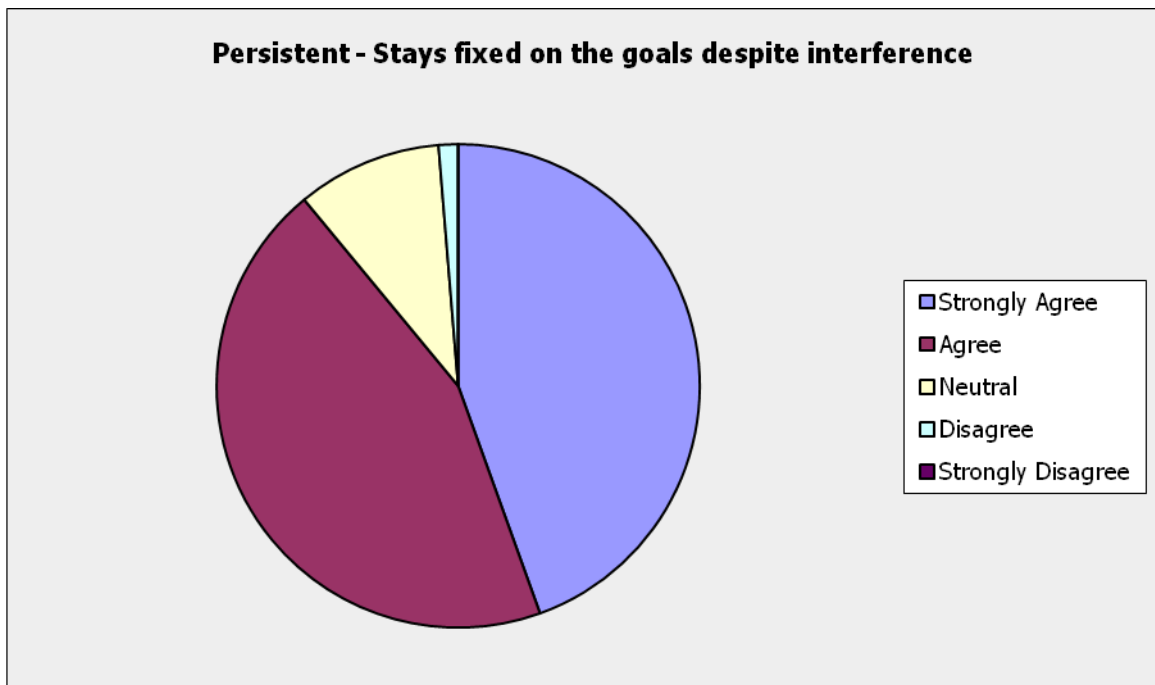
Leadership Trait Questionnaire (LTQ) for Six Sigma Leaders

Determined - Takes a firm stand, acts with certainty		
Answer Options	**Response Percent**	**Response Count**
Strongly Agree	33.8%	53
Agree	50.3%	79
Neutral	14.6%	23
Disagree	1.3%	2
Strongly Disagree	0.0%	0
	answered question	157
	skipped question	17

Determined - Takes a firm stand, acts with certainty
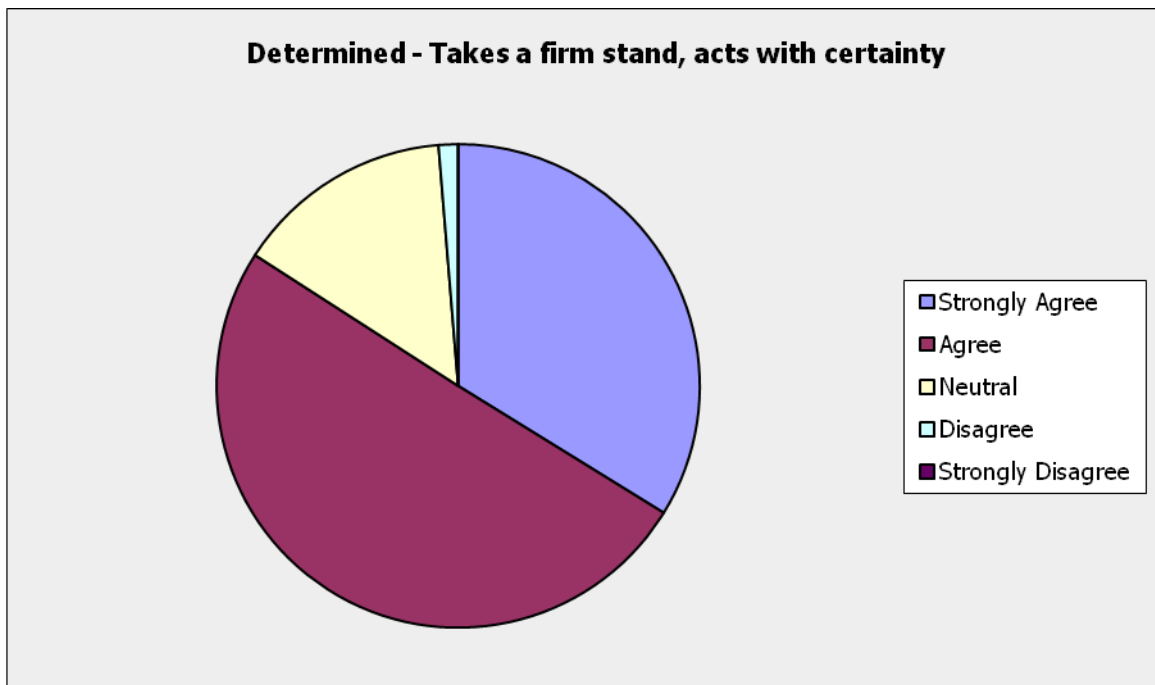
Leadership Trait Questionnaire (LTQ) for Six Sigma Leaders

Trustworthy - Acts believably, inspires confidence

Answer Options	Response Percent	Response Count
Strongly Agree	50.0%	77
Agree	44.2%	68
Neutral	5.8%	9
Disagree	0.0%	0
Strongly Disagree	0.0%	0
answered question		**154**
skipped question		**20**

Trustworthy - Acts believably, inspires confidence

Strongly Agree
Agree
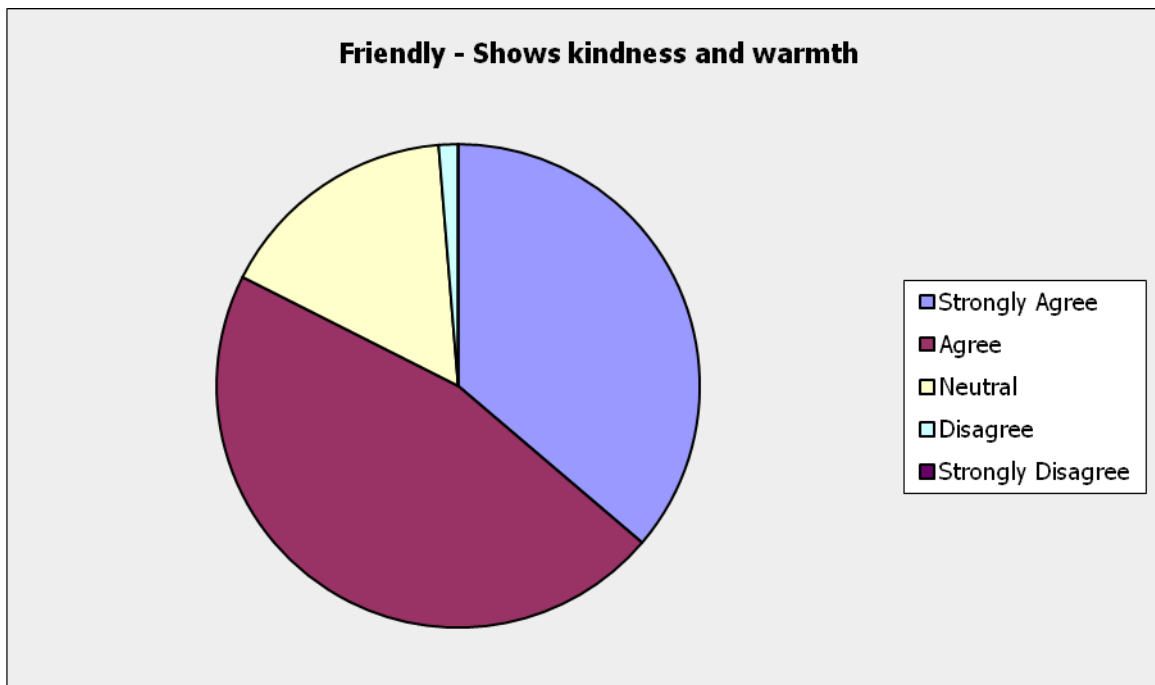Neutral
Disagree
Strongly Disagree
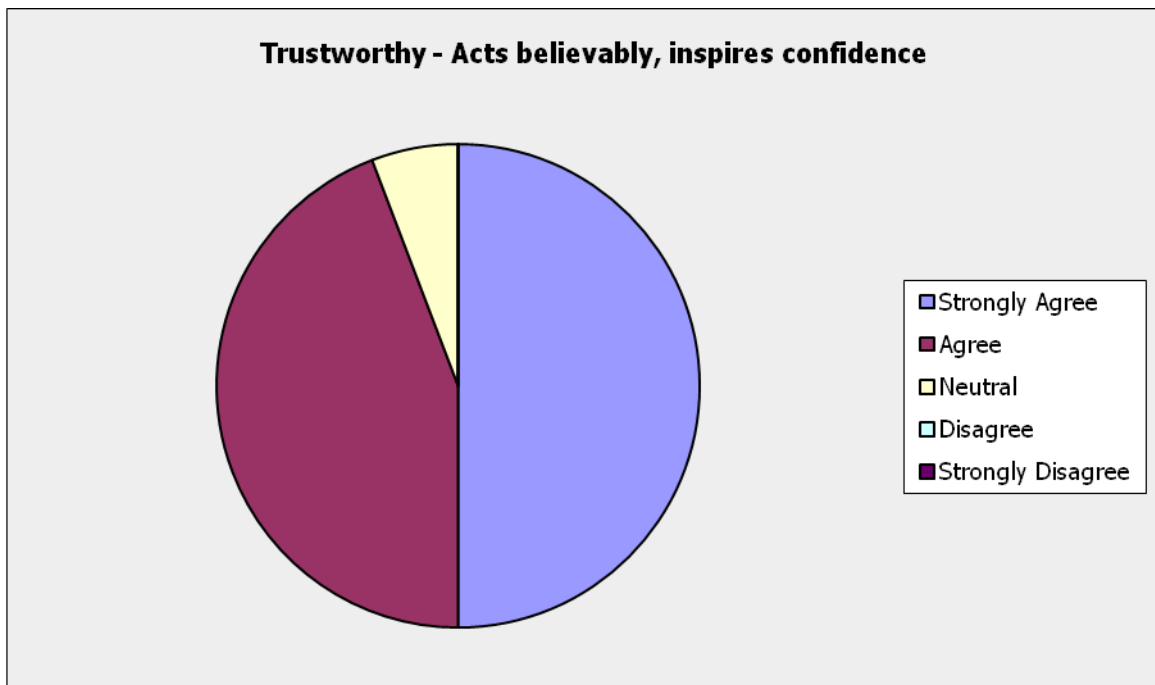
Leadership Trait Questionnaire (LTQ) for Six Sigma Leaders

Dependable - Is consistent and reliable

Answer Options	Response Percent	Response Count
Strongly Agree	50.9%	81
Agree	42.8%	68
Neutral	6.3%	10
Disagree	0.0%	0
Strongly Disagree	0.0%	0
	answered question	**159**
	skipped question	**15**

Dependable - Is consistent and reliable

Strongly Agree
Agree
Neutral
Disagree
Strongly Disagree
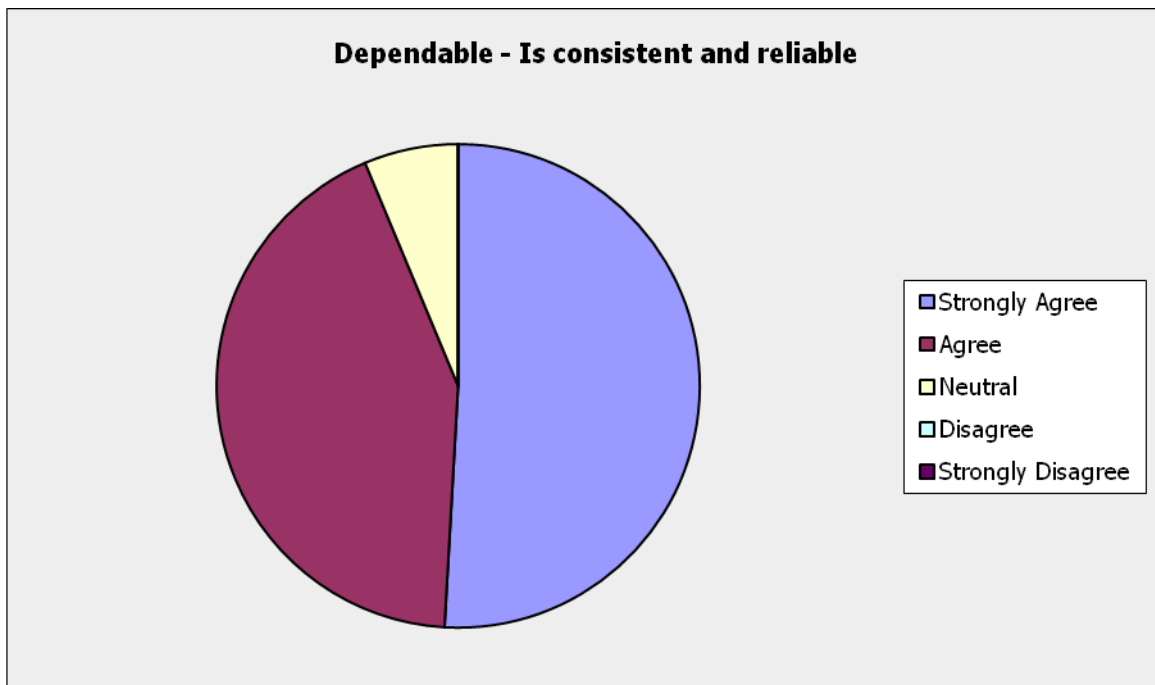
Leadership Trait Questionnaire (LTQ) for Six Sigma Leaders

Friendly - Shows kindness and warmth

Answer Options	Response Percent	Response Count
Strongly Agree	36.3%	58
Agree	46.3%	74
Neutral	16.3%	26
Disagree	1.3%	2
Strongly Disagree	0.0%	0
	answered question	**160**
	skipped question	**14**

Friendly - Shows kindness and warmth

- Strongly Agree
- Agree
- Neutral
- Disagree
- Strongly Disagree

Leadership Trait Questionnaire (LTQ) for Six Sigma Leaders

Outgoing - Talks freely, gets along with others

Answer Options	Response Percent	Response Count
Strongly Agree	42.9%	69
Agree	46.6%	75
Neutral	9.3%	15
Disagree	0.6%	1
Strongly Disagree	0.6%	1
	answered question	161
	skipped question	13