Development of Interpersonal Skills: Theory Building through a Multiple Case Study of Engineers

Ruth Archer, Michigan Technological University

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RUTH A. ARCHER

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by

Ruth A. Archer

Approved by:

Cynthia Loubier-Ricca
Chair: Cynthia Loubier, Ph.D.

December 1, 2016
Date

Subject Matter Expert: Richard Nida, Ph.D.

Methodological Committee Member: Rachel Piferi, Ph.D.

Certified by:

Dean of School: Peter Bemski, Ph.D.

Date

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Abstract

Engineers who are introverts and logic-based decision makers generally lack interpersonal skills. This deficit may inhibit them from moving into managerial leadership positions in the same proportion as extraverts. The research problem was an inadequate understanding about how introverted engineers who are logic-based decision makers develop interpersonal skills. The purpose of this study was to analyze and synthesize the experiences of introverted engineers who are logic-based decision makers on the evolution of their interpersonal skills in the areas of supportive communication, influence, conflict management, and motivating others. A qualitative multiple case study approach was used because of the nature of the proposed research problem and the limited knowledge in this area. Engineers who are introverted and logic-based decision makers were recruited through online groups whose membership is predominately engineers. Six volunteers who met the study criteria were interviewed—three typified the central case and three represented an alternate case. The research identified the process introverted engineers use when applying interpersonal skills. The overall process was very similar for all of the research questions. However, noteworthy differences between the central and alternate cases were observed for the conflict management and motivation research questions. The researcher concluded that a pre-existing knowledge base is fundamental to skill development for introverted engineers. As part of that knowledge base, these engineers need to know reflection, observation, and systems thinking skills. For conflict management skills, a key result was the importance of learning a strategy that keeps conflict focused on evidence. For motivation skills, the implication was that learning how to employ intrinsic rewards is essential. The researcher recommended that
formal training in interpersonal skills be developed for introverted, logic-based engineers. In addition, the researcher recommended that organizations provide network expansion opportunities to build a cohort of coaches, mentors, and peers for their introverted engineers. Future research might look at the components of interpersonal skills training delivery for this audience, the effects of gender on the results, and whether managerial success/effectiveness changes the patterns for applying interpersonal skills.
I wish to thank my family for their support on my academic journey. With them, all things are possible. Glen, you are the light of my life and my inspiration for this journey. Ruthie, you are my spirit, and Geneva, you are my heart. Will and Nathan—my first children, even though you were half grown when we started—I am blessed to be a part of your lives. I am a lucky wife and mother.

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Finally, I would like to remember my parents. They lived in harmony with their values and beliefs, and instilled in me a passion for learning and persistence in overcoming obstacles. I miss them every day.
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Chapter 1: Introduction

Engineers who are introverts and logic-based decision makers generally lack social competence in interpersonal skills like supportive communication, influencing and motivating others, and managing conflict (Joyner, Mann, & Harris, 2012). Engineers with these personality and decision-making preferences are not typically interested in learning how to lead, and they tend to have a negative attitude toward leadership and the usefulness of spending time to develop interpersonal skills (Fulmer & Hanson, 2010; Sansone & Schreiber-Abshire, 2006). This deficit may inhibit them from moving into managerial leadership positions in the same proportion as extraverts. In fact, approximately 96% of all leaders in the United States are extraverted (Grant, Gino, & Hofmann, 2011b). However, introverted leaders are likely to produce better results than extraverted leaders when the tasks employees perform require proactive employees (Grant, Gino, & Hofmann, 2011a). Since engineering projects have a need for proactive employees due to the highly specialized nature of the work and the ethical requirements of engineering design, the need for introverted leaders is strong in this field. Some engineers who are introverts and logic-based decision makers do develop interpersonal skills, and a better understanding of how this happens is needed.

Background

According to the Bureau of Labor Statistics, there are 1.1 million engineers in the United States (Occupational Outlook Handbook, 2012). Of these, approximately 43 percent, or 470,000 are introverted and logic-based (Balsamo, Lauriola, & Saggino, 2012; Felder, Felder, & Dietz, 2002; Joyner et al., 2012; Wankat & Oreovicz, 1992). Engineers with these personality and decision-making preferences are not typically interested in
learning how to lead, and they tend to have a negative attitude toward leadership and the usefulness of spending time to develop interpersonal skills (Fulmer & Hanson, 2010; Sansone & Schreiber-Abshire, 2006). On those occasions when members of this population do choose to lead, people with these personality preferences produced significantly higher profits in an organization, under the right conditions (Grant, Gino, & Hofmann, 2011a). However, through interviews, case studies, and direct observation, it was found that high-tech companies may have a systemic problem extracting leadership behaviors from this group that constitutes a large percentage of their broad engineer employee base (Fulmer & Hanson, 2010; Grant et al., 2011b; Joyner et al., 2012; Robledo, Peterson, & Mumford, 2012; Sansone & Schreiber-Abshire, 2006).

Researchers studying the personalities of leaders have found that people who are extraverts—that is, people who tend to be outgoing and assertive and who enjoy using their interpersonal skills to engage and influence others—are much more likely to become leaders and to be perceived as more effective leaders (Bauer, Erdogan, Liden, & Wayne, 2006; DeRue, Nahrgang, Wellman, & Humphrey, 2011; Grant et al., 2011a). Approximately 96% of leaders in the United States are extraverted (Grant et al., 2011b). In a controlled lab experiment involving teams performing a task, it was observed that employees’ implicit theories of leadership cause them to mentally connect leadership effectiveness with extraversion (Grant et al., 2011a). In addition, in a longitudinal study, Bauer et al. (2006) found that extraverts received higher performance ratings and further suggested that organizations should test for extraversion in their selection process. As an alternative to excluding introverts when hiring employees, they recommended that introverts receive training on how to develop effective interpersonal relationships.
It may be possible to better understand the development of interpersonal skills and support introverted, logic-based decision-making engineers who are interested in becoming leaders (Avolio, Reichard, Hannah, Walumbwa, & Chan, 2009; Avolio, Walumbwa, & Weber, 2009). An introvert, as described by Quenk (2009), Myers (1998), and Keirsey and Bates (1984), is an individual who is self-contained, reflective, and quiet. Introverts prefer solitude and solitary activities. Quenk explained that most introverts lose energy when they are around large numbers of people and recharge when they are alone. They do enjoy time with a small number of friends, but they generally do not seek interactions with new people. An introverted person may not fully develop essential leadership interpersonal skills like supportive communication, influence, conflict management, and motivating others because they do not receive much practice—they systematically choose not to interact with others. Introverts who are also logic-based decision makers compound the interpersonal interaction weakness because people with this decision preference are likely to use logic and analysis to make decisions; they tend to prefer to work alone, and they focus on the task instead of the people who will carry out the task. Introverts could be trained to act more like extraverts (Grant et al., 2011a), but it is possible that this line of thought discourages introverts and prevents them from pursuing leadership positions because it involves the continuous use of a nonpreferred personality preference, which is uncomfortable and tiring (Myers, 1998). In a mixed method, survey/interview study, it was found that when people encounter leadership development challenges that overwhelm their abilities, their development level actually decreases (DeRue & Wellman, 2009). An example of this may be when introverted engineers who are logic-based decision makers find themselves in a situation where they
need to use undeveloped interpersonal skills and then do not have a successful interaction. Implicit leadership models would then predict that their self-identification as a leader was disaffirmed and they would be less likely to even try to be a leader again (Ely, Ibarra, & Kolb, 2011).

The consequence of introverted engineers failing to make the transition into leadership positions may be costing the U.S. economy $142 billion or more per year (Grant et al., 2011a; Kim, Lindberg, & Monaldo, 2009; Lee & Schmidt, 2010). In a pair of studies, Grant et al. (2011a) found that measured profits for proactive employees supervised by extraverted leaders were 12 to 18 percent lower as compared to the profits of proactive employees supervised by introverted leaders. If these inefficiencies cause only a five percent increase in the cost of engineering projects, the overall cost to the United States economy is very high. Several U.S. industries like scientific and technical services, manufacturing, and research and development, depend on engineers. These industries together contribute about $2,846 billion to the U.S. economy (Kim et al., 2009; Lee & Schmidt, 2010). Five percent of $2,846 billion is $142 billion, or one percent of the U.S. Gross Domestic Product.

Statement of the Problem

Engineers who are introverted and logic-based decision makers constitute a large share of the engineering population, but are usually not in leadership positions. However, introverted leaders are likely to produce better results than extraverted leaders when the tasks employees perform require proactive employees (Grant et al., 2011a). Because they seem less receptive to proactivity, extraverted leaders often create inefficiencies by stifling their employees’ proactive behaviors, such as their willingness to make
suggestions, their initiative to improve projects, and their attempts to exert upward pressure to make process changes (Grant et al., 2011a). These inefficiencies may decrease profits (Grant et al., 2011a). In general, engineering projects need proactive employees; due to the high level of expertise engineers bring to a project, the manager often does not know how to perform the individual pieces of a project, nor how the pieces fit together. Additionally, engineering projects often affect the safety, health, or welfare of the public, to the extent that the National Society of Professional Engineers requires engineers to be proactive as part of their code of ethics (National Society of Professional Engineers, 2015).

A better understanding of the vital leadership constructs of interpersonal skills in the areas of supportive communication, influence, conflict management, and motivating others, as they apply to introverts who are logic-based decision makers, may support more leader emergence in this population (Crumpton-Young et al., 2010). These personality preferences are distinct from interpersonal behavioral skills. It is entirely possible for both introverts and extraverts to employ interpersonal skills comfortably; introverts do not need to switch to a nonpreferred personality preference in order to do so (Myers, 1998). According to Avolio (2011) and Farr and Brazil’s observations (2009), leadership ability is in large part a result of the experiences a person chooses as an adult. Because of the organizational need and the limited research on this target population, several researchers recommend more research be performed on how interpersonal skills develop in this population (Crumpton-Young et al., 2010; Farr & Brazil, 2009; Robledo et al., 2012; Sansone & Schreiber-Abshire, 2006; Vie, 2012). The specific problem is an inadequate understanding about how introverted engineers who are logic-based decision
makers develop interpersonal skills.

**Purpose of the Study**

The purpose of this qualitative multiple case study was to analyze and synthesize the experiences of introverted, logic-based engineer leaders on the evolution of their interpersonal skills in the areas of (a) supportive communication, (b) influence, (c) conflict management, and (d) motivating others (Whetten & Cameron, 2011). Some researchers posit that interpersonal skills may be more difficult for introverts to learn, but do not offer specific solutions (Hunt & Baruch, 2003). Leadership development that supports introverted people may enhance logic-based introverts’ willingness to pursue becoming leaders, which might increase their influence at the managerial level and have a positive effect on the engineering profession according to some researchers (Crumpton-Young et al., 2010). For the research, participants were selected and interviewed on the evolution of their interpersonal skills using an interview protocol, as seen in Appendix A. Collection of interview responses was concluded when theoretical replication was achieved or upon data saturation (Yin, 2014). Participants were sought through passive recruitment utilizing notices in LinkedIn groups whose membership is predominantly engineers, like the Tau Beta Pi Engineering Honor Society, Engineering Society of Detroit, and ASQ—The American Society for Quality groups. A small incentive was offered for participating in the study. Potential participants were selected from a pool of volunteers based on the personality preferences of introversion and logic-based decision making as determined by the participant’s self-identified personality and decision preferences, and whether or not the prospective participant had supervisory experience, and whether or not the prospective participant is interested in being a leader. The
participants’ personality and decision preferences were confirmed through the administration of the Myers-Briggs Type Indicator (MBTI) survey instrument. The interview data for each case was analyzed, and then a cross-case review was performed to find converging patterns and relationships.

**Theoretical Framework**

The theoretical framework for this research concentrates on the field of leadership development. Leadership development theory is part of a larger system of theories about leaders. In early leader research, from the late 1800s to the mid-1940s, researchers believed leaders were people who were born with certain personality traits and temperaments (DeRue et al., 2011; Nahavandi, 2012). These traits were grouped into three areas: demographics, task competence, and interpersonal attributes. However, studies done during this time did not result in a common set of leader traits and it became evident that leadership could not be studied in isolation from the context.

From the mid-1940s to the early 1970s, and continuing at a lower level today, the prevalent theories focused on the behaviors of leaders. Researchers grouped behaviors into task-, relationship-, and change-oriented categories (DeRue et al., 2011; Nahavandi, 2012; Pinnington, 2011). According to Nahavandi (2012), task behaviors are providing structure, controlling, and supervising; relationship behaviors are obtaining resources, removing obstacles, encouraging, and coaching; and change-oriented behaviors are setting a vision and supporting new behaviors. However, behavioral theories also fell short because they did not include the system within which the leader worked.

Beginning in the 1960s, contingency theories were developed to account for more of the complex nature of the leader system. In contingency theory, the leader's experience
and innate traits, the task that must be performed, and the environment that surrounds the task are all part of a leadership situation (Nahavandi, 2012). DeRue et al. (2011) proposed an integrative theory that attempted to merge trait and behavioral theory. Their research was comprised of a meta-analytic review of 59 studies. They found that together, these theories only accounted for about 31% of leadership effectiveness, with behavioral theories having a greater impact on the outcome. In the early 2000s, the study of leadership continued to evolve. Recent theories focus on the relationship the leader develops with followers, the development of a leader's psychological resources and the ability of the leader to communicate ideas and vision (Avolio, Walumbwa, & Weber, 2009). The authors examined the literature for several current models in the field of leadership studies, including authentic leadership, implicit leadership theory, and complexity leadership. Behavior and contingency theories focus on leader-follower interactions as the basis for effective leadership. They describe what an effective leader-follower relationship should look like but lack the ability to operationalize the description and have a poor connection to measurable outcomes like morale, satisfaction, and productivity (Northouse, 2016).

In 2000, a team of researchers proposed a model based on capabilities (skills and knowledge) (Mumford, Zaccaro, Harding, Jacobs, & Fleishman, 2000). A focus on skills over behaviors puts the emphasis on people’s ability to improve their leadership and shifts the focus from the people, with their complex mix of personality, skills, traits, and experiences, to the skills people need to develop to become good leaders (Mumford, Campion, & Morgeson, 2007). In the leadership skills theory, leaders have problem-solving skills, social judgement skills, and social skills (Mumford, Zaccaro, Harding, et
al, 2000). Problem solving skills involve identifying the problem, understanding the root causes of the issue, and developing potential solutions. Social judgment skills relate to the selection of a solution considering all of the constraints of the organizational structure, like resources and time, and then implementing it. Social skills are the interpersonal skills that leaders need as they motivate others during the implementation, like conflict management, influence, and coaching. Tightly coupled with these skills is knowledge of the organization. This knowledge relates to the organization’s systems, processes, and people. These core skills and organizational knowledge must all be present in some degree for a leader to function effectively. For example, problem solving may be difficult if a leader does not have basic knowledge about the organization’s operations.

The leadership skills theory has a few unresolved criticisms. For most people, knowledge and skills are developed over time through education and experience, taking seven to ten years to achieve expert levels (Mumford et al., 2000). Because it can be learned, leadership potential resides in most individuals. However, a person’s personality can affect their choices of which experiences to engage and which to avoid. This can result in significant delays and deficiencies in the development of requisite skills. Extraversion is strongly correlated to effectiveness using the skills model, but the reason why is unclear (Mumford, Zaccaro, Johnson, et al., 2000). In addition, this potential dependency on personality traits seems to contradict the basic premise of the theory (Northouse, 2016). Further, this theory has only been validated across a narrow range of organizational contexts, so it is uncertain if the results can be generalized (Northouse, 2016). A final complication that is an inherent part of any leadership theory is that it developed from multiple disciplines—for example, sociology, psychology, and
economics—and these disciplines all use different research methodologies with different theoretical priorities (Polzer, Gulati, Khurana, & Tushman, 2009).

Research in the area of leadership skills development can provide guidance to practitioners in the field of leadership development. Relevance occurs when the research in a field serves the major constituents in that field—in this case, managers (Palmer, Dick, & Freiburger, 2009). To remain relevant, research of organizational theories must move toward managerial practice (Corley & Gioia, 2011; Miller, Greenwood, & Prakash, 2009). This more practical research should cover the full range on a continuum from purely cognitive implications (know, recognize, learn) on one end to actionable ones (change procedures, redesign, or restructure) on the other end, with training in the center of the continuum as both a cognitive and action-oriented event (Bartunek & Rynes, 2010). Leadership skills theory provides a structure for creating curricula for leadership education and development (Northouse, 2016).

Research in the area of leadership skills development added to the body of knowledge in this field by extending existing theory and contributing to a theoretical framework for how introverted, logic-based decision makers develop interpersonal skills. Mumford, Zaccaro, Connelly, and Marks (2000) suggest that the leadership skills theory will supplement and extend leadership theories like transformational leadership, charismatic leadership, path-goal theory, and leader-member exchange theory. Avolio, Walumbwa, et al. (2009) suggested a future area of leadership development research might focus on how the category people place themselves in as a leader, for example introverted or extraverted, impacts the influence techniques they use with others. Avolio, Reichard, et al. (2009) suggested future research explore gender and nationality
differences, as subgroups with distinct and identifiable characteristics, in leadership outcomes. These subgroups could also be applied to engineers. Robledo et al. (2012), along with others (Crumpton-Young et al., 2010; Farr & Brazil, 2009; Sansone & Schreiber-Abshire, 2006; Vie, 2012), have declared that the leadership of scientists and engineers is not adequately accounted for in existing leadership models.

**Research Questions**

The research questions in this study added to the body of knowledge in this field by extending existing theory and contributing to a theoretical framework for how introverted, logic-based decision makers develop interpersonal skills. Specifically, the interpersonal skills of supportive communication, influence, conflict management, and motivating others were investigated. These skills are important for effective leadership (Baldwin, Bommer, & Rubin, 2013; Whetten & Cameron, 2011; Yukl, 2012).

Using these research questions, the thoughts and feelings of the target population about interpersonal skills development were sought to understand how introverted engineers who are logic-based decision makers develop leadership skills on the job. Current research in leadership development models suggests there may be a way to modify content or delivery to enhance the knowledge, ability, and attitude outcomes for the target population. The research questions extended leadership development theory by looking for patterns in the development of these essential interpersonal skills.

**Q1.** How did engineers who are introverted and logic-based decision makers develop interpersonal supportive communication skills?

**Q2.** How did engineers who are introverted and logic-based decision makers develop interpersonal influence skills?
**Q3.** How did engineers who are introverted and logic-based decision makers develop interpersonal conflict management skills?

**Q4.** How did engineers who are introverted and logic-based decision makers develop interpersonal skills in motivating others?

**Nature of the Study**

This research was conducted using a multiple case study method. A multiple case study approach is an appropriate fit for “how” or “why” research questions that require an in-depth description of contemporary behavioral events the researcher has little or no control over (Yin, 2014). According to Yin (2014) and Zikmund, Babin, Carr and Griffin (2010), case studies are a carefully recorded exploration of the phenomena under study, within its real-world context. Researchers investigate the subject, document as much detail as they are able to discern, and explore any aspect of a phenomenon that seems relevant (Zikmund et al., 2010). This allows researchers to pursue relationships as they discover them. In addition, researchers may make unusual, non-intuitive, or creative connections among data because they are able to build an over-arching picture from the details they uncover.

The multiple case study approach was used to build theory inductively. Existing research does not address the research questions, and there is a strong organizational need for this information. In this situation, both Yin (2014) and Eisenhardt and Graebner (2007) recommend that multiple cases be studied to create the conditions for replication of the findings. To build theory, the cases were chosen to demonstrate convergent results. The unit of analysis for the study was the individual engineer, and conclusions for each case were compared to the others until a subset of convergent conclusions was found. If
the results did not converge or were contradictory, more cases were selected until a subset of the findings could be replicated.

The target population for this study was engineers who are introverted and logic-based decision makers. Replication logic was used to select potential research participants. Replication logic entails selecting participants based on the desired profile developed by the researcher (Yin, 2014). For the research, participants were selected from a pool of volunteers based on the personality preferences of introversion and logic-based decision making as determined by the participant’s self-identified personality and decision preferences, and whether or not the prospective participant had supervisory experience and was interested in being a leader.

It is through in-depth interviews that insights were gained into the research problem. Research participants responded to interview questions. The initial interview protocol can be found in Appendix A. The initial interview protocol was refined in response to field testing and emergent questions during interviews.

The cases were analyzed and synthesized to find converging patterns and relationships from which conclusions could be drawn and theory built. The multiple case study analysis began with a detailed description of each case and the themes of that case in a case study report, which was followed by a cross-case analysis, and then an interpretation of the meaning of the cross-case analysis (Yin, 2014). The cross-case analysis allowed generalized findings and generated theory (Burns, 2010; Eisenhardt & Graebner, 2007; Yin, 2014).
Significance of the Study

This research can contribute to the field of leadership development in several ways. The research extended leadership development theory by looking for patterns in the development of essential interpersonal skills for engineers who are introverted and logic-based decision makers. Another way this research contributed to the field is that it discovered and defined concepts or relationships that need further research. Finally, it can guide the activities of people who are practitioners in the theory’s domain. Corley and Gioia (2011) believe this should be the dominant goal of a theoretical contribution. Managers may be able to develop leadership development programs that support and enhance logic-based introverts’ willingness to pursue becoming leaders, which might increase their influence at the managerial level and have a positive effect on the engineering profession (Crumpton-Young et al., 2010).

Definition of Key Terms

The following terms were used in this study.

**Conflict Management.** Conflict management enables employees to resolve disagreements about the best use of resources in the most efficient manner without creating anger and resentment. Effective managers know and use five conflict management strategies, which depend on the importance of the issue and the importance of the relationship. The strategies are competing, avoiding, compromising, accommodating, and collaborating (Whetten & Cameron, 2011).

**Extravert.** Extraverts are people who tend to be outgoing, assertive, and talkative. They are energized by interacting with other people and they tend to seek leadership opportunities (Grant et al., 2011a). A subset of the items on the MBTI survey
instrument is designed to reflect the presence of an extravert or introvert personality preference (Quenk, 2009). Quenk (2009) explains that if the majority of the items a person chooses indicate an extravert preference, the person is considered to have an extravert personality preference. Further information is provided by a “clarity of reported preference” index, which ranges from “Slight” to “Very Clear” and depends on the ratio of extravert to introvert answers.

**Interpersonal Skills.** Interpersonal skills are those skills that smooth the interactions between people in a relationship. Since leadership is inherently a relational activity, good interpersonal skills are essential (DeRue & Ashford, 2010). Important interpersonal skills are supportive communication, influence, conflict management, and motivating others (Whetten & Cameron, 2011).

**Influence.** In a work setting, influence is the ability to get other people to accomplish a desired goal using personal and position power. The three strategies for influencing others are retribution, reciprocity, and reason (Whetten & Cameron, 2011).

**Introvert.** An introvert is a person who prefers solitude and solitary activities and gains energy from this state. Being around other people is an energy drain for introverts (Myers, 1998; Quenk, 2009). A subset of the items on the MBTI survey instrument is designed to reflect the presence of an extravert or introvert personality preference (Quenk, 2009). Quenk (2009) explains that if the majority of the items a person chooses indicate an introvert preference, the person is considered to have an introvert personality preference. Further information is provided by a “clarity of reported preference” index, which ranges from “Slight” to “Very Clear” and depends on the ratio of extravert to introvert answers.
**Leadership development.** Also known as leadership intervention, leadership development is training with the specific intent of developing the leadership ability of an individual (Avolio, 2011). This training could be readings, workbooks, events, workshops, experiences, feedback, self-reflection, or other activities (Kets de Vries & Korotov, 2011). During leadership development, the leader receives new knowledge and experiences and learns better ways to assess the task and the environment. Whetten and Cameron (2011) grouped leadership development into three major areas: personal skills, interpersonal skills, and group skills. Personal skills and behaviors include self-awareness and managing stress. Interpersonal skills consist of supportive communication, power and influence, motivation, and conflict management. Personal and interpersonal skills are also components of emotional intelligence, which is a set of competencies that relate to self-leadership and how people manage emotions—their own and those of the people around them (Polychroniou, 2009); emotional intelligence is positively associated with team effectiveness. The third major area of leadership development is group skills, consisting of empowerment, teams, and change management.

**Logic-based decision makers (Thinkers).** Logic-based decision makers make decisions based on facts and evidence, as opposed to making decisions based on understanding the impact on others (Myers, 1998, Quenk, 2009). Both types of decision making are considered rational. On the MBTI survey instrument, logic-based decision makers are “Thinkers” and those who make decisions based on understanding the impact on others are “Feelers” (Quenk, 2009).

**Motivate others.** The ability to motivate others increases employees’ desire and commitment to accomplish work tasks. There are six elements in an effective motivation
program: establish goals, remove obstacles, reinforce performance-enhancing behavior, provide salient incentives, distribute rewards fairly, and provide timely rewards and feedback (Whetten & Cameron, 2011).

**Personality preferences.** People have psychological personality preferences in areas like interacting with other people, gathering information, and making decisions. The preferences are neither right nor wrong, and people have the ability, though often not the desire, to function using their non-preferred modes (Kiersey & Bates, 1984; Myers, 1998; Quenk, 2009).

**Supportive communication.** At work, supportive communication is verbal interaction between employees that preserve and sustain the relationship while still delivering the intended message to the other person, even when that message is negative (e.g., when correcting behavior or delivering negative feedback). Supportive communication has several attributes; it is descriptive, problem oriented, specific, owned by the sender, and it requires the use of active listening (Whetten & Cameron, 2011).

**Summary**

Introverted engineers who are logic-based decision makers have the potential to be powerful, effective leaders in their organizations. Research shows they are likely to produce better results than extraverted leaders when the tasks employees perform require proactive employees (Grant, Gino, & Hofmann, 2011a). Since engineering projects have a need for proactive employees due to the highly specialized nature of the work and the ethical requirements of engineering design, the need for introverted leaders is strong in this field. Currently, most of the engineers with these personality preferences are not participating in leadership activities. A better understanding of how they develop
interpersonal skills in the areas of supportive communication, influence, conflict management, and motivating others is essential to the leadership development of this population. The purpose of this study was to analyze and synthesize the experiences of engineers with these personality preferences.

Participants were sought through passive recruitment utilizing notices in social media like LinkedIn, targeting groups whose membership is predominantly engineers. Potential participants were selected from a pool of volunteers based on the personality preferences of introversion and logic-based decision making as determined by the participant’s self-identified personality and decision preferences, and whether the prospective participant had supervisory experience and was interested in being a leader. Selected participants were interviewed on the evolution of their interpersonal skills using an interview protocol. The interview data for each case was analyzed, and then a cross-case review was performed to find converging patterns and relationships.
Chapter 2: Literature Review

Competent leaders are essential to organizational success. The field of leadership development is based on evidence which shows that leaders are made, not born (Arvey, Rotundo, Johnson, Zhang, & McGue, 2006; McCall, 2010). Arvey et al. (2006) performed a study on twins to investigate the impact of genetics on a person's willingness to assume a leadership role. The researchers found environmental factors accounted for 70 percent of the variance in leadership emergence. They concluded that a person's upbringing and work experience were the deciding factors in leadership emergence over time.

Leadership development in organizations is a systematic way to create an internalized, positive change in appropriate leader knowledge, skills, abilities, and attributes which is employed during relevant situations (Hannah & Avolio, 2010). A person can choose to engage in leadership development, which may increase their leadership ability. Leadership development has been shown to be effective (Avolio, Reichard, et al., 2009). Overall, people who experienced a leadership development program were twice as likely to experience a positive outcome, such as improved performance, effectiveness, or satisfaction.

Leadership development targets leadership skills that are shared by effective leaders (Baldwin et al., 2013; Whetten & Cameron, 2011). It is significant that the essential attributes of competent leaders are skills, because skills are behavioral and can be learned. Effective skill performance can be distilled into an identifiable set of actions that can be taught to and practiced by people who desire to improve their leadership skills (Whetten & Cameron, 2011). Learning one of the skills can reinforce others, because
there are some positive interrelationships. For example, learning how to motivate others entails the use of supportive communication and influence.

In this literature review, leadership development theory is described and the lack of consensus regarding leadership development programs is explored. Then, four essential leadership skills—the interpersonal skills of supportive communication, influence, conflict management, and motivating others—are described. The importance of each skill is highlighted, followed by the attributes of that skill. Finally, the means to develop these interpersonal skills is explored.

**Documentation**

This literature review is based on articles from peer reviewed journals. The search strategy for this review of literature began with multiple, iterative searches in Northcentral University library databases like ProQuest, EBSCOHost, SAGE Knowledge, ScienceDirect, Gale Academic OneFile, and Google Scholar. Keywords and phrases used included engineer or STEM, research and development, R&D, research organization, scientific leadership, technical leaders, leadership development, leadership intervention, introvert or introversion, leadership skills, leadership behaviors, interpersonal skills, and communication skills. More research was found by tracking backwards through the references of relevant studies and tracking forward through the “cited by” feature on ProQuest and Google Scholar. Additional studies were found by going directly to a specific journal when it was seen that several studies were sourcing from the same journal or if the purpose of the journal was relevant to the purpose of this study. For these journals, the articles in each issue were systematically reviewed for the last several volumes. This strategy was followed until saturation was reached. Books by authors
containing seminal knowledge in leadership development and research methods also were referenced.

**Leadership Development**

The most recent theories of leadership focus on the relationship the leader develops with followers, the development of a leader's psychological resources, and the ability of the leader to communicate ideas and vision (Avolio, 2011; Avolio, Walumbwa, et al., 2009; Pinnington, 2011). These were areas in which organizations believed they could provide training for their employees effectively and efficiently, and leadership development programs became established elements of the succession planning for large companies (Latham, 1988). The new organizational approach was to produce more leaders through leadership development instead of trying to find and hire more leaders (Kets de Vries & Korotov, 2011).

Leadership development theory is a relatively young field that revolves around how to develop the self and social awareness of current and potential leaders (Schyns, Kiefer, Kerschreiter, & Tymon, 2011) in the areas of individual performance and relationships with groups and the organization (DeRue et al., 2011). Another characterization of leadership development is training with the specific intent of developing the leadership ability of an individual, which is also known as leadership intervention (Avolio, 2011). During leadership development, the leader receives new knowledge and experiences and learns better ways to assess the task and the environment. Another description is that leadership development is the altering of affective, cognitive, or behavioral abilities to improve knowledge, expertise, or performance in organizations (Avolio, Reichard, et al., 2009). A fourth meaning is an internalized, positive change in
appropriate leader knowledge, skills, abilities, and attributes which are employed during relevant situations (Hannah & Avolio, 2010). Other descriptions emphasize that an essential element of leadership development is some sort of experience, in addition to the other components (DeRue & Wellman, 2009; Dragoni, Tesluk, Russell, & Oh, 2009; McCall, 2010; Schyns et al., 2011). There is little consensus on what form this experience should take. Leadership development can be effective (Avolio, Reichard, et al., 2009).

Leadership development theory is a relatively young field. During leadership development, the leader receives new knowledge and experiences, learning better ways to assess and interact with the people who will perform a task in a given environment. Researchers agree that relatively little research had been done in the area of leadership development compared to the leadership field in general (Avolio, Walumbwa, et al., 2009; Kets de Vries & Korotov, 2011; Murphy & Riggio, 2011). At the time of their research, Avolio, Walumbwa, et al. (2009) found fewer than 70 studies focused on developing leaders, and they found no models or evidence-based research. The authors concluded that the field still has many opportunities for basic research.

**Leadership Development Program Design**

There is no theoretical consensus on how a leadership development program should be designed (Allen, Miguel, & Martin, 2014). Even casual reading of the literature reveals differing opinions on the important elements of a leader development model, several of which are described below (Avolio, Walumbwa, et al., 2009; Farr & Brazil, 2009; Fulmer & Hanson, 2010; Hotho & Dowling, 2010; Sansone & Schreiber-Abshire, 2006; Whetten & Cameron, 2011). Complicating matters, individuals enter a leadership development program with a unique set of genetics and previous experiences (Farr &
Brazil, 2009). In addition, before they even engage in leadership development, trainees already have an implicit concept of what a leader is in their mind. Schyns et al. (2011) explained that everything that happens when a person interacts with a leader is interpreted using the implicit concept. The ability to take on a leader identity easily depends on the implicit theory matching the person’s self-concept. The authors proposed that leadership development programs should begin by making this concept explicit. This makes cognitive room for learning new information about leaders.

A well-constructed program can increase the individual's capacity in the leadership arena, meeting them where they are upon entry and carrying them forward to a new (but not predetermined) level, according to Farr and Brazil (2009). These authors outlined a possible model for a leadership development program with three components—assessment, challenge, and support. Assessment includes self-awareness, peer and superior feedback, and a personal plan to identify and address any resulting gaps. Challenging experiences that are sufficiently difficult to induce growth without causing discouragement are selected to fill in the gaps. Support from teachers, mentors, managers, and peers enables the individual to process the experiences and make adjustments in attitudes and behaviors. The problem with this model is the subjective nature of the gap analysis and the challenge selection. If either is incorrectly identified, little or no development would occur. Another leadership development model recommended that leadership development remain focused on identifying and building positive leader attributes, instead of on deficit reduction where the focus is on what is wrong with a leader and steps are taken to correct those areas (Avolio, Walumbwa, et al., 2009). A third model described an optimal training environment as one that includes
assessment of the person’s current skill levels, knowledge about and clarification on how to develop the skill, analysis of cases and examples to build understanding, skill practice to try out the skill in controlled conditions, and skill application to attempt the skill in actual conditions (Whetten & Cameron, 2011).

High-tech organizations face unique cultural and developmental challenges for leaders (Sansone & Schreiber-Abshire, 2006). Sansone and Schreiber-Abshire (2006) had extensive experience with leadership program development in scientific and technical organizations and coaching their professionals. Their observations led them to the conclusion that scientific and technical leaders are different from other leaders. The engineering culture values competence and mastery; engineers tend to pursue leadership to achieve technical goals and need the most development in relational areas. In addition, scientific and technical professionals tend to be intense, act with urgency, and are rarely satisfied with their current level of technical competency. They believe relational skills, including conflict management and motivating employees, tend to be the most difficult area for this group. The authors proposed a leadership development model that includes the study of human dynamics and interpersonal relationships framed as a relevant professional objective, action learning, and managerial support for personal and professional changes.

In another model proposed to meet the challenges of leadership development in high-tech organizations (Fulmer & Hanson, 2010), 23 technology-driven organizations were surveyed on leadership development techniques and challenges, followed by interviews of the same organizations. The authors found that leaders in technical organizations want measurable evidence that leadership development training is
necessary and effective. These leaders value their technical competency more than a leadership position and see leadership duties as a hindrance to team task completion, so organizations need to help leaders see the value and impact of being a leader. Many of the technical organizations surveyed operate using a master/apprentice model for training, but the authors believed that leadership development is better aligned with a coaching model. For high-tech organizations, the most successful model appears to be peer coaching because of the absence of a superior/subordinate relationship that may make the trainee feel compelled to show continuous displays of competence. Peer coaching topics included conflict management, followership, and influence.

Leadership development programs can also be viewed through different lenses. A shift in perspective developed by Hotho and Dowling (2010) looked at how leadership development program participants made sense of their training. Traditionally, leadership development programs were designed with the participant as a training recipient instead of a collaborator. Generally, the training content and methods used are selected for, not by, the participant. In the emergent view, the participant uses self-assessment, evaluation, interpretation, and reflection to design and interact with the program. The authors used a case study with 24 participants to do exploratory research using the new perspective. The participants were mid-level managers, both male and female. In addition to the leadership development program, they also participated in focus groups and interviews. The authors found that the participants came to their own conclusions about the usefulness of the program and the possibility of personal behavior change, despite the intentions and information provided by the facilitators. The authors suggested that leadership development programs must go through a fundamental shift from learning delivery to
learning collaboration to be effective and recommended further research in this area.

Focusing on leadership development through challenging work experiences, DeRue and Wellman (2009) looked at the role of developmental challenge in organizational efforts to develop leaders. Sixty managers from multiple organizations who were enrolled in an MBA program at a single university participated in a mixed method study. The study consisted of in-depth surveys and semi-structured interviews of the managers and surveys of the managers’ supervisors. When the challenge was matched to the leader appropriately, it required support from teachers, mentors, managers, and peers to enable the individual to process the experiences and make adjustments in attitudes and behaviors. The authors found there was a point of diminishing returns. As the challenge increased, the employees developed as leaders until they encountered a challenge that overwhelmed their abilities. At this point, the employees became very ineffective. The authors recommended that supervisors monitor challenge level to keep it at the appropriate amount.

Another lens is implicit leadership theories. Implicit leadership theories can cause problems when an identifiable group of people does not possess some of the necessary attributes as defined by society. Ely, Ibarra, and Kolb (2011) believed that this is the case with women leaders. They merged gender studies with leader identity to take leadership development in a different direction. They believed that women struggle to form a leader identity, and this is what prevents them from progressing into the top ranks of organizational leaders in a way that is proportional to their numbers at the lower echelons. A leader identity is the set of characteristics that the people in a society and the organizations inside it identify with being a leader. In most cases, a person forms his or
her personal leader identity implicitly through trial and error—trying a behavior and receiving either positive, reinforcing feedback or negative, disconfirming feedback. These characteristics then form a person's leadership identity. The authors explain that, in American culture, the prototypical leader is decisive, assertive, and independent. These characteristics are considered appropriate for men and inappropriate—abrasive, arrogant, and self-promoting—for women. As a result, when women try on leader behaviors, they are generally disaffirmed. When they act like “typical” women—friendly, unselfish, and caretaking—they are not seen as leaders. The authors found that traditional women's leadership development programs assume either that gender does not matter in leadership development or it matters in such a way that, to be leaders, women must change their behavior to act like men. The authors suggested that organizational leaders look at the ways that subtle implicit theory bias may be interfering with their promotion decision processes, preventing them from truly promoting the best person for the position.

Several models for leadership development have been proposed, but none of them has achieved a consensus among researchers in the field. There is little consensus on what the development experience will entail or how to match a person with an appropriate experience for growth. In addition, new research indicates that there are prior experience and psychological mindset aspects to leadership development that have not been incorporated into program models. Engineers in particular are a challenge for the leadership development community because they are generally indifferent to the leadership opportunities, valuing technical competence and mastery over social skills. Some emerging leadership development models suggest collaborating with the participants instead of designating training content. In this way, participants could be
coached to develop a growth mindset, discover personal value from engaging in leadership development, and design their own program, incorporating developmentally appropriate experiences.

**Leader Interpersonal Skills**

Leadership development targets leadership skills that are shared by effective leaders (Baldwin et al., 2013; Whetten & Cameron, 2011). Whetten and Cameron (2011) interviewed 402 managers who had all been rated as highly effective by their supervisors. The ten most common skills identified by the managers were all behavioral, and could be classified into three categories: personal, interpersonal, and group skills.

Interpersonal skills “involve the interpersonal and social skills relating to interacting with and influencing others” (Mumford et al., 2007, p. 156). These skills require an awareness of why and how others will react in social situations (Mumford et al., 2007). Having good interpersonal skills is essential when leading research and development organizations that employ technical professionals (Vie, 2012). According to Baldwin et al. (2013), Whetten and Cameron (2011), and Yukl (2012), supportive communications, influence, conflict management, and motivating others are important interpersonal skills.

There are several challenges with understanding leader interpersonal skills. Most research and training on interpersonal skills considers them independently, so there is an apparent disregard or exclusion of confounding behaviors (Yukl, 2012). In addition, Yukl (2012) found the level of each skill that a leader should manifest has yet to be studied. It may be that the optimum skill level is not high but moderate or even low. Riggio (2014) was concerned that there may be a hierarchy of interpersonal skills, with some skills
foundational to the learning of others. In most learning domains (for example, sports, or music), knowledge, skills, and abilities build on each other. Riggio also noted that the desirability of certain interpersonal skills might be dependent on the culture in the leader’s organization.

**Leader supportive communication.** In the workplace, supportive communication is verbal interaction between employees that preserve and sustain the relationship while still delivering the intended message to the other person, even when that message is critical or disapproving (Cameron, 2012). In any organization, negative messages must be conveyed to employees—mistakes must be corrected, errors in problem solving must be resolved, and lapses in judgement must be addressed. These negative messages can be delivered in ways that support the growth and development of the individual. Supportive communication is an important factor in predicting high organizational performance (Cameron, 2012). In a study of 60 top management teams, teams were categorized by the evaluations of the team members and the organization’s profitability and customer satisfaction. Then the team’s communications were studied. The best predictor of high performance was a ratio of positive to negative statements of 5.6 to 1 (Cameron, 2012).

In their research on communication in organizations, Dasgupta, Suar, and Singh (2013) looked at the relationship between supportive communication, perceived supervisory support, communication satisfaction, and organizational commitment. The researchers analyzed survey information from 400 employees randomly drawn from 10 manufacturing companies in India; 95% of the respondents were male. The researchers found that supportive communication increased perceived supervisory support, which
improved employee communication satisfaction and commitment. In a second experiment related to the first, the researchers asked eight of the 400 participants to write journal entries relating to the communication exchanges they had with their supervisors. The themes in their journals reinforced the findings in the survey.

Supportive communication has several attributes; it is descriptive, problem oriented, specific, owned by the sender, and it requires the use of active listening (Dasgupta et al., 2013; Whetten & Cameron, 2011). When using descriptive communication, a leader objectively describes a behavior without judging or labeling it (Cameron, 2012). The leader communicates what happened, the leader’s reaction to it, and offers alternatives. The description should contain enough information that it could be verified by another person and the behavior described must be under the control of the employee (Whetten & Cameron, 2011). The leader’s communication should focus on the problems or consequences that were created by the behavior, and not on the person’s characteristics or traits (Dasgupta et al., 2013). In addition, the communication must address specific examples of the behavior and avoid generalizing or evaluating. The leader has to take responsibility for the communication instead of referring to a higher authority, with the exception of references to policy or standards (Cameron, 2012). Finally, the leader must employ active listening techniques like paraphrasing, reflecting, clarifying and summarizing (Cormier, Nurius, & Osborne, 2012; Whetten & Cameron, 2011).

It is relatively easy to use supportive communication when a leader is complimenting good behaviors (Whetten & Cameron, 2011); it is much more difficult when the leader has to correct poor work behaviors. Coaching and counseling are
common managerial roles in which the leader needs to use supportive communication to change or correct behavior or discuss uncomfortable issues. As coaches, leaders provide advice and enforce standards, generally related to employee skills. Their approach is to help the employee become more skilled. As counselors, leaders engage in joint problem solving for employee attitude issues relating to comprehension, emotion, and personality. The leaders’ approach is to help the employee to recognize that there is a problem. When coaching and counseling are performed using supportive communication, the outcome can be a stronger relationship (Dasgupta et al., 2013; Whetten & Cameron, 2011).

One of the important interpersonal skills for leaders to employ is supportive communication. These are verbal interactions between leaders and employees that preserve and sustain the relationship at the same time that they deliver the intended message, whether it is positive or negative. If a leader is able to communicate supportively, it can increase employee satisfaction and commitment and create a stronger relationship. There are many attributes of supportive communication that must be learned to become skilled in this area. The most difficult application of supportive communication is when a leader must correct poor work behaviors.

**Influence by leaders.** Influence at work is a critical factor in a leader’s ability to get employees to accomplish work (Whetten & Cameron, 2011). Influence is the ability to convince others to work with you to achieve a goal. It can be either intentional, where the person deliberately sets out to influence, or unintentional, where the influence is a byproduct of social structures (Vie, 2012). In the best influencing situations, others are willing partners in the work, but strategies also exist to influence the reluctant or unwilling (Lewis-Duarte & Bligh, 2012).
In order to wield influence, a leader must have power. There are two main sources of power: personal power and position power (Whetten & Cameron, 2011). Personal power can be based on expertise in relevant tasks, interpersonal attraction from having desirable characteristics associated with friendship, perceived effort in accomplishing the task, and alignment with organizational values. Position power comes from access to information in a communication network, the amount of decision-making discretion available to the position, visibility of task outcomes and performance to influential people at the organization, and relevance of assigned duties to the organization’s priorities. Power often has a negative connotation, but without power, a leader can have no influence, and without influence, the leader cannot garner the support and resources needed to do the job (Whetten & Cameron, 2011).

Looking at influence in research and development organizations, Vie (2012) conducted a study with data from both interviews and observations. He shadowed four research and development engineer managers for one week each. These managers worked for two different international companies. In addition to the observations, Vie conducted 30 semi-structured interviews, including interviews with the engineers, their supervisors, and their direct reports. Vie found that knowledge workers prefer autonomy and dislike being directed by a supervisor. Direct attempts by managers to influence knowledge workers were often rejected. Vie confirmed that the research and development managers were able to exert the most influence on their employees indirectly, by maintaining a social relationship—getting to know their employees personally and understanding their problems, issues, and concerns at work and at home.
There are many different influence tactics that can be grouped into three main strategies (Whetten & Cameron, 2011; Yukl, 2010). The first influence strategy is retribution, which is influence based on coercion and intimidation. Next is reciprocity, or influence that satisfies the self-interest of both parties. It is based on bargaining and ingratiation. The third influence strategy is reason; with reason, persuasion is based on facts, needs, or personal values. Reason is the strategy most easily used to exert upward influence. These strategies are often used sequentially (Lewis-Duarte & Bligh, 2012).

Lewis-Duarte and Bligh conducted a study on influence tactics in coaching relationships. They surveyed 110 participants from ten American organizations to determine which influence tactics were likely to be used. The participants were approximately equal proportions of men and women. Lewis-Duarte and Bligh discovered that a reason strategy was most often used in initial attempts to change behavior or assign work. If that failed, it was often followed by retribution in the form of pressuring. The limitations of the study included sample size, self-reported data, and lack of information on the organization to put findings into context.

While influence is generally used in a positive fashion to further the goals of the organization, it can also be used negatively, to manipulate or control a person’s behavior (Whetten & Cameron, 2011). Power imbalances may cause others to think using retribution influence strategies is an option. A lack of assertiveness allows individuals to use coercion or manipulative bargaining tactics or make unreasonable requests (Whetten & Cameron, 2011).

Influence is another important interpersonal skill for leaders. It is the ability to convince others to achieve a goal. Personal and position power are the two main sources
of influence. Because engineers are typically independent and see leadership as a
hindrance to accomplishing their assigned duties, leaders of engineers must focus on
influence using personal power over position. Leaders must develop competency in
several different influence tactics because they are often used sequentially, and guard
against using influence for personal gain.

Conflict management for leaders. Conflict is a person’s awareness of opposing
positions or negative effects on an organizational area of interest (de Reuver & van
Woerkom, 2010). Conflict in an organization is not only inevitable, but also desirable
(Baldwin et al., 2013; Chung-Yan & Moeller, 2010). Organizations with leadership teams
that have high levels of agreement actually fail at a higher rate than organizations that do
not. The same is true for high levels of conflict. However, a moderate level of conflict
optimizes organizational outcomes (Whetten & Cameron, 2011). At the same time, most
people are not comfortable dealing with conflict. In a study of conflict in management
teams, small groups of managers were asked to perform a problem-solving task (Whetten
& Cameron, 2011). The researchers placed a person on half of the teams who were
confederates. This person was asked by the researchers to challenge the groups’ every
decision. At the end of the session, each group’s solutions were rated for quantity and
quality; in every case, the group with the confederate performed significantly better.
Next, each group was allowed to drop one team member before performing a similar task
again. All of the confederates were asked to leave their groups. The researchers
concluded that people dislike conflict so much that they will avoid it even when they
know it gives them an advantage.
To manage healthy organizational conflict, leaders must develop skills in dealing with interpersonal disagreements (Chung-Yan & Moeller, 2010). Effective management of conflict strengthens the supervisor-employee relationship and by extension the employee’s commitment to the organization (de Reuver & van Woerkom, 2010). In a study on supervisors’ conflict strategy and how it impacted employee commitment, de Reuver and van Woerkom analyzed 173 questionnaires which were completed by people employed in both professional and staff positions. The questionnaires provided a conflict scenario and asked the respondents to describe how their boss might react; the use of a scenario provided a uniform situation for the responses. The questionnaires also measured affective commitment on a Likert scale. In addition, the authors collected objective data on absenteeism for each respondent, which the authors used as a surrogate for commitment.

Conflict can be personal or resource based (Baldwin et al., 2013). Personal conflict is conflict caused when people question another person or group’s competence, intent, understanding, or ability. Resource conflict occurs when people are vying for limited resources, like money, space, or personnel. Whether personal or resource based, conflict can source from personal differences, information deficiencies, role incompatibility, or environmental stress.

The leader’s role is to keep the conflict focused on resources and prevent it from becoming personal (Chung-Yan & Moeller, 2010). Conflict may also stem from misinformation or misunderstandings (Whetten & Cameron, 2011). Conflict from role incompatibility results when people have responsibilities that conflict with each other
Environmental stress like downsizing or rapid or constant change can also create conflict (Baldwin et al., 2013).

Another important interpersonal skill for leaders is conflict management. A moderate level of conflict over the best use of an organization’s resources optimizes organizational outcomes, but it must be managed well to prevent it from becoming personal. Leaders must be prepared to deal with resource conflict stemming from information that is incorrect or misunderstood, incompatible job responsibilities, or organizational stressors like downsizing or rapid change.

**Leaders motivating others.** Motivation is the willingness of an employee to make an effort to accomplish an organizational objective (Ramlall, 2012). Ramlall (2012) reviewed many existing motivation models and distilled the critical factors common to them. He found that motivation has several components that can be represented by the categories of the employee’s desire to do the job, their commitment to completing tasks, and the opportunity for them to do so. Two factors that can affect work performance are skill and will; that is, whether the employee has the ability to do the task and the motivation to expend personal effort to accomplish the task (Whetten & Cameron, 2011). Assuming that the employee has the requisite ability, then the leader can make a difference in performance by influencing the employee’s motivation.

Motivation is an important skill for leaders to learn because motivated employees are more productive and less likely to leave their current position (Whetten & Cameron, 2011). Springer (2011) examined the relationship between motivation and performance of bank employees. Seventy employees responded to his survey, which collected demographic information and data on the employees’ motivation, satisfaction, and job
performance. His findings suggested that leaders could increase employee performance on the job by employing strategies to increase their motivation. Additionally, in a study on motivation as a predictor of an employee leaving their position, Sajjad, Ghazanfar, and Ramzan (2013) collected data from 106 employees at four banks in Pakistan. They used questionnaires to gather information on attributes related to motivation and intention to remain in their current position. Their study showed that employees with low motivation were more likely to consider leaving their jobs.

When fostering a motivating work environment, leaders walk a fine line between supporting employee efforts as they grow and develop on the job and manipulating their employees to perform so productivity goals can be met (Whetten & Cameron, 2011). They hold people accountable for results through work performance goals at the same time they remove obstacles to performance, like deficits in resources, training, or support from other units (Ramlall, 2012; Springer, 2011). The leader uses rewards and discipline as needed to encourage good performance and discourage poor performance. Being a high performer has to be more rewarding than being a low performer (Whetten & Cameron, 2011).

The fourth important interpersonal skill is motivating others. A leader must develop in others a willingness to make an effort to accomplish organizational objectives. Motivated employees are more productive and more likely to remain at their organization. The leader must learn how to analyze work performance issues and determine if a performance problem is caused by insufficient job skills or insufficient motivation, then provide the employee with the appropriate remedy.
Interpersonal Skills Development

Interpersonal skill development is intended to improve a leader’s relationships with employees, peers, and superiors through the development of their supportive communication, influence skills, conflict management, and/or motivating skills (Riggio & Lee, 2007). According to Riggio and Lee (2007), the rationale for spending organizational resources on development is based on research that showed interpersonal skills were predictors of leadership effectiveness. Because of this, many organizations have developed training for their leaders in interpersonal skills, but there are no agreed upon models for doing so (Allen et al., 2014, Riggio, 2014). In addition, there is no method to measure current levels of a skill or the effectiveness of training. Riggio (2014) observed that the skill level of followers might also need to be developed to see the full benefit of interpersonal skills training for leaders. In addition, he noted that it is unknown if all interpersonal skills are needed by all leaders in every context and organizational level.

In general, organizations have developed standardized training for their leaders using some combination of four basic pathways to learning interpersonal skills (Allen & Hartman, 2008; Kets de Vries & Korotov, 2011; Whetten & Cameron, 2011). On the first pathway, the person might become aware of the deficiency or opportunity and be motivated to improve (self-awareness/personal growth). The awareness may develop through several different avenues, like reflection, teambuilding, experiences designed to challenge thinking and evaluate behaviors, and mentorships (Allen & Hartman, 2008). On the second path, the person may conceptually learn ways to improve (conceptual understanding/skill learning). Knowledge learning can occur in a classroom, online, or be...
Another possible way to learn interpersonal skills is through practicing a new skill (application). This practice can be done in settings like a formal training program, individual trial and error, and personal development planning and assignments developed by supervisors (Allen & Hartman, 2008; Whetten & Cameron, 2011). Finally, the person may be given or seek out performance feedback. This feedback is given with the intent of guiding the skill development with continual adjustments. Feedback can come in many forms, for example through a coach, mentor, supervisor, formal assessments, or sought by the individual as needed (Allen & Hartman, 2008).

Focusing on these sources of learning in and of themselves may not develop leadership. Leadership development also depends on several other factors such as the individual’s current level, learning style, identity, organizational role, and self-efficacy (Allen & Hartman, 2008). Organizations tend to develop standardized training for everyone, without assessing individual needs, resulting in suboptimal training for nearly everyone (Allen & Middlebrooks, 2013). Another obstacle for effective development is the inability of the leader to consistently practice a skill after it is learned; repetition is key to learning (Allen & Middlebrooks, 2013). For example, the leader typically would not need to use conflict management skills at work often enough to develop skills. In addition to practice and repetition, Allen and Middlebrooks (2013) discussed the importance of real-time coaching from an experienced mentor and a progressive set of skill training opportunities instead of the usual one-time training.

There is little empirical evidence regarding the best way to teach interpersonal skills, but organizations are forging ahead anyway. Leaders may learn interpersonal skills
in several different ways. These include self-awareness and personal growth, conceptual understanding and skill learning, application, and performance feedback. In best-case leadership development, the learning occurs through multiple modalities. However, there are many factors that limit the ability of training to make a difference to many leaders.

Summary

Leadership development theory is a relatively young field. There is little consensus on what the experience will entail or how to match a person with an appropriate experience for growth. Several models for leadership development have been proposed, but none has become widely recognized among researchers in the field. In addition, recent research indicates that there are prior experience and psychological mindset aspects to leadership development that have not been incorporated into program models. Engineers in particular are a challenge for the leadership development community because they are generally indifferent to the leadership opportunities, valuing technical competence and mastery over social skills.

There are four important interpersonal skills for leaders to develop, but there is little understanding about how they might interact, the balance of the skills, or possible skill hierarchies. One interpersonal skill is supportive communication. These are verbal interactions between leaders and employees that preserve and sustain the relationship at the same time that they deliver the intended message, whether it is positive or negative. If a leader is able to communicate supportively, it can increase employee satisfaction and commitment, and create a stronger relationship. There are many attributes of supportive communication which must be learned to become skilled in this area. The most difficult
application of supportive communication is when a leader must correct poor work behaviors.

Influence is another important interpersonal skill for leaders. It is the ability to convince others to achieve a goal. Personal and position power are the two main sources of influence. Because engineers are typically independent and see leadership as a hindrance to accomplishing their assigned duties, leaders of engineers must focus on influence using personal power over position. Leaders must develop competency in several different influence tactics that are often used sequentially, and guard against using influence for personal gain.

Another important interpersonal skill for leaders is conflict management. A moderate level of conflict over the best use of organizations resources optimizes organizational outcomes, but it must be managed well to prevent it from becoming personal. Leaders must be prepared to deal with resource conflict stemming from information that is incorrect or misunderstood, incompatible job responsibilities, or organizational stressors like downsizing or rapid change.

The fourth important interpersonal skill is motivating others. A leader must develop in others a willingness to make an effort to accomplish organizational objectives. Motivated employees are more productive and more likely to remain at their organization. The leader must learn how to analyze work performance issues and determine if a performance problem is caused by insufficient job skills or insufficient motivation, then provide the employee with the appropriate remedy.

Leaders may learn interpersonal skills in several different ways. These include self-awareness and personal growth, conceptual understanding and skill learning,
application, and performance feedback. In best-case leadership development, the learning occurs through multiple modalities. Leadership development also depends on several other psychological and experiential factors. There is no single accepted model for designing a leadership development program that transfers knowledge into effective leadership behaviors.

Much is not known about how participants’ knowledge, skills, and abilities are changed by a leadership development program. Leadership development programs are becoming differentiated based on people who can be categorized by a set of distinguishing characteristics, like minorities or women. Engineering professionals have such a distinct set of characteristics and an identifiable need for leadership development. Historically, they have had no desire for leadership development, but this may change if a program could be developed that was in line with their personality preferences and the competency-based culture they work in.
Chapter 3: Research Method

This chapter on research methods describes the research method and design for this study. The reasoning behind choosing the multiple case study method is explained, the design steps are described, and how the design accomplished the study goals is demonstrated. Next, a description of the study population is provided and the method for soliciting and selecting participants is described. Data collection, processing, and analysis and the role of the researcher are explained. Assumptions about the population and design, study limitations, and ethical assurances are also reviewed.

Engineers who are introverted and logic-based decision makers constitute a large share of the engineering population, but are usually not in leadership positions (Bauer, Erdogan, Liden, & Wayne, 2006; DeRue, Nahrgang, Wellman, & Humphrey, 2011; Grant et al., 2011a). However, introverted leaders are likely to produce better results than extraverted leaders when the tasks employees perform require proactive employees (Grant et al., 2011a). Because they seem less receptive to proactivity, extraverted leaders often create inefficiencies by stifling their employees’ proactive behaviors, such as their willingness to make suggestions, their initiative to improve projects, and their attempts to exert upward pressure to make process changes (Grant et al., 2011a). These inefficiencies may decrease profits (Grant et al., 2011a). In general, engineering projects need proactive employees; due to the high level of expertise engineers bring to a project, the manager often does not know how to perform the individual pieces of a project, nor how the pieces fit together. Additionally, engineering projects often affect the safety, health, or welfare of the public, to the extent that the National Society of Professional Engineers requires engineers to be proactive as part of their code of ethics (National Society of Professional
A better understanding of the vital leadership constructs of interpersonal skills in the areas of supportive communication, influence, conflict management, and motivating others, as they apply to introverts who are logic-based decision makers, may support more leader emergence in this population (Crumpton-Young et al., 2010). These personality preferences are distinct from interpersonal behavioral skills. It is entirely possible for both introverts and extraverted to employ interpersonal skills comfortably; introverts do not need to switch to a nonpreferred personality preference in order to do so (Myers, 1998). According to Avolio (2011) and Farr and Brazil’s observations (2009), leadership ability is in large part a result of the experiences a person chooses as an adult.

Because of the organizational need and the limited research on this target population, several researchers recommend more research be performed on how interpersonal skills develop in this population (Crumpton-Young et al., 2010; Farr & Brazil, 2009; Robledo et al., 2012; Sansone & Schreiber-Abshire, 2006; Vie, 2012). The specific problem is an inadequate understanding about how introverted engineers who are logic-based decision makers develop interpersonal skills.

The purpose of this qualitative multiple case study was to analyze and synthesize the experiences of introverted, logic-based engineer leaders on the evolution of their interpersonal skills in the areas of (a) supportive communication, (b) influence, (c) conflict management, and (d) motivating others (Whetten & Cameron, 2011). Some researchers posit that interpersonal skills may be more difficult for introverts to learn, but do not offer specific solutions (Hunt & Baruch, 2003). Leadership development that supports introverted people may enhance logic-based introverts’ willingness to pursue
becoming leaders, which might increase their influence at the managerial level and have a positive effect on the engineering profession according to some researchers (Crumpton-Young et al., 2010). For the research, participants were selected and interviewed on the evolution of their interpersonal skills using an interview protocol, as seen in Appendix A. Collection of interview responses was concluded when theoretical replication was achieved or upon data saturation (Yin, 2014). Participants were sought through passive recruitment utilizing notices in LinkedIn groups whose membership is predominantly engineers, like the Tau Beta Pi Engineering Honor Society, Engineering Society of Detroit, and ASQ—The American Society for Quality groups. A small incentive was offered for participating in the study. Potential participants were selected from a pool of volunteers based on the personality preferences of introversion and logic-based decision making as determined by the participant’s self-identified personality and decision preferences, and whether or not the prospective participant had supervisory experience, and whether or not the prospective participant is interested in being a leader. The participants’ personality and decision preferences were confirmed through the administration of the Myers-Briggs Type Indicator (MBTI) survey instrument. The interview data for each case was analyzed, and then a cross-case review was performed to find converging patterns and relationships.

The research questions in this study added to the body of knowledge in this field by extending existing theory and contributing to a theoretical framework for how introverted, logic-based decision makers develop interpersonal skills. Specifically, the interpersonal skills of supportive communication, influence, conflict management, and
motivating others were investigated. These skills are important for effective leadership (Baldwin, Bommer, & Rubin, 2013; Whetten & Cameron, 2011; Yukl, 2012).

Using these research questions, the thoughts and feelings of the target population about interpersonal skills development were sought to understand how introverted engineers who are logic-based decision makers develop leadership skills on the job. Current research in leadership development models suggests there may be a way to modify content or delivery to enhance the knowledge, ability, and attitude outcomes for the target population. The research questions extended leadership development theory by looking for patterns in the development of these essential interpersonal skills.

**Q1.** How did engineers who are introverted and logic-based decision makers develop interpersonal supportive communication skills?

**Q2.** How did engineers who are introverted and logic-based decision makers develop interpersonal influence skills?

**Q3.** How did engineers who are introverted and logic-based decision makers develop interpersonal conflict management skills?

**Q4.** How did engineers who are introverted and logic-based decision makers develop interpersonal skills in motivating others?

**Research Methods and Design**

This research was conducted using a multiple case study method. A multiple case study approach is an appropriate fit for “how” or “why” research questions that require an in-depth description of contemporary behavioral events the researcher has little or no control over (Yin, 2014). According to Yin (2014) and Zikmund et al. (2010), case studies are a carefully recorded exploration of the phenomena under study, within its real-
world context. Researchers investigate the subject, document as much detail as they are able to discern, and explore any aspect of a phenomenon that seems relevant (Zikmund et al., 2010). This allows researchers to pursue relationships as they discover them. In addition, researchers may make unusual, non-intuitive, or creative connections among data because they are able to build an over-arching picture from the details they uncover.

The multiple case study approach was used to build theory inductively. Existing research does not address the research questions, and there is a strong organizational need for this information. In this situation, both Yin (2014) and Eisenhardt and Graebner (2007) recommend that multiple cases be studied to create the conditions for replication of the findings. To build theory, the cases were chosen to demonstrate convergent results. The unit of analysis for the study was the individual engineer, and conclusions for each case were compared with the others until a subset of convergent conclusions was found. If the results did not converge or were contradictory, more cases were selected until a subset of the findings could be replicated.

The target population for this study was engineers who are introverted and logic-based decision makers. Replication logic was used to select potential research participants. Replication logic entails selecting participants based on the desired profile developed by the researcher (Yin, 2014). For the research, participants were selected from a pool of volunteers based on the personality preferences of introversion and logic-based decision making as determined by the participant’s self-identified personality and decision preferences, and whether or not the prospective participant has supervisory experience and is interested in being a leader.

The conditions that were investigated are shown in Figure 1. The central case was
participants with supervisory experience who are interested in being a leader. Two or three cases were sought for this condition, to achieve literal replication (Yin, 2014). Then the central case conditions were varied for two to three more cases, in order to see if new patterns emerged. Together the set of cases provided theoretical replication (Yin, 2014). Collection of interview responses was concluded when theoretical replication was achieved or upon data saturation.

It is through in-depth interviews that insights were gained into the research problem. Research participants responded to interview questions. The initial interview protocol can be found in Appendix A. The initial interview protocol was refined in response to field testing and emergent questions during interviews.

The cases were analyzed and synthesized to find converging patterns and relationships from which conclusions could be drawn and theory built. The multiple case
study analysis began with a detailed description of each case and the themes of that case in a case study report, followed by a cross-case analysis, and then an interpretation of the meaning of the cross-case analysis (Yin, 2014). The cross-case analysis allowed generalized findings and generated theory (Burns, 2010; Eisenhardt & Graebner, 2007; Yin, 2014).

A quantitative strategy was considered for this research. Quantitative research addresses research objectives through empirical studies involving numerical measurements and statistical analysis (Zikmund et al., 2010). The goal is to discover relationships among independent and dependent variables. Quantitative research is structured, uses large samples, and has objective results. The quantitative approach was not selected for this study because the data collected for this study was not measured numerically.

A phenomenology strategy was also considered for this research. According to Zikmund et al. (2010), phenomenology is the study of people as they exist inside their natural environment; it draws meaning from first-person reports of life experiences. In this research orientation, the researcher works to put the participant at ease and get the participant to relate stories in response to open-ended questions. The phenomenological approach was not selected for this study because the participants must all have experienced the phenomena under study so the researcher can discern the underlying themes (Creswell, 2013).

**Population**

The target population for this study was introverted engineers who are logic-based decision makers. Some of these engineers had supervisory experience and were interested
in being a leader. Others had supervisory experience but were not interested in being a leader. According to the Bureau of Labor Statistics, there are 1.1 million engineers in the United States (Occupational Outlook Handbook, 2012). Of these, approximately 43 percent, or 470,000 are introverted and logic-based (Balsamo, Lauriola, & Saggino, 2012; Felder, Felder, & Dietz, 2002; Joyner, Mann, & Harris, 2012; Wankat & Oreovicz, 1992). A better understanding of how this population develops interpersonal skills in the areas of supportive communication, influence, conflict management, and motivating others may support more leader emergence in this population (Crumpton-Young et al., 2010).

Sample

Participants were sought through passive recruitment utilizing notices in LinkedIn groups whose membership is predominantly engineers, like the Tau Beta Pi Engineering Honor Society, Engineering Society of Detroit, and ASQ—The American Society for Quality groups. A request for volunteers was posted in these groups, as shown in Appendix B. The request sought participants who have a minimum of three years of supervisory experience. The request also specified that volunteers self-identify as introverted. This was later confirmed through administration of the MBTI survey instrument. Those who were interested were asked to complete a pre-qualifying survey, as shown in Appendix C, to document their responses. Those selected from the pre-qualifying survey were asked to provide a resume which included information about any management and leadership positions and/or duties they have held to confirm their supervisory experience. A small incentive was offered for participating in the study.

Under certain conditions, like high-risk studies, research that is degrading, or when the
participant is dependent on the researcher or has an aversion to the study, incentives may be problematic (Grant & Sugarman, 2004). However, these issues were not in effect for this study because none of these conditions apply to this research.

Participants were selected from a pool of volunteers based on three criteria. The first criterion was the personality preferences of introversion and logic-based decision making. This was first determined by the participant’s self-identified personality and decision preferences and later confirmed on the MBTI survey instrument. Those volunteers whose results on the MBTI survey instrument for introversion and logic-based decision making showed clarity of moderate to very clear on the “clarity of reported preference” index were included in the research (Quenk, 2009). The “clarity of reported preference” index ranges from “Slight” to “Very Clear” and depends on the ratio of extravert to introvert answers. The index shows how consistent the respondent’s selections were for a given preference. It was determined during the survey scoring process. The second criterion was whether they hold or have held any leadership positions. The third criterion was whether or not they were interested in being in a leadership position.

**Materials/Instruments**

The Myers-Briggs Type Indicator (MBTI) survey instrument, developed by Katherine Briggs and Isabel Myers, identifies personality preferences related to how people interact with the world and make decisions (Kiersey & Bates, 1984; Myers, 1998; Quenk, 2009). The Myers Briggs survey uses theory originally developed by Carl Jung. It is based on the assumption that people have preferences for the way they interact with the world, similar to the right hand or left hand preference most people have when writing.
On the MBTI, an introvert is a person who prefers solitude and solitary activities and gains energy from this state. Being around other people is an energy drain for introverts (Myers, 1998; Quenk, 2009). A logic-based decision maker, or thinker, on the MBTI is a person who makes decisions based on facts and evidence, as opposed to making decisions based on understanding the impact on others (Myers, 1998, Quenk, 2009).

The MBTI is a well-established survey instrument, and the reliability and validity of the instrument has been thoroughly vetted (Quenk, 2009). A subset of the items on the MBTI survey instrument is designed to reflect the presence of an extravert or introvert personality preference (Quenk, 2009). Quenk (2009) explains that if the majority of the items a person chooses indicate an introvert preference, the person is considered to have an introvert personality preference. Further information is provided by a “clarity of reported preference” index, which ranges from “Slight” to “Very Clear” and depends on the ratio of extravert to introvert answers. The same process is used to determine those who have a logic-based decision-making preference (“Thinkers”).

The interviews were conducted using an interview protocol. The questions for the interview protocol were developed to align with the research purpose and questions. Authoritative advice on developing the interview protocol was found in the work of Creswell (2013), Jacob and Furgerson (2012), and Rubin and Rubin (2012). The interview protocol provides a procedure for the interviewer to follow, including a script for what should be covered at the beginning and end of the interview, the interview questions, and prompts and probes to ensure all research areas are included (Creswell, 2013; Jacob & Furgerson, 2012; Rubin & Rubin, 2012). The initial interview protocol can be found in Appendix A. The initial interview protocol was refined in response to field
testing and emergent questions during interviews. A field test was conducted to establish the credibility and dependability of the interview questions. Two non-research participants were asked to participate as field testers. They reviewed the interview protocol and provided feedback. Revisions to the interview protocol were made based on the field test.

Data Collection

After selection, individuals were asked to sign an informed consent form (Appendix D). Next, they were asked to confirm their personality preferences through administration of the MBTI survey instrument. After participants qualified through the MBTI survey instrument, they were asked to provide personal profile information by providing a resume which included information about any management and leadership positions and/or duties they have held. After participants provided the profile information, they participated in individual, in-depth interviews. The audio of these interviews was recorded and later transcribed.

It was through in-depth interviews that insights were gained into the research problem. Marshall and Rossman (2011) explained that interviewing is a process that results in the transferring of information from one person to another. They described interviewing as a skill that is developed through study and practice. Not only must researchers create appropriate interview questions, but also they must manage the dynamics of the interview process, including nonverbal and paraverbal signals. The interaction of the researcher with the participants means that the researcher must identify intellectual interests, biases, and assumptions and set them aside (Creswell, 2013; Schram, 2006). The researcher maintained field notes. The field notes contained
theoretical, observational, and methodological descriptions and reflections, as suggested by Punch (2010). Before and after the interviews, the researcher reflected on personal interests, biases, and assumptions and recorded them in the theoretical section of the field notes.

Research participants responded to interview questions. The initial interview protocol can be found in Appendix A. An interview protocol provides a procedure for the interviewer to follow, including a script for what should be covered at the beginning and end of the interview, the interview questions, and prompts and probes to ensure all research areas are included (Creswell, 2013; Jacob & Furgerson, 2012). The initial interview protocol was refined in response to field testing and emergent questions during interviews. In the course of developing a relationship with the researcher or when the researcher is observing the participant, the participants also spontaneously provided naturally occurring statements that were not prompted by an interview question. Both types of responses were considered authentic and meaningful and were recorded as part of data collection. Statements recorded during participant observation and responses prompted through interviews were treated in a similar fashion.

If participants incorporated a prompt or comment into their response to an interview question, the meaning of what was said becomes shared. The wording of a question may have led the participant to answer the question in the direction of the prompt (Merriam, 2009). This would also indicate that the question needs to be reformulated; the question is probably not an open-ended question that would allow participants to create their own unique response (Merriam, 2009). This information would be conveyed in the write up of the interview in the observations section of the field
notes. Observational notes are notes on the interview experience, which the researcher records after reflecting on observations utilizing all of the senses (Marshall & Rossman, 2011; Punch, 2010). For example, the interview room may have been hot or had a bad odor, and that would be recorded in the observational notes.

**Data Processing**

A participant record was created for each of the participants in the research study. Data for the participants came from the interviews conducted, the recordings of the interviews, the transcripts of the interviews, written field notes, resumes collected, informed-consent agreements, and cross-case analyses. Any written data, for example field notes, was converted to electronic format. A backup of all electronic files was stored using Google Drive, a cloud file storage and synchronization service. The participants were all engineers who are introverted and logic-based decision makers. Beyond that, they all have different career histories, successes, and failures. Engineers were interviewed who have had supervisory experience. Participant records were developed in order to capture as much context as possible for each interview (Merriam, 2009). Next, all of the participant responses were analyzed using the case study approach, and finally, cross-case analysis was performed to draw conclusions from the research.

Decisions made in developing and conducting the research were documented and assessed in the methodological section of the field notes. The research proposal was continually compared to the ongoing research and the initial research decisions were reassessed and reviewed periodically. No issues were found, but if there were any, the research would have been paused and the problem corrected. This ensures that the research remains properly aligned and ethically sound. These review items were gleaned
from several sources, like Creswell (2013), Merriam (2009), and Marshall and Rossman (2010).

Some steps were taken to improve data processing. During times when physical processing was not possible, the recorded interviews were replayed. While this did not directly advance the analysis, the review was very beneficial and helped enhance the feel of the flow when moving from one interview to the next. One particular interview went very well, and it was difficult keeping it mentally in balance with the other interviews. Writing about this experience in the observational field notes put things into a better perspective. Rother and Shook (2009) wrote that the “…development of the current and future states are overlapping efforts. Future-state ideas will come up as you are mapping the current state. Likewise, drawing your future state will often point out important current-state information you have overlooked” (p. 7). This is similar to the process which occurs while processing interview data. The value of field notes was readily apparent. Flashes of insight and thoughts on possible connections were written down as they occurred. It was obvious that waiting until the findings and recommendations were being written to think about these things would have resulted in missing some important possibilities.

**Data Analysis**

Once the researcher assembled the participant records, analysis of the data for each participant began using multiple case study methods. Case study researchers seek an in-depth understanding of a phenomenon in a real-life setting (Yin, 2014). The procedures from the case study approach were used to analyze the data and create the summary of the phenomena being researched. For case study research, the steps in the
process have been listed and clarified by many researchers (e.g., Creswell, 2013; Stake, 2006; Yin, 2014). The goal is to understand the research participants' perceptions of their experiences with interpersonal skills development on the job or at a training site and what implicit definitions, thought processes, explanations, events, and training they feel may have helped them to develop, discouraged them from developing, or caused them to avoid developing interpersonal skills, as they are applied in organizations.

The cases were analyzed and synthesized to find converging patterns and relationships from which conclusions were drawn and theory built. The multiple case study analysis began with a detailed description of the themes of each case, developed through a cross-case analysis, and then an interpretation of the meaning of the cross-case analysis (Yin, 2014). During the process, the researcher’s personal insights, thoughts, and mental connections were recorded in theoretical field notes (Fram, 2013; Marshall & Rossman, 2011). The cross-case analysis allowed generalized findings and generated theory (Burns, 2010; Eisenhardt & Graebner, 2007; Yin, 2014).

This method had several steps. First, words and phrases were discerned that related to the research questions being studied. This data was then reflected on, and a detailed description of the case themes was created. Then the themes were grouped into patterns, which informed the findings and recommendations.

As each case was processed, the data was coded using a self-defined coding scheme. The code was developed from the theoretical framework, literature review, interview questions, initial review of the interviews, and ad hoc categories (Creswell, 2013; Miles, Huberman, & Saldaña (2014); Ruona (2005)). The chosen codes were descriptive or process codes. Descriptive codes are short words or phrases that describe
the basic topic (Miles et al., 2014). Process codes are “–ing” words that imply action
(Miles et al., 2014). Subcoding was also employed because the data seemed to have
natural relationships for these initial groupings. Subcoding is a secondary word or phrase
assigned to a primary code because further refinement of the primary code was needed or
an obvious interrelationship was observed (Miles et al., 2014). Codes were continually
added, removed, reorganized, and redefined based on multiple reviews of the interviews.
This was particularly important when the code choice during data analysis seemed
ambiguous; when this occurred, the code needed further refinement to ensure consistent
application. A table with operational definitions was created to facilitate this consistent
application. Then, codes were compared across participant records (Burns, 2010). Codes
that were common to many of the participants were identified, noting relationships and
variations within and across cases.

After the first-cycle code list was developed, patterns were sought. This is also
known as second cycle coding (Miles et al., 2014). All unused codes were removed, and
the remaining codes were developed into patterns using a thinking process tool called an
affinity diagram. Affinity diagrams create an environment that enhances the creative and
intuitive grouping of a collection of ideas, and can be used by individuals and groups
(Keller, 2011). Each idea was placed on a separate card or sticky note, and then all of the
ideas were set out at one time in a random cloud formation (Keller, 2011). Next, the ideas
were slowly matched into groupings based on perceived similarities. This works best if
the ideas can be placed in a common area and rearranged over several days. When the
ideas reached the final groupings, a brief label that described the grouped ideas was
generated for each set of related ideas. In this case, these were the patterns I was seeking.
Finally, the patterns and relationships were examined and conclusions drawn about them. Findings, tables, and/or figures flowed naturally from the resulting patterns in conjunction with a thorough review of the field notes. Description of the research and interpretation of the data was balanced in the report. Unique or minority themes were included.

Assumptions

A basic assumption in this research was that the volunteers who participate in the study will have had the experiences being studied. Research progress was monitored to see if it was difficult to find participants who could answer the interview questions or if there did not appear to be common threads in their responses. These problems would have indicated that an invalid assumption had been made.

Limitations

Limitations of this study were the small sample size, the self-selection of the participants, and the self-reporting of interpersonal skills and encounters. A multiple case study format was used to mitigate these limitations. The interview protocol helped ensure all participants answered the complete set of questions.

Ethical Assurances

Ethical dilemmas can be avoided with thorough preplanning of the research study. Unethical situations can cast a shadow on the entire study, calling into question the honesty of the researcher. Documentation of decisions in the field notes helped keep ethics in the forefront of this research study. There are four main areas that researchers must monitor in order to preserve the ethics of their research. First are the ethical issues that may arise in writing a report—in this case, a dissertation. Next are the ethics related
to interactions with participants. The third area is data handling and reporting. Finally, researchers must address the possibility of mistakes, negligence, and misconduct.

Ethical issues can arise in the mechanics of writing a dissertation. These issues include working with a mentor and Institutional Review Board (IRB) approval and review. While completing this dissertation, the researcher worked with several mentors. It is the researcher’s responsibility to be honest and professional with mentors and behave ethically at all times ("Committee on Science," 2009; Dissertation Handbook, 2012). The researcher must also be careful to incorporate mentors’ advice and critiques into the dissertation without plagiarizing. In addition, federal regulations require potential researchers to obtain approval to conduct research on human subjects. Approvals are granted by IRBs, which exist at every research institution that receives federal money ("Committee on Science," 2009; Cozby & Bates, 2012). This research followed prescribed guidelines. IRB approval was sought prior to any data being collected.

Employees at technology firms had a high potential for matching the desired profile for participants in this research. This was not the same as obtaining consent from the participants who were selected. Informed consent is a disclosure statement about the research study’s purpose and audience that is provided to and signed by the participant at the beginning of the research (Wester, 2011). The informed consent statement, as seen in Appendix D, included information like the research purpose, the participant’s right to choose to participate and withdraw, benefits and risks, confidentiality, and researcher contact information (American Psychological Association, 2010a; Wester, 2011).

Research may have both risks and benefits. This research was envisaged to consist of individual, in-depth interviews with study participants. The interviews were
related to the participants’ thoughts and feelings on the topic of interpersonal skills development. A potential risk to the research participants was mild discomfort or embarrassment resulting from speaking frankly with a stranger. A potential benefit to the research participants was a positive attitude in the area of this research after talking through some of their ideas. All data collected in the study was treated confidentially. This information was communicated to the participants during informed consent.

The participants for this research were white-collar professionals. The use of formal methods of gaining consent did not exclude them or make them difficult to access. As a result, difficulties in obtaining formal consent were not anticipated. Consent with the study participants was continually negotiated and renegotiated. At the beginning of the interview, the participant was informed about the purpose and importance of the research (Wester, 2011). As the interviews progressed, it was possible that the questions would change and the goals would evolve. If that occurred, participants would need to be notified to ensure they understand the purpose of the research as it changed. They were able to opt out of the research at any time.

The privacy of the research participants was maintained by keeping their identifying information private. The participants were informed of the intent to protect and not disclose any personal information about them, except as may be required by law (American Psychological Association, 2010b). Only one document was maintained that connects an individual to an identification code number. In all other documents, the participant was referred to by the code number. The information is stored on a dedicated USB drive and the drive is locked in a desk drawer. Data will be kept for seven years. Then, electronic data will be deleted and paper data will be destroyed.
The participants of this study may be part of a group where they are known to each other—for example, in the same organization or same small town. This situation required extra confidentiality precautions on the part of the qualitative researcher, including maintaining a constant high level of sensitivity to confidentiality, which is called reflexivity (Damianakis & Woodford, 2012). As the results of the research were being written, checks were made to be sure any narratives used could not be connected to a single individual. If it was pertinent to include a story or quote that may be identifiable, permission of the participant would have been asked, first.

A critical aspect of research integrity is data validity. Other researchers must believe that the data collected is good data (Frechtling & Boo, 2012). Data validity is a measure of how well the data collected measures what was intended to be measured. It is directly related to the trustworthiness, rigor, and quality of the study ("Committee on Science," 2009). To increase the data validity, observer effects were accounted for, the researcher’s perspective was honestly recorded, the strongest available data was used, and an audit trail was created ("Committee on Science," 2009; Wester, 2011).

Gender, ethnicity, and social position effects on the data were not encountered. Most engineers are white males, making a moderate, middle-class salary (Newman, n.d.; Occupational Outlook Handbook, 2012; OOChart, 2004). The researcher is also white and middle class, and so does not feel that ethnicity or social position affected the relationship with the research participants. The researcher’s gender is female, but the researcher was not attempting to interact with them as a peer. The role of interviewer and assessment administrator would appear as managerial to them, where gender equity is more common (Solis & Hall, 2011).
As an interviewer, the researcher plays an integral role in the interview (Schram, 2006; Shank, 2006). Shank (2006) explains that people bring their personal experiences, culture, and perspective into their qualitative research, and so they must acknowledge the impact this may have on their perceptions and interpretation. In an interview, the interaction of the researcher with the participant can affect the data, so researchers must identify their interests, biases, and assumptions (Creswell, 2013; Schram, 2006). In this study, the researcher is an electrical engineer, introverted, and a logic-based decision maker. Her background, education, and career path can inform her research and guide her in the search for understanding. Because of the similarities, the researcher was able to relate easily to the research participants, readily establishing credibility and rapport. The researcher did not tell the research participants what she believed was going on; she worked to avoid reaching premature conclusions. Because the participants’ perceptions of interpersonal skills development was discussed, and the researcher has experience in this area, it would have been easy for her to answer questions from participants about what they should do or how they should handle a situation. However, the researcher’s goal was to gather information about their perceptions of interpersonal skills development, and she hoped to learn about obstacles and affinities that she did not already know about. In order to do this, the researcher was careful not to interject her own assessment of their situations. If a participant asked the researcher for advice, the researcher reminded him or her of the research purpose and gently redirected the questions back to the participant.

The researcher’s perspective on this research has been shaped by her own personal experiences. The researcher feels that she is like the people she wants to study. The researcher needed to be sensitive to her own biases so she remained open to other
paths to or away from leadership skill development that differed from her own. The researcher felt excited about conducting this research with her group. People with the personality and decision preferences the researcher studied are mocked by society and the media as "nerds" (for example, in the television show *The Big Bang Theory* and the cartoon *Dilbert*) and viewed by many as insensitive and unfriendly (Hirsh & Kummerow, 1998). The researcher is a member of this marginalized group, and she feels the stereotype is unfair. The researcher kept all of these feelings under control, did not convey personal feelings to the participants, and recorded personal feelings in the field notes.

An audit trail for the data was maintained. This strengthened the validity of the data because it will allow readers to review the original data if necessary ("Committee on Science," 2009; Wester, 2011). An audit checklist was used as an aid to manage data related to the audit, and secure copies of all data was maintained.

Errors may occur in research due to mistakes or negligence. Mistakes are unintentional; they are errors which may occur in any part of the research process, including research design, data collection and storage, and even writing the dissertation ("Committee on Science," 2009; Karadag, 2010). Negligence is caused by researchers failing to take reasonable care and precautions in their actions ("Committee on Science," 2009). Mistakes were avoided through careful individual and committee review of the research protocol and the dissertation. Negligence was avoided by consistently acting in a deliberate and thoughtful fashion.

Research misconduct may take the form of fabrication or falsification of data. It may also occur through plagiarism ("Committee on Science," 2009; Frechtling & Boo,
Fabrication and falsification were avoided by maintaining a high level of personal integrity. Plagiarism is using someone else’s ideas or words without giving credit to the original source (American Psychological Association, 2010b). Plagiarism may be intentional or unintentional. Plagiarism was avoided by carefully acknowledging sources, paraphrasing, using quotes when using an author’s exact words, and asking permission to quote if the text exceeded 400 words (Roig, 2011).

Summary

Based on the research problem and the state of current research in this area, the research was conducted using a multiple case study method. The characteristics of leadership development for introverted engineers are unknown; this problem was exploratory in nature. Multiple case study was an appropriate research method for this research because meaning can be drawn from close examination of in-depth, first-person reports of life experiences. Using replication logic, participants were found who matched the criteria in the participant profile, and data was collected through several means, including interviews and background documents. A comprehensive individual record was completed for each participant to learn how they perceived the development of their interpersonal skills, and then a cross-case analysis of the findings was performed. Findings were reported using a combination of description and interpretation.

The integrity of the research is paramount. This integrity has several aspects: writing the dissertation, interacting with research participants, data handling and reporting, and mistakes, negligence, and misconduct. All of these areas must be continually monitored to ensure the trustworthiness of the research. If readers cannot trust the researcher or the data, they will not trust the observations or conclusions stated by the
researcher. Fortunately, integrity can be achieved through careful planning of research procedures.
Chapter 4: Findings

The purpose of this qualitative multiple case study was to analyze and synthesize the experiences of introverted, logic-based engineer leaders on the evolution of their interpersonal skills in the areas of (a) supportive communication, (b) influence, (c) conflict management, and (d) motivating others (Whetten & Cameron, 2011). For the research, six participants were selected and interviewed on the evolution of their interpersonal skills using an interview protocol, as seen in Appendix A. Participants were selected from a pool of volunteers based on the personality preferences of introversion and logic-based decision making as determined by the participant’s self-identified personality and decision preferences, supervisory experience, and whether or not the prospective participant was interested in being a leader. The participants’ personality and decision preferences were confirmed through the administration of the Myers-Briggs Type Indicator (MBTI) survey instrument. All participants were male, but not by design of the research. The interview data for each case was analyzed, and then a cross-case review was performed to find converging patterns and relationships. Saturation was reached with six participants.

This chapter presents the analysis of six interviews with participants who met the study criteria. The analysis process is described and the findings from the data are reported. The research questions for this study were:

Q1. How did engineers who are introverted and logic-based decision makers develop interpersonal supportive communication skills?

Q2. How did engineers who are introverted and logic-based decision makers develop interpersonal influence skills?
Q3. How did engineers who are introverted and logic-based decision makers develop interpersonal conflict management skills?

Q4. How did engineers who are introverted and logic-based decision makers develop interpersonal skills in motivating others?

Results

Five telephone interviews and one in-person interview were conducted. The volunteer participants answered all of the interview questions. The interviews were recorded and then transcribed into individual documents. All identifying information was removed from the transcripts to protect confidentiality. From the qualified volunteers, volunteer participant numbers C04, C07, and C12 were selected as participants to represent the central case—an engineer who is introverted and a logic-based decision maker who has been a supervisor for a minimum of three years and is interested in being a leader. Volunteer participant numbers A03, A09, and A15 were selected to represent the alternate case—an engineer who is introverted and a logic-based decision maker who has been a supervisor for a minimum of three years and is not interested in being a leader.

As each case was processed, the data was coded using a self-defined coding scheme. The code was developed from the theoretical framework, literature review, interview questions, initial review of the interviews, and ad hoc categories (Creswell, 2013; Miles, Huberman, & Saldaña (2014); Ruona (2005)). The chosen codes were descriptive or process codes. Descriptive codes are short words or phrases that describe the basic topic (Miles et al., 2014). Process codes are “–ing” words that imply action (Miles et al., 2014). Subcoding was also employed because the data seemed to have natural relationships for these initial groupings. Subcoding is a secondary word or phrase
assigned to a primary code because further refinement of the primary code was needed or an obvious interrelationship was observed (Miles et al., 2014). Codes were continually added, removed, reorganized, and redefined based on multiple reviews of the interviews. This was particularly important when the code choice during data analysis seemed ambiguous; when this occurred, the code needed further refinement to ensure consistent application. A table with operational definitions was created to facilitate this consistent application. Then, codes were compared across participant records (Burns, 2010). Codes that were common to many of the participants were identified, noting relationships and variations within and across cases.

After the first-cycle code list was developed, patterns were sought in second cycle coding (Miles et al., 2014). All unused codes were removed, and the remaining codes were rearranged into patterns using a thought organizational tool called an affinity diagram. Affinity diagrams create an environment that enhances the creative and intuitive grouping of a collection of ideas, and can be used by individuals and groups (Keller, 2011). Each idea was placed on a separate card or sticky note, and then all of the ideas were set out at one time in a random cloud formation (Keller, 2011). Next, the ideas were slowly matched into groupings based on perceived similarities. This works best if the ideas can be placed in a common area and rearranged over several days. When the ideas reached the final groupings, a brief label that described the grouped ideas was generated for each set of related ideas. The process is shown in Figure E1.

Seven patterns emerged from this process, as shown in Table 1. The pattern “Build Knowledge Base about Interpersonal Skills” included gaining knowledge based on longer term relationships, like supervisors, mentors, and other role models. It also
included more formal training programs and early experiences like being involved in high school or college leadership roles or athletic programs. A participant’s self-awareness and an articulation of belief about how the world works defined the pattern “Discover Patterns in Knowledge.” The pattern “Monitor Activities for Possible Need to Intervene” was comprised of the participants’ continual self-assessment of their performance and skill levels, thinking about the process and outcomes of events and considering alternative ways to try, and learning to discern a possible issue at an early stage. The “Decide to Intervene” pattern included the behaviors and responsibilities the participants assumed were part of their organizational roles. The pattern “Choose Intervention Strategy” included the participants’ analytic problem-solving skills and recognition of the systems nature of relationships, including how their own behavior affected the outcomes, the other person’s point of view, and other people or processes that might be affected beyond the obvious stakeholders. For the “Develop New Intervention Strategies” pattern, participants would observe or consult with peers, other managers, or their human resources department, or simply use a trial-and-error process where they learned as they went and adjusted as the situation unfolded. The pattern “Operationalize Intervention Strategy” included the relational philosophies the participants used when they were directly interacting with the person, like emotion management, fairness, and respect.

From the patterns, a network display was developed to illustrate how the patterns interacted, as shown in Figure 2. The engineers entered their supervisory positions with an existing knowledge base from training and/or significant support from a mentor. They then engaged in substantial introspection on what they knew, developing and storing a set
of patterns about how management works. The findings for these patterns will be
described in more detail for each research question.

Table 1

*Patterns About Developing Interpersonal Skills*

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While managing, the engineers monitored the activities of their subordinates,
watching for a need to intervene, with an emphasis on self-assessment of their
performance. C07 stated, “It doesn’t matter if we make mistakes or not. The sooner we
find a mistake, the quicker we can address it and move ahead,” and C12 said, “The one
thing that people hate more than an uncomfortable conversation is not having the
conversation.” A03 related, “If I notice that something’s trending the wrong way, I talk to
the employee about that sooner rather than let it get worse and get out of hand, or letting
it become standard operating procedure.” A15 stated, “As a more experienced manager,
I’m quicker to give small, frequent feedback rather than let something develop.” This
step was based, in part, on what they saw as their responsibilities in their role as a
manager. C04 felt that “I was there to help them and make sure they were successful.”
C07 related, “People tell me that I give them enough rope to hang themselves. Let them go and do! I’m not going to micromanage.” A15 stated, “I don’t spend a lot of time putting myself in other people’s business, so it’s not like I’m spending a lot of time trying to… I don’t think anyone who works for me would call me a micromanager by any means.”

If they decided to intervene, they selected an intervention strategy, usually based on a rational, analytical course of action. Part of this strategy involved looking at the issue from many perspectives, including the needs of the business and how their presence affects the system. C04 said,

I waited for an opportunity where we were offsite, outside of the workplace, and took that one-on-one. I was very candid and honest about the behaviors and issues with those behaviors and what effect it had on their coworkers as well as their productivity.

C07 stated, “We’re all a team right here. If you’re getting behind, the customer’s not going to be happy and that’s going to affect all of us.” C12 commented, “If you can’t look at your own role in a situation, then you’re never going to move forward in improving that kind of situation in the future.” A03 reflected, “I was risking bringing down the morale and the ability of our whole group by allowing a couple of the technicians to slide.” A09 commented,

I try to think things through and put myself in the other person’s shoes. I make sure I’m keeping their interest in mind as well and try to come up with positive ways to put a spin on it and instill confidence in themselves.

A15 related,
I think part of my job then is setting expectations for the leadership group that we’ve got limited resources, we’re only going to be able to get this much work done. At the same time, pitching it to the guys in my group, to see it as an opportunity as well as an additional burden.

Next, the engineers operationalized their strategy, deliberately and systematically choosing the tone and content of the exchange. Then they monitored the outcomes to see if further intervention was needed. C07 commented,

If you can respect people, at the end of the day we may agree to disagree, but if they know all the information that I have then they at least know that I’m not holding anything back from them or hiding something. We still don’t know the answer, but this is all the info that we have.

C12 stated, “You have to deliver the message in a way that it’s not a vindictive thing, not a negative thing.” A03 said,

My recommendation, if I was talking to someone, is you’ve got to have a firm attitude, because you’re trying to correct behavior, but treat them like a person and understand the situation, the conversation that you’re having, and maybe the effects of that, is going to be difficult for them, as well.

A15 remarked, “I tried to make sure I had a specific, recent example to talk through where I’d gotten that feedback without naming names, an example that I could use to make sure I was telling a coherent story.”

If the engineers did not know an appropriate intervention strategy, they sought new strategies to deploy. This may have been through consultation with available peers and support personnel, observation of other managers, or the decision to use a trial and
error approach. I will describe the findings for this step in more detail for each research question.

Once this flow was understood, a deeper look at the individual research questions was undertaken. Each research question was evaluated by looking at the participants in the central case and then the participants in the alternate case. Participant numbers C04, C07, and C12 represented the central case—an engineer who is introverted and a logic-based decision maker who has been a supervisor for a minimum of three years and is interested in being a leader. Participant numbers A03, A09, and A15 represented the alternate case—an engineer who is introverted and a logic-based decision maker who has been a supervisor for a minimum of three years and is not interested in being a leader.
Q1. How did engineers who are introverted and logic-based decision makers develop interpersonal supportive communication skills? Most of their skill development occurred in the “Build Knowledge Base about Interpersonal Skills,” “Discover Patterns in Knowledge,” and “Develop New Intervention Strategies” patterns. The engineers entered their supervisory positions with an existing knowledge base from training and/or significant support from a mentor. C04 commented, “Through some of the organizations I’ve worked in—my bosses pushed responsibilities down to me and gave me the latitude to make decisions, make change, make improvements.” C07 stated, “Dale Carnegie definitely gave me a jump.” C12 said, “If you can find a really good class it always helps with some of this.” A09 related, “I’d come back to the supervisor training. If a person hasn’t gone through a seminar like that, I would recommend it.”

They engaged in significant introspection on what they knew, developing and storing a set of patterns about how management works. The essence of this is captured by C04, “It’s something in the engineering mind. You’re thinking forward but at the same time reflecting back. Trying to make sure you’re not repeating any errors.”

If the engineers did not know an appropriate intervention strategy, they sought new strategies to deploy. This may have been through consultation with available peers and support personnel, observation of other managers, or the decision to use a trial and error approach. C04 said, “I had many bosses in my day, and I’ve had very good treatment and I’ve had very poor treatment. I try to learn from the poor treatment, especially how not to do it.” C12 stated, “It’s sometimes hard to transfer some of those concepts into action. I think that sometimes you just have to be able to go through it.” A09 reflected, “Stuff is going to happen on a daily basis. Just watching for it, take it
away. There are good and bad aspects of it, and learning from what you see is a good way to get better yourself.” A15 remarked, “I think it’s fair to say that pretty regularly I’ll find myself talking to somebody and in the act of having the conversation I’m solving the problem. People connect by talking it through.”

In summary, the participants’ responses to the interview questions supported the patterns developed from the data. The participants developed interpersonal skills by building a knowledge base, discovering patterns in knowledge through introspection, and developed new intervention strategies when they were needed. The knowledge base was developed through quality training courses and interaction with mentors. New intervention strategies were developed from observations, trial and error, and consultation with peers and support personnel.

Q2. How did engineers who are introverted and logic-based decision makers develop interpersonal influence skills? Most of their skill development occurred in the “Build Knowledge Base about Interpersonal Skills,” “Discover Patterns in Knowledge,” and “Develop New Intervention Strategies” patterns. The engineers entered their supervisory positions with an existing knowledge base from training and/or significant support from a mentor. C04 remarked, “I think that’s really where it all started for me, was that mentoring that I received from my sensei.” C12 stated, “I’ve been lucky enough to attend these fantastic classes that have really sent my mind into overdrive thinking about these things. It caught my imagination. I keep a running list of these lessons learned for myself.” A09 commented, “Even now, we’re still in contact; I’ll bounce ideas off of him and see if he has any suggestions. I certainly try to use him as a resource as much as possible.”
The participants engaged in significant introspection on what they knew, developing and storing a set of patterns about how management works. C12 said, I didn’t focus so much on the people I knew who did not wish to comply, or were the nonbelievers, because most of them... they call it the 80-20 rule. Some people spend 80 percent of their time with the 20 percent of resistors, when it’s really more beneficial to only spend 20 percent of your time on them.

A09 commented, That’s kind of one thing I’ve learned over the last couple years. Aim high and hope for some middle ground. The worst they’re going to say is no and you’re going to be back in the position where you’re at. In a somewhat realistic manner, shoot for the sky, but kind of be planning around what happens if that doesn’t come to full fruition.

A15 remarked, “Looking backwards, aside from just the effect of more experience, over time more and more things look like something you’ve seen before.”

If the engineers did not know an appropriate intervention strategy, they sought new strategies to deploy. This may have been through observation of other managers or the decision to use a trial and error approach. C04 commented, “I would have to refer back to observation. Thinking of the best things that you’ve experienced from your bosses and the people around you, and trying to apply those to the situation to influence people in the right direction.” C12 remarked, “I think you have to live through it and do a little trial and error.” A09 stated, Just observing some of the higher level senior leadership in the organization helps. They didn’t get to the position where they’re at by accident; they’ve had
some influence success. I try to observe how they conduct themselves and how they approach their interactions with other people.

In summary, the participants’ responses to the interview questions supported the patterns developed from the data. The participants developed interpersonal skills by building a knowledge base, discovering patterns in knowledge through introspection, and developed new intervention strategies when they were needed. The knowledge base was developed through quality training courses and interaction with mentors. New intervention strategies were developed from observations and trial and error.

**Q3.** How did engineers who are introverted and logic-based decision makers develop interpersonal conflict management skills? Most of their skill development occurred in the “Discover Patterns in Knowledge,” and “Develop New Intervention Strategies” patterns. For this research question, the participants only related a couple of generic comments regarding the building of an existing knowledge base from training and no comments about significant support from a mentor.

The participants engaged in introspection on what they knew, developing and storing a set of patterns about how management works. C12 commented, “Normally, I don’t have any problem keeping my emotions in check because I recognize that it doesn’t help the situation. I just don’t let things get out of control.” A09 remarked, “If you don’t take action and just let it fester, most of the time it won’t resolve itself on its own.” A15 related, “I think I do prefer decisions to be collaborative.”

If the engineers did not know an appropriate intervention strategy, they sought new strategies to deploy. Central case participants opted for trial and error. C04 commented, “Just hit it head on. I don’t know that there’s any preparation. If you’re
certain they’re going to get angry, it’s bound to be uncomfortable.” C07 stated, “I tried everything. Go talk to Person A, get their side of the story, talk to Person B, get their side of the story… Well they said this, then that person doesn’t think he said that. It was just frustrating.” An alternate case participant chose role-play to prepare. A03 stated,

Many times she would have to role play with me a little bit, for a number of these situations. I remember sitting down with her, trying to practice how I’d start out the conversation and role play that through. Especially at the beginning, going through with some of these engineers, trying to role play with her, and/or in my mind, how I wanted to word certain things so they wouldn’t be too offensive or so I could get the message I wanted across without conveying a negative message that I wasn’t trying to express.

For this research question, significant differences were noted in the other patterns, as well. The central case participants appeared to have come to terms with managing conflict. C04 stated “the discomfort is diminishing” and “I do think I’m getting better at it.” C07 remarked, “It’s more of asking questions rather than telling or dictating what to do. Maybe that’s the key of it, is asking questions.” C12 said, “I just realized that it doesn’t have to be a confrontation. It may be uncomfortable for him, but it doesn’t have to be uncomfortable for me.” Some of the alternate case participants expressed a more direct dislike for conflict. A03 commented,

I never got real comfortable with that, and even today I don’t like to be in a confrontational position with someone. I’m not as good as I’d like to be. I wish I could tell you that I got to the point where confrontations are no big deal to me, like they are to some people, but for me it’s difficult.
A09 said, “I guess if I had to classify myself, I’m conflict averse. I try to avoid conflict.”

When operationalizing an intervention strategy, the central case participants maintained a strong focus on keeping the discussion evidence based. C04 stated, “The one thing I will do in the beginning of the discussion is tell them I understand if you’re upset right now but bear with me and let me say my piece before you react to it.” C07 remarked, “It’s apparent that you two are not hearing what the other one is saying, you’re so upset that that’s clouding the other issues.” C12 commented, “When I see people get into trouble with conflict, it’s when they start letting their emotions rule them. If someone is really getting upset, you have to get them to step away.” The alternate case participants did not relate any comments regarding evidence-based discussions.

In summary, the participants’ responses to the interview questions supported the patterns developed from the data, except the knowledge base did not seem to be present. Then they discovered patterns in knowledge through introspection. Central case participants developed new intervention strategies through trial and error, while an alternate case participant chose role-play. The central case participants appeared to have come to terms with managing conflict, while some of the alternate case participants expressed a dislike for it. The central case participants all maintained a strong focus on keeping the discussion evidence based, while none of the alternate case participants mentioned this strategy.

**Q4.** How did engineers who are introverted and logic-based decision makers develop interpersonal skills in motivating others? Most of their skill development occurred in the “Build Knowledge Base about Interpersonal Skills,” “Discover Patterns in Knowledge,” and “Develop New Intervention Strategies” patterns. Some of the engineers
entered their supervisory positions with an existing knowledge base from their supervisors. C04 said, “Through some of the organizations I’ve worked in—my bosses pushed responsibilities down to me and gave me the latitude to make decisions, make change, make improvements. It helps build your confidence.” A09 stated, “I arrived at this way of thinking through my supervisor, primarily.”

They engaged in introspection on what they knew, developing and storing a set of patterns about how management works. C04 remarked,

When it’s all said and done, we’ll work ourselves out of jobs, and the business should be able to run itself, if you can motivate the supporting employees to take charge and have some ownership in what’s going on and try to improve it. I guess it’s from an improvement culture.

A09 stated, “It opened my eyes to the fact that really, people are motivated by different things. Everybody’s motivated by the same general small things. It’s not really anything revolutionary, but it’s something that I hadn’t realized.”

If the engineers did not know an appropriate intervention strategy, they sought new strategies to deploy. This may have been through observation of other managers or the decision to use a trial and error approach. C04 commented, “For all the bad bosses I’ve had, I’ve had at least half as many good ones. The good ones I’ve had were exceptional. They were all about focusing on the positives and changing the culture of the business.” C12 stated,

I see other people motivate through negative means. It doesn’t work with my personality. I don’t think it’s the right thing to do. I definitely learned that it doesn’t work for me. It’s back to focusing on figuring out how to get empathy for
other people, understand them, and focus on the positive. A03 said, “I had to spend a lot of time trying to think of ways to motivate them outside of what the program itself offered. We had to be creative.” A09 remarked, “I’m always trying to figure out ways to observe people for how I can do things better or handle situations in a different manner or whatever it might be. Try to learn and continue to improve myself.”

When operationalizing an intervention strategy, the central case participants’ comments focused on intrinsic motivators like praise and gratitude. C04 stated, “I try to find good, positive behavior and reinforce it one-on-one. Whether it be trying to draw ideas out of people, or if they’ve got a good idea, reinforce it, give them positive feedback.” C07 said, “Appreciate them. Tell them they did a good job on that one.” C12 commented, “Just tell them thank you.” The alternate case participants’ strategy was focused on the extrinsic motivation of incentives. A03 remarked, “A couple of different things we did to motivate them were prizes and tickets.” A15 related, “I tried to give more recognition for getting through gates than for the quality of them.” A09 reflected,

Some people are motivated by money. Some people are motivated by time away from work. Some people are motivated by just a thank you. That was something that I really hadn’t given much thought to or been exposed to, it was kind of an eye opener--different ways to reward and motivate people.

In summary, the participants’ responses to the interview questions supported the patterns developed from the data. Some of the engineers entered their supervisory positions with an existing knowledge base from their supervisors. Then they discovered patterns in knowledge through introspection, and developed new intervention strategies
when they were needed. New intervention strategies were developed from observations and trial and error. The central case participants focused on intrinsic motivators like praise and gratitude. The alternate case participants appeared more focused on incentives as an extrinsic reward.

**Evaluation of Findings**

This qualitative multiple case study was designed to analyze and synthesize the experiences of introverted, logic-based engineer leaders on the evolution of their interpersonal skills. Seven patterns were identified relating to the development of interpersonal skills in introverted engineers. The research questions were evaluated against those patterns. In this section, the results are interpreted in light of the conceptual framework and results are compared to expectations.

The results of this study contributed to leadership skills theory by extending leadership skills research to introverted engineers, a group that has been recognized for their paucity of skills in this arena. A need existed to understand how this group developed leadership skills. This study addressed this need by identifying a pattern to their leadership skills development and some differences between those supervisors who were interested in being a leader and those who were not interested in being a leader. These differences may affect an introverted engineer’s desire to become and continue as a leader.

The differences in the patterns for the central case and the alternate case appeared in the conflict management and motivation skills areas. The central case participants developed a just-do-it approach to conflict that focused on the facts of the situation, and they asked the other person to take a time out if their emotions hampered the discussion.
They directly intervened in the case of two feuding subordinates, personally mediating the dispute. The alternate case participants attempted to deal with feelings, allowing others to vent and express their frustration in meetings, and they took on the work of others to make space for priority tasks. When subordinates were feuding, they encouraged them to resolve it themselves. For motivation, the central case participants attempted to inspire subordinates, helping them see how they fit into the organization's vision and mission. The alternate case participants focused on providing extrinsic rewards to subordinates in order to motivate them. It appears from the composition of the patterns that the participants did not have much of an initial knowledge base in these areas, so the development of these leadership skills was principally random.

In leadership skills theory (Mumford, Zaccaro, Harding, et al, 2000), conflict management and motivation skills are components of the social skills leaders need to implement solutions to problems. These core skills must all be present in some degree for a leader to function effectively; conversely, if these skills are missing, people may not do well as a leader and so not prefer a leadership position. This is supported by the research findings.

Transformational leadership theory is supported by the pattern established for the motivation research question. In transformational leadership, leaders attempt to influence followers to support the organization’s vision and direction through intrinsic motivation (Northouse, 2016). The central case participants used intrinsic motivation strategies when responding to interview questions for the fourth research question regarding motivation.

Adaptive leadership theory is aligned with the pattern established for the conflict management research question. Adaptive leadership defines leadership as the interaction
between leaders and followers in different situations and stresses the activities of leaders (Northouse, 2016), including identifying challenges, providing direction and productive norms, and managing conflict. The central case participants faced and dealt with conflict as part of their normal activities, confident in their ability to manage it, in their responses to the third research question.

It was very clear, however, that some of these introverted engineers wanted to be supervisors. This does not support Avolio, Walumbwa, et al. (2009), who suggested a future area of leadership development research might focus on how the category people place themselves in as a leader affects the influence techniques they use with others. In this study, influence techniques were similar for both those who identified with a leadership role and those who did not.

The results of this study can also be used in the development of a leadership model for scientists and engineers. Current models described by Farr & Brazil (2009) and Sansone & Schreiber-Abshire (2006) are based more on extensive field experience than field research. This study can provide a foundation for an engineering leadership model that includes introverted engineers as leaders.

The findings of the study were consistent with the model proposed by Sansone and Schreiber-Abshire (2006). Their contention that relational skills, including conflict management and motivating employees, are the most difficult area for this group are supported in the findings. In addition, the patterns and network display in the findings coincide with their assertions that the leadership development program should include human dynamics and interpersonal skills, action learning, and managerial support.

Based on the findings, the leadership development model outlined by Farr and
Brazil (2009) would not be sufficient for leadership development in engineers. This model consists of three components—assessment, challenge, and support. It is missing a training component; some sort of formal training in basic skills appears foundational to skill development for introverted engineers.

A surprising outcome of the research was the response by several participants to the final, catchall question in the interview protocol: “Is there anything else you would like to share with me today?” Several participants expressed intense feelings about their positive perceived value of introverts taking on leadership roles. Two central case participants felt there was passive discrimination against introverted leaders. C04 remarked,

I guess just in a closing, being introverted is something that is hard to shake. I meet a lot of introverted engineers; the ones I do are by far, in my opinion, the most accurate and detailed as well as the most invisible. A lot of people look at it as a bad trait; I think it’s an opportunity. Build off of that strength and force yourself into awkward situations that will make you open up a little more and learn a bit about yourself and other people.

C12 commented,

I think one of the things that happens to introverts is that they often get the short end of the stick. They don’t stand out in a crowd. Myself, I’m not one that goes out and seeks attention. I think what a lot of people don’t recognize is that you can have an extravert who manages or leads a group of people, and that can be a complete mess if you’ve got a bunch of—well, it doesn’t really matter if they’re introverts or extraverts. If the guy at the top is taking all the attention, it can really
lead to a lot of discomfort down below. But if you’ve got an introvert at the top, they’re usually happy to have the extraverts down below in the organization stand out and shine. They also usually want to make sure that the introverts down below get the proper credit as well, and in the form that they want. I think it can lead to a very effective work organization. I think extraverts have to be very careful about that, because I think oftentimes they don’t understand what it is that they do to the introverts, who can absolutely be high performers.

An alternate case participant wanted to encourage introverts to give leadership a try. A09 responded,

I would encourage people that don’t have an interest in it to at least take an assignment once and expose themselves to that side. I think that some people might actually enjoy that side more once they learn more about it, the management side. I think it’s a really good opportunity to grow and get better at interacting with other people. I guess one thing I would stress is that people who don’t have interest in it should at least explore the opportunity once. Just because you’re in the position at an early stage doesn’t necessarily mean it’s the path you’ll always be in. I’d encourage people to explore it.

Summary

The purpose of this study was to analyze and synthesize the experiences of introverted engineers who are logic-based decision makers on the evolution of their interpersonal skills in the areas of supportive communication, influence, conflict management, and motivating others. Six volunteers who met the study criteria were interviewed. Three of the volunteer engineers typified the central case; they were
introverted and logic-based decision makers who were supervisors for a minimum of three years and were interested in being managers. The other three volunteers were selected to represent the alternate case—an engineer who is introverted and a logic-based decision maker who has been a supervisor for a minimum of three years and is not interested in being a manager.

In the results section, the outcomes of the interviews were organized and analyzed. A distinct network display emerged for how the participants built their knowledge base and developed new interventions when needed. The overall pattern of responses was very similar for all of the research questions. The participants developed interpersonal skills by building a knowledge base, discovering patterns in knowledge through introspection, and developed new intervention strategies when they were needed. However, noteworthy differences were observed for the pattern coding outcomes of the conflict management and motivation research questions.

Patterns were identified regarding the development of interpersonal skills in introverted engineers. The research questions were evaluated against those patterns. In the evaluation of findings, the results were interpreted in light of the conceptual framework and results were compared to expectations. The evaluation of findings concluded that several theories were supported or extended by this research. A surprise outcome was the participant emotions regarding introverted leaders. Several participants expressed strong emotions about feeling overlooked because they were introverts and the positive potential value of introverts taking on leadership roles.
Chapter 5: Implications, Recommendations, and Conclusions

The problem explored in this study was an inadequate understanding about how introverted engineers who are logic-based decision makers develop interpersonal skills. Engineers with these personality and decision-making preferences are not typically interested in learning how to lead, and they tend to have a negative attitude toward leadership and the usefulness of spending time to develop interpersonal skills (Fulmer & Hanson, 2010; Sansone & Schreiber-Abshire, 2006). However, introverted leaders are likely to produce better results than extraverted leaders when the tasks employees perform require proactive employees (Grant, Gino, & Hofmann, 2011a). Since engineering projects have a need for proactive employees due to the highly specialized nature of the work and the ethical requirements of engineering design, the need for introverted leaders is strong in this field. A better understanding of the vital leadership constructs of interpersonal skills in the areas of supportive communication, influence, conflict management, and motivating others, as they apply to introverts who are logic-based decision makers, may support more leader emergence in this population (Crumpton-Young et al., 2010).

The purpose of this study was to analyze and synthesize the experiences of introverted engineers who are logic-based decision makers on the evolution of their interpersonal skills in the areas of supportive communication, influence, conflict management, and motivating others. Six volunteers who met the study criteria were interviewed. Three of the volunteer engineers typified the central case; they were introverted and logic-based decision makers who were supervisors for a minimum of three years and were interested in being managers. The other three volunteers were
selected to represent the alternate case—an engineer who is introverted and a logic-based decision maker who has been a supervisor for a minimum of three years and is not interested in being a manager.

A qualitative approach was used because of the nature of the proposed research problem and the limited knowledge in this area. The characteristics of leadership development for introverted engineers are unknown; this problem was exploratory in nature. Multiple case study was an appropriate research method for this research because meaning can be drawn from close examination of in-depth, first-person reports of life experiences. Using replication logic, participants were found who matched the criteria in the participant profile, and data was collected through interviews and background documents.

Limitations of this study were the small sample size, the self-selection of the participants, and the self-reporting of interpersonal skills and encounters. A multiple case study format was used to mitigate these limitations. The interview protocol helped ensure all participants answered the complete set of questions.

Ethical issues were avoided with thorough preplanning of the research study. Ethical issues have several facets: writing the dissertation, interacting with research participants, data handling and reporting, and mistakes, negligence, and misconduct. All of these areas were continually monitored to ensure the trustworthiness of the research.

This chapter discusses the implications for the research that are supported by the research findings. The results are examined in the context of the study problem and purpose, and the literature review. Recommendations for practical applications of the study are listed. Areas for future study are presented.
Implications

Five telephone interviews and one in-person interview were conducted. The volunteer participants answered all of the interview questions. From the qualified volunteers, volunteer participant numbers C04, C07, and C12 were selected as participants to represent the central case—an engineer who is introverted and a logic-based decision maker who has been a supervisor for a minimum of three years and is interested in being a leader. Volunteer participant numbers A03, A09, and A15 were selected to represent the alternate case—an engineer who is introverted and a logic-based decision maker who has been a supervisor for a minimum of three years and is not interested in being a leader. All participants were male, but not by design of the research.

Seven patterns emerged from this process, as shown in Table 1. I will discuss the implications for the patterns “Build Knowledge Base about Interpersonal Skills,” “Discover Patterns in Knowledge,” and “Develop New Intervention Strategies” for each research question. The implication for the presence of the “Monitor Activities for Possible Need to Intervene,” the “Decide to Intervene,” and the “Operationalize Intervention Strategy” patterns is reflection is an essential skill for engineers with these personality preferences when developing and applying interpersonal skills. Reflection activities include self-assessment of their performance and skill levels, thinking about the process and outcomes of events and considering alternative ways to try, contemplating behaviors and responsibilities as part of their organizational roles, and relational philosophies used when directly interacting with a person. The implication for the “Choose Intervention Strategy” is introverted engineer leaders use systems thinking when employing interpersonal skills, which seemed to be an inherent skill for this group.
As a result of the reflection inherent in this interpersonal skill application process, following the collaborative training model developed by Hotho and Dowling (2010) may be effective. In this model, the participant uses self-assessment, evaluation, interpretation, and reflection to design and interact with the program. This aligns well with the process these engineers are already using.

Q1. How did engineers who are introverted and logic-based decision makers develop interpersonal supportive communication skills? The participants’ responses to the interview questions supported the patterns developed from the data, shown in Figure 3. The participants developed interpersonal skills by building a knowledge base, discovering patterns in knowledge through introspection, and developing new intervention strategies when they were needed. The knowledge base was developed through quality training courses and interaction with mentors. New intervention strategies were developed from observations, trial and error, and consultation with peers and support personnel. The participant responses reflect the use of all four learning pathways by introverted engineers: self-awareness/personal growth, conceptual understanding/skill learning, application, and feedback (Allen & Hartman, 2008; Kets de Vries & Korotov, 2011; Whetten & Cameron, 2011). The implications for this research question are that a pre-existing knowledge base is fundamental to skill development for introverted engineers, reflection is an integral part of good interpersonal skill development, and learning through observing others is a critical skill.

The leadership development model proposed by Farr and Brazil (2009) includes self-assessment and assigning growth projects with support from a coach or mentor and peers. The inclusion of formal training would be an important addition to this model.
Sansone and Schreiber-Abshire’s (2006) model contends that a leadership development program should include human dynamics and interpersonal skills, action learning, and managerial support. This is consistent with the patterns and network display in the findings. The reflection patterns in the process may make following the collaborative training model developed by Hotho and Dowling (2010) effective. In this model, the participant uses self-assessment, evaluation, interpretation, and reflection to design and interact with the program. This aligns well with the process these engineers are already using. The peer coaching suggested by Fulmer and Hanson (2010) is also an element of learning supportive communication skills for these engineers.

Q2. How did engineers who are introverted and logic-based decision makers develop interpersonal influence skills? The participants’ responses to the interview questions supported the patterns developed from the data, shown in Figure 3. The participants developed interpersonal skills by building a knowledge base, discovering patterns in knowledge through introspection, and developing new intervention strategies when they were needed. The knowledge base was developed through quality training courses and interaction with mentors. New intervention strategies were developed from observations and trial and error. The participant responses reflect the use of all four learning pathways by introverted engineers: self-awareness/personal growth, conceptual understanding/skill learning, application, and feedback (Allen & Hartman, 2008; Kets de Vries & Korotov, 2011; Whetten & Cameron, 2011). The implications for this research question are that a pre-existing knowledge base is fundamental to skill development for introverted engineers, reflection is an integral part of good interpersonal skill development, and learning through observing others is a critical skill.
The results for this research question are similar to the first research question, and are similarly supported by the literature. The leadership development model proposed by Farr and Brazil (2009) includes self-assessment and assigning growth projects with support from a coach or mentor and peers. The inclusion of formal training would be an important addition to this model. Sansone and Schreiber-Abshire’s (2006) model contends that a leadership development program should include human dynamics and interpersonal skills, action learning, and managerial support. This is consistent with the patterns and network display in the findings. The reflection patterns in the process may make following the collaborative training model developed by Hotho and Dowling (2010) effective. In this model, the participant uses self-assessment, evaluation, interpretation, and reflection to design and interact with the program. This aligns well with the process these engineers are already using.

Q3. How did engineers who are introverted and logic-based decision makers develop interpersonal conflict management skills? The participants’ responses to the interview questions supported the patterns developed from the data, shown in Figure 3, except the knowledge base did not seem to be present. Then they discovered patterns in knowledge through introspection. Central case participants developed new intervention strategies through trial and error, while an alternate case participant chose role-play. The central case participants appeared to have come to terms with managing conflict, while some of the alternate case participants expressed a dislike for it. The central case participants all maintained a strong focus on keeping the discussion evidence based, while none of the alternate case participants mentioned this strategy. The implications for this research question are that introverted engineers do not have a pre-existing knowledge
base for conflict management and learning a strategy that keeps the conflict focused on evidence is an important element in the skill base for engineers who choose to be leaders. The implication that reflection is an integral part of good interpersonal skill development is also visible.

For this research question, the alternate case participants’ conflict management skill levels may have been mismatched with the challenge level of the conflicts they needed to manage. This could be due to a lack of a knowledge base and/or lack of an effective intervention strategy in this area. DeRue and Wellman (2009) predicted that this would cause the managers to feel ineffective, which may result in them questioning their fit for the role of a manager, in effect disaffirming their leader identity (Ely et al., 2011). The outcome might be a decision to choose not to be a leader.

**Q4.** How did engineers who are introverted and logic-based decision makers develop interpersonal skills in motivating others? The participants’ responses to the interview questions supported the patterns developed from the data, shown in Figure 3. Some of the engineers entered their supervisory positions with an existing knowledge base from their supervisors. Then they discovered patterns in knowledge through introspection, and developed new intervention strategies when they were needed. New intervention strategies were developed from observations and trial and error. The central case participants focused on intrinsic motivators like praise and gratitude. The alternate case participants appeared more focused on incentives as an extrinsic reward. The implications for this research question are that a pre-existing knowledge base is fundamental to skill development for introverted engineers, reflection is an integral part of good interpersonal skill development, and learning how to employ intrinsic rewards
when motivating others is an important element in the skill base for engineers who choose to be leaders.

The participants in this study did not appear to have success with the traditional model for motivating others using extrinsic rewards tailored to the individual. The central case participants’ reliance on intrinsic motivators more closely resembled a positive leadership model, which focuses on intrinsic values. The positive leader emphasizes strengths, fosters gratitude and positive communications, seeks the opportunity in problems, and encourages contribution to the organization in addition to individual achievement, inspiring employees to work hard to achieve organizational goals (Cameron, 2012).

At the end of the interview, some of the participants volunteered their thoughts on the positive potential value of introverted engineer leaders. The implication from their unexpected responses is that introverted engineers have a lot to offer engineering management but their potential is not being utilized. Their statements align with the research of Grant et al. (2011a) that show introverted leaders are likely to produce better results than extraverted leaders when the tasks employees perform require proactive employees. In addition, the statement encouraging introverts to explore a leadership role highlights the idea that these engineers may not be willing to try an assignment as a leader. This may be because introverts do not fit the implicit identity for leaders in American culture as described by Ely et al. (2011).

**Recommendations**

The participants of this study followed a common pattern when in a situation requiring the application of interpersonal skills. This pattern could be used by academics
and practitioners to better understand how introverted, logic-based engineers develop and apply interpersonal skills. The results also highlight the strengths and challenges of these engineers. In addition, the results establish the existence of introverted engineers who prefer being in a leadership role and believe they are effective in that role.

There are some practical applications for the study results. Formal training in interpersonal skills is foundational to leadership development for introverted, logic-based engineers. The training should provide practical skill-based development in supportive communications, influence, conflict management, and intrinsic motivation. In addition, the training should model good reflection techniques, the steps for learning through observation, and examples of how systems-thinking applies to interpersonal skills. In addition, since observation is a key component of the learning process for introverted engineers, it becomes important for all managers to develop interpersonal skills so introverts have good role models to observe.

Because of the predominance of learning through coaches, mentors, and peers, a program which expands the network of introverted engineers could benefit their interpersonal skill development. This would not be a networking event, but rather a pairing of engineers to support an organizational need. An example of this would be assigning two engineers to an accident investigation team, where they would interview witnesses, supervisors, and key experts together.

Future research in this area could explore the components of interpersonal skills training delivery for introverted engineers. The study participants seemed to value practical training that explored concepts, provided tips and tricks, and involved skill practice. In addition, they either mentioned well known programs, like Dale Carnegie and
Fred Pryor, or talked about the high level of reputation and expertise that a program leader had.

Another area for future research would be the effects of gender on the results. All of the participants in the current study were male. Women experience leadership identity in a different way than men do, as described in the research by Ely et al. (2011). This may result in different patterns for learning interpersonal skills.

Finally, the results from this study might benefit from an exploration of the success and/or effectiveness of the participants. The current study did not use any objective measure of success or effectiveness. It is possible that the patterns that were discovered change based on manager success.

**Conclusion**

The problem explored in this study was an inadequate understanding about how introverted engineers who are logic-based decision makers develop interpersonal skills. This was accomplished by analyzing and synthesizing the experiences of introverted engineers who are logic-based decision makers on the evolution of their interpersonal skills in the areas of supportive communication, influence, conflict management, and motivating others. A qualitative multiple case study method was used for this research to draw meaning from the close examination of in-depth, first-person reports of life experiences. Study limitations were mitigated by the use of the multiple case research method and an interview protocol. Ethical issues were avoided by careful planning of the research study.

Multiple implications were supported by the research findings. One implication is that reflection is an essential skill for engineers with these personality preferences when
developing and applying interpersonal skills. Another implication is that introverted engineer leaders use systems thinking when employing interpersonal skills, and this seemed to be an inherent skill for this group. The next implication is that a pre-existing knowledge base is fundamental to skill development for introverted engineers, followed by the implication that learning through observing others is a critical skill. The implication that introverted engineers do not have a pre-existing knowledge base for conflict management is coupled with the implication that learning a strategy that keeps conflict focused on evidence is an important element in the skill base for engineers who choose to be leaders. For motivation skills, the implication is that learning how to employ intrinsic rewards is essential. Finally, the implication from the unexpected responses from some of the participants is that introverted engineers have a lot to offer engineering management but their potential is not being utilized.

The participants of this study followed a common pattern when in a situation requiring the application of interpersonal skills. A practical application for the study results is the development of formal training in interpersonal skills for introverted, logic-based engineers. Another practical application is the development of network expansion opportunities for these engineers. Future research might look at the components of interpersonal skills training delivery for this audience, the effects of gender on the results, and whether managerial success/effectiveness changes the patterns for applying interpersonal skills.
References


Damianakis, T., & Woodford, M. R. (2012). Qualitative research with small connected
communities: Generating new knowledge while upholding research ethics.
*Qualitative Health Research, 22*(5), 708-718. http://dx.doi.org/10.1177/1049732311431444


Felder, R. M., Felder, G. N., & Dietz, E. J. (2002). The effects of personality type on


Appendixes
Appendix A: Initial Interview Protocol

Interviewee ________________________________
Location __________________________________
Date/Time _________________________________

Opening Script

Thank you for agreeing to speak with me. This interview will last approximately one hour. You will receive a small incentive for participating. To reduce the amount of notes I have to take and allow me to concentrate on your interview, I will be recording our conversation. I will provide you with a copy of the transcript for you to review, comment on, and correct. Your individual responses will be kept confidential and you will never be referred to by name.

Please read and sign the Consent Form. In summary, it states that all information gathered from you is confidential, your participation is voluntary, and you may stop participating at any time for any reason.

The purpose of my study is to learn more about the evolution of interpersonal skills in introverted engineers who are logic-based decision makers. Today we’ll look at the specific skills of supportive communication, influence, conflict management, and motivating others. My study will not evaluate your experiences, only record them and look for patterns with others.
This research study will be submitted in partial fulfillment of the requirements for my doctor of philosophy degree at Northcentral University. The results will be published as a dissertation.

*Interview Questions*

Warm-up questions covering basic background

1. Tell me about any formal training you’ve received or courses you’ve taken that relate to supervision, management, leadership or interpersonal skills.
   
   Probes: What did you like about the formal training?
   
   What did you dislike about the formal training?

2. Tell me about any leadership roles you held in school, your community, or at work.
   
   Probe: How did you move into that position?

Research questions

1. At work, supportive communication is verbal interaction between employees that preserve and sustain the relationship while still delivering the intended message to the other person, even when that message is negative (e.g., when correcting behavior or delivering negative feedback).
   
   • Tell me about a time when you had to use supportive communication skills with someone else at work.
   
   Probes: What was the situation in which the experience occurred?
   
   Why did that experience matter?
   
   • How did you learn how to use the skill in that way?
   
   Probe: What was it like for you when you were using that skill?
• In what other ways did you learn about this skill?
  
  Probe: How did you feel about learning it in that way?
• In what ways have your supportive communication skills changed or developed over time?
• What experiences would you recommend for someone who was like you, to help them develop their supportive communication skills?

2. In a work setting, influence is the ability to get other people to accomplish a desired goal using personal and position power.
• Tell me about a time when you had to use influence skills with someone else at work.
  
  Probes: What was the situation in which the experience occurred?
  
  Why did that experience matter?
• How did you learn how to use the skill in that way?
  
  Probe: What was it like for you when you were using that skill?
• In what other ways did you learn about this skill?
  
  Probe: How did you feel about learning it in that way?
• In what ways have your influence skills changed or developed over time?
• What experiences would you recommend for someone who was like you, to help them develop their influence skills?

3. Conflict management enables employees to resolve disagreements about the best use of resources in the most efficient manner without creating anger and resentment.
• Tell me about a time when you had to use conflict management skills with someone else at work.

   Probes:  What was the situation in which the experience occurred?
            Why did that experience matter?

• How did you learn how to use the skill in that way?

   Probes:  What was it like for you when you were using that skill?

• In what other ways did you learn about this skill?

   Probes:  How did you feel about learning it in that way?

• In what ways have your conflict management skills changed or developed over time?

• What experiences would you recommend for someone who was like you, to help them develop their conflict management skills?

4. The ability to motivate others increases employees’ desire and commitment to accomplish work tasks.

• Tell me about a time when you had to use motivation skills with someone else at work.

   Probes:  What was the situation in which the experience occurred?
            Why did that experience matter?

• How did you learn how to use the skill in that way?

   Probes:  What was it like for you when you were using that skill?

• In what other ways did you learn about this skill?

   Probes:  How did you feel about learning it in that way?

• In what ways have your motivation skills changed or developed over time?
• What experiences would you recommend for someone who was like you, to help them develop their motivation skills?

5. Is there anything else you would like to share with me today?

Closing Script

Thank you for participating. I will be providing you with a transcript of this interview for your review, comments, and changes. We have a Follow up Interview scheduled for __________________________ (date/time/location). I will let you know when my dissertation is available and provide you with a digital copy if you want one.
Appendix B: Research Participant Request for Volunteers

Invitation to Participate in a Research Study

Please consider joining this research study. The purpose of this study is to learn more about the growth of interpersonal skills in introverted engineers who are logic-based decision makers. This study will not evaluate your skills. It will only record them and look for patterns with others.

To be considered for this study, you will need to:

- Hold at least a bachelor’s degree in electrical, computer, mechanical, civil, or chemical engineering from an ABET accredited university in the United States (U.S.)
- Have 3 or more years of supervisory experience as a full-time engineer
- Be a US citizen
- Believe you make decisions based on facts and evidence, as opposed to making decisions based on understanding the impact on others
- Believe you are an introvert. In this case, an introvert is a person who prefers solitude and solitary activities and gains energy from this state. Being around other people is an energy drain for introverts.
- Complete a pre-qualifying survey

If you are willing to be considered for this study, please complete the brief pre-screening survey, which is a Google form. An informed consent form will be sent to you for you to sign. Those who complete the process described below will receive $50 USD.

If selected for the study, you will be asked to take the Myers-Briggs Type Indicator (MBTI) survey. Based on the MBTI results, you may be asked to participate in the next phase of the study. For this phase you will provide a current resume. Then you will take part in a one hour interview, which may be in person, on the phone, over the internet, or through a video service. In the interview, you will be asked to provide information about your work relating to interactions with coworkers. Later, a follow-up chat will be held to clear up any questions. Finally, you can choose to review the interview transcripts and make corrections.

Your responses will be kept confidential. You will never be referred to by name. This research study will be submitted in partial fulfillment of the requirements for a doctor of philosophy degree. The results will be published as a dissertation.

Please contact Ruth Archer with any questions. Her phone is (906) 370-4252 or email R.Archer5815@email.ncu.edu. Ruth is a doctoral student at Northcentral University.
Appendix C: Pre-Qualifying Survey

Google Form Questions for Pre-Qualifying Survey

1. Do you hold at least a bachelor’s degree in electrical, computer, mechanical, civil, or chemical engineering from an ABET accredited university in the United States (U.S.)?

2. Do you have 3 or more years of supervisory experience as a full-time engineer?

3. Are you a U.S. citizen?

4. Do you believe you make decisions based on facts and evidence, as opposed to making decisions based on understanding the impact on others?

5. Do you believe you are an introvert? In this case, an introvert is a person who prefers solitude and solitary activities and gains energy from this state. Being around other people is an energy drain for introverts.

6. This study will benefit from both participants who are interested in being in a leadership position and participants who are not interested.
   I am interested in being in a leadership position.
   ___ True
   ___ False

7. I am NOT a current employee or student at Michigan Technological University.
   ___ True
   ___ False

8. Please provide the following contact information:
   Name:
   Email Address:
   Phone Number:
   Linkedin profile URL, if available:
Appendix D: Informed Consent Form

Introduction:

My name is Ruth Archer. I am a doctoral student at Northcentral University. I am conducting research on the growth of interpersonal skills in introverted engineers who are logic-based decision makers. I am completing this research as part of my doctoral degree. I invite you to participate.

Activities:

If you are selected to participate in this research, you will be asked to:

1. Take the Myers-Briggs Type Indicator (MBTI) survey (30 minutes)
2. Provide a current resume or access to a current and comprehensive LinkedIn profile (30 minutes or less)
3. Take part in an interview (1 hour)
4. Take part in a follow-up conversation (30 minutes)
5. (Optional) Review the interview transcripts and make corrections (30 minutes)

Eligibility:

You are eligible to participate in this research if you:

1. Hold at least a bachelor’s degree in electrical, computer, mechanical, civil, or chemical engineering from an ABET accredited university in the United States (U.S.)
2. Have 3 or more years of supervisory experience as a full-time engineer
3. Are a U.S. citizen
4. Believe you make decisions based on facts and evidence, as opposed to making decisions based on understanding the impact on others
5. Believe you are an introvert. In this case, an introvert is a person who prefers solitude and solitary activities and gains energy from this state. Being around other people is an energy drain for introverts.
6. Complete a pre-qualifying survey

You are not eligible to participate in this research if you:

1. Are a current employee or student of Michigan Technological University

I hope to include 8 to 12 people in this research.

Risks:

There are minimal risks in this study. A possible risk is mild discomfort resulting from speaking to a stranger.
To decrease the impact of these risks, you can skip any question and/or stop participation at any time.

**Benefits:**

If you decide to participate, there are no direct benefits to you.

The potential benefits to others are the improvement of leadership development programs for introverted engineers who are logic-based decision makers.

**Compensation:**

To thank you for your willingness to participate, you will be given $50 USD.

**Audiotaping:**

I would like to use a voice recorder to record your responses. You cannot still participate if you do not wish to be recorded.

Please sign here if I can record you: ________________________________

**Confidentiality:**

The information you provide will be kept confidential to the extent allowable by law. Some steps I will take to keep your identity confidential are: I will use a code number to identify you. I will keep your name separate from your answers.

The people who will have access to your information are myself and my dissertation chair. The Institutional Review Board may also review my research and view your information.

I will secure your information with these steps: I will store the information on a dedicated USB drive. I will keep the drive locked in a desk drawer. Only one document will be maintained that connects you to a code number. In all other documents, you will be referred to by the code number.

I will keep your data for 7 years. Then, I will delete electronic data and destroy paper data.

**Contact Information:**

If you have questions for me, you can contact me at email R.Archer5815@email.ncu.edu. Also you may call me at (906) 370-4252.
My dissertation chair’s name is Cynthia Loubier. She works at Northcentral University. She is supervising me on the research. You can contact her at email cloubier@ncu.edu. You may also call her at 888-327-2877 x6007.

If you have questions about your rights in the research, contact the Institutional Review Board (IRB). Also, if a problem has occurred or if you are injured during your participation, please contact the IRB. You may reach them at irb@ncu.edu or 1-888-327-2877 ext. 8014.

**Voluntary Participation:**

Your participation is voluntary. If you decide not to participate, or if you stop participation after you start, there will be no penalty to you. You will not lose any benefit to which you are otherwise entitled.

**Signature:**

A signature indicates your understanding of this consent form. You will be given a copy of the form for your information.

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Participant Signature          Printed Name          Date

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Researcher Signature          Printed Name          Date
Appendix E: Affinity Diagram for Finding Patterns

Figure E1. The sorting progression in an Affinity Diagram process begins with (a) creating a cloud of the codes to be sorted, followed by (b) grouping those codes which seem to have perceived similarities. Grouping and regrouping is repeated over time until (c) an acceptable outcome is achieved. The dark square indicates the label which describes the grouped ideas.