THE EXPERIENCE OF ENGINEERS LEADING PROJECT TEAMS: A GENERIC QUALITATIVE INQUIRY

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Abstract

This generic qualitative inquiry focuses on the leadership experiences of engineers leading project teams. Ten face-to-face interviews were conducted with current engineers in project leadership roles. These individuals were selected by their organizational leaders and other engineers as effective project leaders. The results indicated that although these leaders do not necessarily use a common leadership style, they lead their project team members by: developing trust-based relationships, committing to the team, perspective taking, learning from experience, and utilizing the engineering mindset. Additionally, it was essential that leadership training was provided within the context of actual experiences and that the leadership approaches supported the individuals involved in a project and the work to be completed. This provides a foundation for further investigation into these leadership attributes and the relationships to each other and project outcomes, engineering leadership skill development, and developing a model of leadership that is grounded in the engineering profession.

Dedication

To my husband Patrick and daughters, Alyssa and Camille, for their constant support and understanding as I completed the dissertation process. I know that you sacrificed for me so that I could accomplish what was important to me; I hope that you know how much it is appreciated. To my dad, Arthur Rose, who instilled in me the value of education and the unquestioned importance of a fulfilling career. Your values of fairness, understanding, empathy, and acceptance have long influenced my perspective and outlook on life, driving me to help others see what is possible in themselves.

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CHAPTER 1. INTRODUCTION

Background of the Study

This study examined engineering project leadership, which has been an understudied application of leadership theory. Considering the work of engineers tends to be creative and complex, requires a broad range of skills and expertise, and tends to be closely connected to the economic drivers of an organization (Robledo, Peterson, & Mumford, 2012), it is worthy of independent study. The work of engineers tends to be project-based (Robledo et al., 2012), which is an approach that has been increasingly used as a means to organize, structure, and manage the complexity of engineering work and ensure that the outcomes are achieved (Hodgson, Paton, & Cicmil, 2011). These complex problems require that multiple experts work together to develop an effective solution, which requires higher levels of collaborative effort and ultimately places an importance on the team's leadership (Mumford, Scott, Gaddis, & Strange, 2002).

As project-based organizations become more prevalent (Hodgson et al., 2011), the experience of engineers in these project leadership roles needs to be understood to best support the training and development of the skills required to be successful. Specifically, it is important to understand how engineering project leaders have supported the professional identity, motivation, creativity, and project performance of engineers. Furthermore, considering the impact engineering work has on the economic viability of the organization, this is of particular importance to industrial-organizational psychology and the success of organizations. Currently, there is little research to direct the training, evaluation, and development of engineering leaders (Robledo et al., 2012; Rottman, Sacks, & Reeve, 2014). This study will utilize generic qualitative methodology to develop an understanding of how these engineers experience these leadership positions.

This study examines engineering leadership within the context of project-based work. Often, the work of engineers is completed through projects where one of the engineers on the team is responsible for project leadership. Although engineers, and engineering projects, are common in organizations, there is little research that provides insights into how they experience this leadership (Robledo et al., 2012; Rottman et al., 2014). Furthermore, because there is little research that indicates how engineers experience project leadership, the education and training curricula are not necessarily reflective of the leadership approach and processes that would best benefit engineers and their work (Rottman et al., 2014). This disconnect may lead to underperformance, lack of cohesion, and ultimately higher costs, lack of innovation, and less profit for organizations (Garcia-Chas, Neira-Fontela, & Varela-Neira, 2015; Laglera, Collado, & Montes de Oca, 2013).

Engineering is the application of technical knowledge to solve problems and create possibilities. Engineers design, build, and implement improvements that are technically-orientated through an ability to solve complex problems and translate abstract ideas into reality in practical and cost-effective manners. Engineers often serve in consequential roles throughout all phases of innovation within for-profit organizations (Williamson, Lounsbury, & Han, 2013). This means that they must function more entrepreneurially, drawing on qualities that have not been typically found required in traditional engineering jobs including visionary thinking, flexibility, risk-taking, comfort with uncertainty, curiosity, self-motivation, and creativity

(Williamson et al., 2013). Their work is often completed through project-based teams, requiring cross-disciplinary collaboration and technical mastery (Rottman et al., 2014). This places a heightened importance on intrinsic motivation, influence, and facilitation skills (Williamson et al., 2013).

Historically, engineers have been viewed as introverted and tough-minded, and with less than average social skills (Van der Molen, Schmidt, & Kruisman, 2007). Their training places a strong emphasis on technical mastery, professionalism, and application expertise (Elegbe, 2015). Most programs utilize internship experiences and draw on team-based projects to develop a sense of interdependence on others, communications, and leadership. However, the learning does not appear to be internalized, and the value of these skills are undervalued in comparison to technical knowledge and capabilities (Elegbe, 2015; Rottman et al., 2014). This is likely a result of the technical demands of the field and the general lack of focus on a broader education (Elegbe, 2015; Rottman et al., 2014) which can deprive students of developing a broader, richer perspective of their roles.

Individuals in engineering positions are often key to the economic success and ongoing sustainability of their organizations (Robledo et al., 2012). Their work is by nature creative and complex, requires a wide range of skill and expertise, requires the investment of substantial resources, and often occurs in project teams (Robeldo et al., 2012). At the same time, there is little research regarding engineering leadership. Rottman et al. (2014) found that engineers value leaders who were skilled in group process, those that could effectively bring together different organizational groups to achieve a goal, and those that acknowledged and drew upon their team members' strengths. The Rottman et al. (2014) research found that the areas of technical mastery, collaborative skills, and organizational innovation were the dominant leadership themes that emerged. They found that although engineers do lead, they do so in a way that is largely resistant to the dominant leadership paradigms that have been studied in other disciplines (Rottman et al., 2014). In general, there is little research that indicates how engineers lead, how current leadership theories support the engineering profession, or how to educate engineers in leadership theory that is grounded in the professional leadership experiences of engineers (Robledo et al, 2012). The early stage of the research and the complexity of the population and their work indicates further understanding of how engineers experience leadership is required.

Although there is a lesser focus on developing leadership skills (Rottman et al., 2015), engineers are typically more sensitive to leadership (Laglera et al., 2013). This indicates an importance in understanding how engineers lead so that the corresponding leadership skills can be developed. Engineers tend to be higher in intrinsic motivation (Williamson et al., 2013) and work in project teams where there is high task interdependence that requires collaboration and creativity (Hon & Chan, 2012). Although they are perceived as introverts, they tend to be slightly more extraverted than non-engineers and are drawn toward working with others (van der Molen et al., 2007). At the same time, they tend to have a high desire for autonomy and need to be able to concentrate and focus (Williamson et al., 2013). This poses a unique requirement on project leadership to balance these needs, facilitate teamwork and communications, and achieve the results required by the organization. Considering engineering work is largely executed through projects (Mumford et al., 2002), this application of leadership will provide valuable insights into how engineers come together to accomplish a goal.

An important aspect of project success is creativity (Mumford et al., 2002). Creative work can occur when the tasks required involve complex, ill-defined problems and where the generation of novel, useful solutions is required (Mumford et al., 2002). This is reflective of engineering projects. Additionally, autonomy contributes to a creative climate (Hunter, Bedell, & Mumford, 2007). Combining autonomy, professional identity, and autonomous motivation, as well as the project ambiguity and risks, the tactics of leadership in other settings may not apply (Mumford et al., 2002). It is also unknown how the project leaders support the autonomous motivation and creativity of team members (Mumford et al., 2002). Furthermore, models of leadership that have shown to be effective in other contexts may negatively impact engineers by restricting autonomy, which ultimately reduces creativity (Mumford et al., 2002). More specifically, additional information is needed to understand how engineers experience the transition to project leadership roles, how they view the structural and organizational contexts in which they work, and how they have supported the autonomy and creativity of team members (Hodgson et al., 2011).

Based upon previous work history, this topic is of particular interest to the researcher. For over ten years the researcher has worked within an engineering organization and experienced the unique behaviors, respect of individual knowledge, and the ease with which they work together to accomplishment a project. When reviewing the literature to better understand the leadership of engineers, there was minimal research available. Considering the uniqueness of the population, understanding how engineers experience leadership with the context of project-work was of great interest.

Need for the Study

There is a small body of literature on engineering project management and leadership. Much of the engineering leadership literature is based on engineering education approaches (Rottman et al., 2014), and existing models of leadership have not been studied to understand their application to engineering (Robledo et al., 2012). We know that leadership can have a strong influence on the performance, engagement, and creativity of individuals (Ghadi, Fernando, & Caputi, 2012; Mohammed, Fernando, & Caputi, 2013). We also know that engaged workers are more creative, productive, and more willing to put in extra effort (Bakker & Demerouti, 2008). In order to stay globally competitive, engineering training needs to expand beyond technical problem solving to incorporate the humanistic elements of their profession (Rottman et al., 2014).

However, there has been little research conducted on how engineers lead (Rottman et al., 2014), and specifically how engineers lead project teams (Hodgson et al., 2011). Furthermore, much of the project management research is based on model implementation (El-Sabaa, 2001; Hodgson et al., 2011), transition struggles (Hodgson et al., 2011), required skills for effective managers (El-Sabaa, 2001), and team processes (Rahman & Kumaraswamy, 2005). Additional information is needed to understand how engineers leading projects experience the structural and organization contexts in which they work, how they experience the transition into project leadership, and how they support the creative, collaborative work required (Hodgson et al., 2011). This profession is unique in the context and requirements of their work, the typically high desire for autonomy, and the strong achievement orientation (Van Der Molen et al., 2007), which indicates that the population is worthy of specific study. Therefore, it is important to understand how this population experiences project team leadership.

Purpose of the Study

The purpose of this study is to describe how engineers experience the leadership of project teams. Project teams are common in engineering and are often created to solve ambiguous, complex problems (Mumford et al., 2002) that will require adaptation to the changing risks and requirements of the project (Rahman & Kumaraswamy, 2005). The leader needs to create and adapt structures to meet the needs of the project, support the autonomous motivation of the individual team members (Mumford et al., 2002), and manipulate knowledge for new applications (Smith & Paquette, 2010).

This study identifies how engineers leading project teams experience this specific application of leadership. Furthermore, this study advances the knowledge of engineering leadership in a broader sense by providing insights through this application of engineering leadership experiences. This includes gaining additional understanding of how engineers support the professional identity, motivation, creative work, and performance of other engineers which can be utilized to support the education, training, and skill development of engineers to lead these types of projects.

Project-based work is common for engineers (Robledo et al., 2012). These projects can be described as ambiguous, high-risk, and complex (Mumford et al., 2002), and the project structure is often a means to reduce complexity, promote innovation, and ensure outcomes (Robledo et al., 2012). This work requires creativity, expertise, the ability to work through ambiguity, and the substantial investment of resources (Robledo et al., 2012). Williamson et al. (2013) found that engineers tended to be characterized by openness, flexibility, cognitive complexity, self-confidence, dominance, and introversion. These characteristics, coupled with the investment in their knowledge and profession, allow for the manipulation of knowledge to solve new problems (Smith & Paquette, 2010). This fits the nature of creative work, which requires a substantial level of expertise (Byrne, Mumford, Barrett, & Vessey, 2009). Due to the uniqueness of the population, it is important to understand how this group experiences project team leadership.

Significance of the Study

There is a current gap in the literature that this study will address. Engineering typically requires that multiple experts work together to develop an effective solution to a complex problem, and this process requires high levels of collaboration. This places a heightened importance on the project team's leadership (Mumford et al., 2002). However, there is little research to inform industrial-organizational psychology as to how engineers effectively lead these teams (Laglera et al. 2013; Rottman et al., 2014). It is important to understand how existing leadership theories may inform the practice of engineering leadership as well as the development of leadership skills.

As we continue to transition into a knowledge economy (Akhavan, Ramezan, Moghaddam, & Mehralian, 2014), the work of engineers and their ability to manipulate knowledge to solve problems is of a heightened importance. In a knowledge economy, organizational knowledge and intellectual capital are the keys to competitive advantage (Bjornson & Torgeir, 2008; Jafari, Akhavan, & Mortezaei, 2009). The direct impact that the results of engineering project work have on the organization, including its profitability and competitive advantage (Robledo et al., 2012), make this an important topic for industrial-organizational psychology. Additionally, Murugesan (2012) emphasized the complexity of engineering project work and the importance of engineering project leadership to the success of an organization. In order to support the profession, it is important to understand how engineers lead project teams, and how engineers develop these skills and experience these leadership situations. This will allow for both future research and practical implications for practitioners.

Murugesan (2012) shared potential leadership theories that may support engineering leadership such as transactional leadership, transformational leadership, and servant leadership.

The Murugesan (2012) article also presents the importance of balancing the project management approach with the motivation required from leadership. Furthermore, Emison (2011) presents the current challenge in engineering leadership as the need to transform the profession so that the adaptability of the profession matches the complexities that it is facing. This places further importance on understanding engineering leadership, and how it relates to the current industrial-organizational psychology research. This study will provide insights into these experiences that can be utilized by industrial-organizational researchers and practitioners.

At the same time, there is a desire to increase the leadership training of engineers (Rottman et al., 2014). However, there is little research that indicates how current leadership theories support the engineering profession (Robledo et al., 2012). Furthermore, there is little research that indicates how project leaders can best support the necessary autonomy and creativity of the engineers on a project team (Mumford et al., 2002). This research study adds to the knowledge base by describing the experience of engineers in project leadership roles which will inform project management research, engineering leadership research, and the application of self-determination theory to engineering research.

As project-based organizations become more prevalent (Hodgson et al., 2011), the importance of understanding the experience of engineers leading projects elevates. The results will provide value to organizations by providing guidance as to the effective leadership of engineers. Considering engineers play consequential roles for organizations, it is important to better understand this population. Effective leadership can enhance their intrinsic motivation, supporting creativity, innovation, and teamwork, leading to increased value to organizations. Additionally, this study will enhance the knowledge of self-determination theory by applying it to a new population within the workplace context. The results will inform theory, practice, and the education of future engineering leaders.

This study has several practical implications for education, training, and organizations. Although there is a large amount of research on leadership and project management, there is little research to direct the training, evaluation, and development of engineering leaders (Robledo et al., 2012; Rottman et al., 2014). Research is required to more fully understand how leadership impacts the creativity of engineers and the success of project teams so that effective practices can be identified, researched, and put into practice. Considering the work of engineers is so closely tied to the economic drivers of organizations (Robledo et al., 2012), this research would be valuable to organizations that employ these individuals. Furthermore, there has been a recent push to incorporate leadership skills in engineering education (Rottman et al., 2014). However, without an understanding of how engineers lead project teams, the education may not emphasize a process that has proven to work with this population. As the elements of effective engineering leadership are learned, training and implementation programs can be developed to ensure that the practice of engineering leadership is aligned with research.

Research Question

The research question for this study involved an exploration of how engineers experience project leadership roles. The question sought to gain an understanding of these experiences, the influence of leadership on the work of engineers, and how this role supports their professional identity. The research question is: What is the experience of engineers leading project teams?

Definition of Terms

Emotional Experiences: The stated emotions reported by participants regarding how they feel about their leadership experiences.

Engineering project team: A group of at least three individuals, led by an engineer, working together to achieve a known outcome. These teams can include non-engineers, but must contain at least one engineer.

Project leadership: The engineer explicitly or implicitly assigned responsibility of project execution.

Reflections of Experiences: Any statements showing their understanding, beliefs, attitudes, and ideas about their experiences as reflected during their interviews.

Self-image: How engineers integrate this experience into their self-image will be defined as their reports during the interview of their attempts to make sense of the experience, to link it to previous experiences, and how they have changed because of the experience.

Research Design

Qualitative methodology is an in-depth and detailed study of human or social issues (Patton, 2002). It is important that the study is conducted without first predetermining the major factors, potential categories, or variables involved in a phenomenon so that the themes and factors emerge from the data collection process (Patton, 2002). This makes the methodology especially valuable in the beginning stages of understanding a phenomenon. For this study's research question, a qualitative approach was appropriate as there was minimal understanding of how these concepts are experienced within an engineering population (Langlera et al., 2013; Robledo et al., 2012). Furthermore, generic qualitative methodology was appropriate as it focuses on understanding an experience (Caelli, Ray, & Mill, 2003). The findings from this study can be used to direct other qualitative studies or quantitative studies of variables identified.

The research question was studied within its real-life context using generic qualitative methods. Generic qualitative inquiry focuses on the participants' reports of their subjective opinions, attitudes, beliefs, and reflections on their experiences (Percy, Kostere, & Kostere, 2015). This was valuable in gaining an understanding of how engineers experience these leadership positions, within the original context in which the positions exist. The generic qualitative approach also allowed for the further study of the experiential knowledge gained by the researcher working with engineering leaders. Although there is minimal research to draw upon, the themes and components discussed in the previous research can be used to develop the interview questions.

The population is under-represented in previous leadership research, and it is unknown how leadership approaches impact engineering work (Langlera et al., 2013; Robledo et al., 2012). More specifically, additional information is needed to understand how engineers adapt to project leadership roles, how they view the structural and organizational contexts in which they work, and how they support the autonomy and interdependence of team members (Hodgson et al., 2011).

Data collection typically occurs through structured methods as the methodology is focused on the actual events and experiences rather than the inner thinking of participants (Percy et al., 2015). Data collection methods includes semi- and fully-structured interviews, surveys, and observations (Percy et al., 2015). This research approach utilized an initial demographic questionnaire and semi-structured interviews to generate the data. The data was analyzed through inductive analysis following the process outlined by Percy et al. (2015). Inductive analysis allows for themes to emerge from the data rather than attempting to fit the data in preexisting categories. The data will be analyzed for each participant individually to identify the patterns and themes, then the data will be reviewed as a whole to identify overarching themes and patterns. This approach will provide rich information to describe the experience of engineering project leadership, and the themes that emerge can be studied further in later research.

Assumptions and Limitations

The research paradigm of interpretivism will be the basis of this research. This paradigm assumes that there are multiple realities, which are socially constructed, and that subjective meanings are attributed to them (Creswell, 2013). As a result, the value is in understanding the experiences of individuals. This assumption directs qualitative research to gain understanding of these different perspectives and identify themes that emerge through this inquiry (Creswell, 2013). The objective of the research question is to understand the subjective experiences of engineers leading project teams.

The epistemological assumption of constructivism indicates that knowledge is gained through understanding each participant's reality, experiences, and understandings (Creswell, 2013). These meanings vary across individuals and across groups, and in order to understand them, the research needs to focus on gathering rich information that draws out the participant's experiences, views, and meanings (Creswell, 2013). The epistemological assumption also drives qualitative researchers to get as close to participants as possible, which means to spend as much time as possible in the field observing or interviewing, to gather data (Creswell, 2013).

The axiological assumption was that the researcher had her own subjective values and biases, and that these played a role in how the questions were developed and how the data was interpreted (Creswell, 2013). The researcher needs to be honest about these values and biases, and included them in the interpretation phase of the research (Creswell, 2013). In order to achieve dependability, a depth of information should be gathered, and solid research practice should be followed. This required open-ended questions, listening, and recording interviews.

The methodological assumption was that the researcher used inductive logic to study the topic within its context (Creswell, 2013). Based upon the ontological assumption of multiple realities, it was important for the questions to be broad and allow individuals to share their experiences and interpretations (Creswell, 2013). This methodological assumption also placed an importance on the way the researcher collected information. It was important that the researcher allowed the patterns and themes to emerge from the data within the context of the study and sample.

Although generalizations are not a priority of qualitative studies, the study identified elements of effective engineering project leadership and provide insights into the experiences engineers have in these roles. The researcher assumed that engineers are sensitive to leadership (Laglera et al., 2013) and that this leadership influences their ability to work together to solve complex problems in creative and cost-effective manners. The researcher also assumed that engineers are intrinsically motivated, and that self-determination theory would provide insights into how leadership supports the autonomy, competence, and relatedness of engineers. Considering the type of work, team dynamics, and personalities of engineers are markedly different than other professions (Laglera et al., 2013; Robledo et al., 2012; Rottman et al., 2014; Williamson et al., 2013), it was assumed that the leadership required by this group differs from other populations that have been well-studied within this context. With project work common among engineering work, the concept of leadership will be studied within this context.

Theoretical Framework of the Study

The theoretical framework of this study is self-determination theory (SDT). SDT assumes that individuals possess an innate desire for personal growth (Deci & Ryan, 2000). Furthermore, SDT posits that the basic psychological needs of autonomy, competence, and relatedness need to be met in order for an individual to be intrinsically motivated and achieve optimal functioning (Deci & Ryan, 2000). Autonomy refers to the ability to self-organize one's behavior through a sense of choice and a feeling of not being controlled by an outside force or person (Kovjanic, Schuh, Jonas, van Quaquebeke, & van Dick, 2012). Competence is a feeling of mastery and effectiveness within a specific context, while relatedness refers to a feeling of being significant to others (Deci & Ryan, 2000). Previous research has demonstrated that satisfaction of these three basic psychological needs results in a wide range of positive outcomes including performance, self-esteem, and organizational commitment (Gagne & Deci, 2005). Additionally, rather than focusing on individual differences in need strength, it focuses on the opportunity that individuals have to satisfy these needs (Kovjanic et al., 2012).

Motivation is important to understand as it serves as a competitive asset within an organization (Tremblay, Blanchard, Taylor, Pelletier, & Villeneuve, 2009). SDT recognizes motivation and amotivation, but also differentiates motivation into autonomous motivation and controlled motivation. Autonomous motivation occurs when a person fully endorses a behavior and experiences a sense of volition and choice (Deci & Ryan, 2000). Controlled motivation occurs when the individual feels coerced into the behavior and experience a sense of obligation and pressure (Deci & Ryan, 2000).

Autonomous motivation has been shown to be related to creativity, innovation, and heightened engagement (Gagne & Deci, 2005) as well as active information seeking (Koestner & Losier, 2002). It has also been studied within the context of transformational leadership (Kovjanic et al., 2012). It also indicates that creative teams work best when they have considerable autonomy and decision-making ability (Hon & Chan, 2012). This theory is especially relevant to leadership where the tasks are highly interdependent and complex, which creates the potential for novel and creative approaches (Hon & Chan, 2012; Janz, Colquitt, & Noe, 1997). This study seeks to understand how the satisfaction of these three basic psychological needs have influenced engineering leadership.

This theory is especially relevant to engineering project leadership due to the connection of the basic needs of SDT and the essential elements of effective project teams previously discussed. Leadership supportive of SDT principles includes leading by example, coaching, participative decision making, and sharing information and concern (Hon & Chan, 2012). These elements are supportive of autonomy by providing the information needed to act independently, and the ability to make decisions and act on them. They support relatedness by developing constructive, positive relationships, providing the context for individuals to work together, and a forum to share ideas and opinions. These elements support competence by allowing for commitment to the work, coaching to develop confidence and skills, and collaboration which supports. Additionally, focusing on empowering employees is supportive of SDT and in achieving team creative performance (Hon & Chan, 2012). Furthermore, group effectiveness increases with task interdependence (Wageman, 1995). This is especially important in project teams where there is a high need for exchange of information, resources, and expertise. In addition to project creativity and results, it is also effective in building high-quality relationships and trust (Mesmer-Mangus & DeChurch, 2009). Autonomous motivation, which results from need satisfaction, is associated with greater persistence, flexibility, creativity, interest, long-term learning, and well-being (Gagne & Deci, 2005).

SDT is a theory of motivation that has been applied in the workplace setting, although not specifically with the study population. This study will provide in-depth experiential information about how engineers lead project teams which will have implications for a new application of

SDT. Due to the high desire for autonomy, the creativity required for their work, and the influence of meaningfulness of work, SDT should provide a valuable lens to understand how leadership influences engineers.

Limitations

This study investigated the experience of engineers in project leadership roles. This study will not investigate leadership training or education, engineering personality, or the leadership transition. These factors, although related to the topic, were not specifically studied. As with any qualitative study design, there is a limitation in the generalizability of the findings. However, to gain a deeper understanding of the experiences of these engineers, it is important to maintain a generic qualitative design. Therefore, although it limits the generalizability, the methodology supports the objective of the study. The small sample size may have limited the breadth of information gathered from the study. However, a larger sample was not feasible and was not required by the methodology. Although the study did not indicate potential relationships that influence the leadership of engineers, it did provide a foundation for future research by indicating potential areas of further study.

Researcher Expectations

In regard to the study population, the researcher has worked within an engineering organization for over ten years. This has driven the interest in engineering project leadership as well as created some preconceptions regarding the sample and how it relates to leadership. The researcher expected that engineers have not deeply considered the role of leadership, how it influences the work of engineers, or its importance to the profession. Additionally, the researcher expected that engineers would be described as more adept at leading other engineers due to the congruence of their professional identities, personalities, and their leadership approach

(Rottman et al., 2014). It is also assumed that current leadership theories and approaches do not fully address the needs of this group (Robledo et al., 2012). Based upon the need for autonomy and creativity, it is expected that the data from participants will fit the concepts of self-determination theory. However, because this population has only been minimally studied in terms of leadership theory, it is important that these biases are not inserted into the research approach. Each of these expectations were set aside when investigating this topic to ensure that a breadth of information was gathered. Specifically, the interview process was structured so that these expectations were not evident in the questions and did not limit the breadth of the information gathered.

Organization of the Remainder of the Study

The remainder of the study is presented in four additional chapters. Chapter 2, the Literature Review, discusses the role of engineers in organizations and project groups, theoretical orientation, methodology, and research related to engineering leadership, small group leadership, professional identity, and engineering personality. Chapter 3 discusses the methodology of the study in more detail, including a justification for the research design, target population, and selection approach. Chapter 4 includes the data analysis and results. To conclude, chapter 5 contains a discussion of the results, study conclusions, and recommendations for further research and practice.

CHAPTER 2. LITERATURE REVIEW

Introduction to the Literature Review

There is a small body of literature on engineering leadership, and specifically engineering project leadership. Much of the engineering leadership research is regarding how to educate and train engineers in leadership skills (Rottman et al., 2014). However, existing models of leadership have not been well studied within the engineering profession (Robledo et al., 2012) in order to evaluate if similar models work with this population.

Although there is little research regarding engineering project leadership, there are key findings from previous studies that will be expanded upon in this study. We know that engineers are sensitive to leadership (Laglera et al., 2013) and that leadership influences creativity, performance, and engagement (Ghadi et al., 2012). We also know that engineers are uniquely positioned within organizations to retain competitiveness, reduce costs, and increase profitability (Laglera et al., 2013). Furthermore, we know that they are relied upon for their technical knowledge, creativity, and ability to work with other experts to accomplish a goal (Robledo et al., 2012). Although the importance is understood, there has been little research conducted on how engineers lead (Rottman et al., 2014), and specifically how engineers lead project teams (Hodgson, Paton, & Cicmil). This is a gap in the literature that is valuable to organizations and educational institutions looking to add leadership skills to the curriculum. This study addresses this gap in the literature.

Methods of Searching

In order to conduct the literature review, multiple databases were searched with various key words to identify the relevant articles for the current study. Business Source Complete, PsycArticles, and PsycINFO were all utilized as part of the literature review. The following terms were searched in each database to identify relevant articles: *engineering leadership, engineering project leadership, project leadership*, and *engineer* AND *personality*. Additionally, the same databases were searched for articles relevant to the theoretical orientation of the study. Each was searched with the terms: *small group leadership, social identity theory of leadership, engineer* AND *identity, self-determination theory, motivation* AND *engineer*, and *autonomy* AND *engineer*. Summon was also searched with the key terms from both the leadership and theoretical search terms. In order to identify methodology-related literature, the terms generic qualitative and thematic analysis were searched in the following databases: SAGE Research Methods, PsycINFO, and Summon. Recommended research methods texts were also purchased for review. Lastly, remaining articles were identified through the review of each article's reference list.

Theoretical Orientation for the Study

The theoretical framework for this study is self-determination theory (SDT) and social identity theory of leadership (SITL). SDT was selected based on the similarities of the psychological needs outlined by the theory and the essential elements of effective engineering project leadership that have been identified in previous studies. Using SDT to explore leadership within an engineering population will provide a framework for understanding the needs of engineers and the leadership approach that may be most supportive.

This study provides in-depth experiential information regarding how engineers lead project teams, which has implications for SDT by applying the theory to a new population. It also has implications for SITL by identifying how group prototypes influence the group leaders. SITL was utilized to better understand the social identity aspects of the engineering profession, the experiences in leadership transitions, and the struggle to balance the focus of the profession and the assumptions of leadership that plague many engineering leaders (Rottman et al., 2014). SDT places a focus on individual motivation and can be drawn upon to explain effective leadership behaviors. SITL also places a focus on intergroup dynamics and the potential role of prototyping.

Self-Determination Theory

Self-determination theory (SDT) is a theory of motivation, development, and wellness (Deci & Ryan, 2008). It assumes that humans are active, growth-oriented, and have a desire pursue connections with others and to achieve optimal functioning (Gagne & Deci, 2005). SDT differs from other theories of motivation in that it presents motivation as a continuum between autonomous and controlled motivation, rather than on levels of motivation. SDT presents three types of motivation: autonomous motivation, controlled motivation, and amotivation (Deci & Ryan, 2008). These types of motivation operate on a continuum. It addresses the social contributions to motivation through focusing on the degree of fulfillment of the basic psychological needs of autonomy, competence, and relatedness. According to SDT, the fulfillment, or thwarting, of these needs determines the type of motivation that results.

Autonomous motivation is a self-perpetuating cycle of engagement in an activity. It is comprised of intrinsic motivation and extrinsic motivation that the individual identifies as the activity's value which has been integrated into their sense of self (Deci & Ryan, 2008). Autonomous motivation is ideal as the behaviors are more likely to continue when the motivating incentive is no longer present. Autonomous motivation has been correlated to creativity, innovation, enthusiasm, and heightened engagement (Gagne & Deci, 2005). Due to the high desire for autonomy, the creativity required for their work, and the influence of meaningfulness of work, SDT should provide a valuable lens to understand how leadership influences engineers.

Controlled motivation, although internally regulated, is externally driven. Behaviors that result are a combination of outward rewards and punishments, and internal regulations for approval, avoidance of shame, contingent self-esteem, and ego needs (Deci & Ryan, 2008). Controlled motivation is much less likely to sustain after the external incentive is removed. Autonomous and controlled motivation both energize and direct behaviors, whereas amotivation is a lack of intention and motivation (Deci & Ryan, 2008) or the absence of intentional regulation of behavior (Güntert, 2015).

SDT posits that there are three basic psychological needs, and the fulfillment of these needs determines an individual's psychological well-being. The three psychological needs are autonomy, competence, and relatedness. Autonomy refers to the individual's need to feel that they are in control of their actions and decisions. Relatedness refers to the individual's need to be connected to others. Competence refers to the individual's perception that they control the outcomes of their actions. SDT does not focus on individual differences in terms of strength of need, but rather on how the need has been satisfied or thwarted. It assumes the strength of the need is basic and universal. Need satisfaction also determines the type of motivation experienced (Deci & Ryan, 2008).

Individual differences are explained through causality orientations rather than through levels of need fulfillment. These causality orientations include autonomy oriented, control oriented, and impersonally oriented (Gagne & Deci, 2005). These orientations indicate the general tendency of an individual to perceive social contexts as autonomy supportive, controlling, or impersonal, which influence attitudes and behaviors. Autonomy orientation is related to self-actualization, self-esteem, and satisfying interpersonal relationships whereas a controlled orientation is related to self-consciousness, defensive functioning, and a general orientation towards external motivators (Gagne & Deci, 2005). Lastly, the impersonal orientation is related to an external locus of control and depression (Gagne & Deci, 2005). These orientations help to explain the individual differences in how the three basic psychological needs are met and the behavioral tendencies of individuals.

SDT and the Workplace. SDT has been researched within the workplace setting, although not specifically with the study population. The focus of SDT research within an organizational context has mainly focused on education, health care, and sports organizations (Gagne & Deci, 2005). Organizational research indicates that autonomy support leads to greater satisfaction of the needs of autonomy, competence, and relatedness, as well as increased job satisfaction, greater persistence, and increased acceptance of organizational change (Baard, Deci, & Ryan, 2004; Gagne, Koestner, & Zuckerman, 2000). Additionally, Wagner and French (2010) found that intrinsic motivation influenced their desire for professional growth as well as their experience during these programs. SDT has also been researched in its relationship to explaining authentic leadership outcomes (Miniotaite & Buciuniene, 2013). Gagne and Deci (2005) present findings that indicate need fulfilment is related to persistence, job satisfaction, well-being, and higher performance when the work requires creativity, cognitive flexibility, and conceptual understanding. These findings are especially relevant outcomes for engineering project leadership.

Feedback has also been shown to negatively impact need satisfaction as defined by SDT (ten Cate, 2013). This is based upon the violation of autonomy and competence typically resultant of feedback (ten Cate, 2013). Developmental feedback, defined as information that enables individuals to learn, develop, and improve (Zhou, 2003), has been shown to have positive impacts on employee attitudes and behaviors (Joo, Song, Lim, & Yoon, 2012). Guo, Liao, Liao, and Zhang (2014) found that intrinsic motivation was the mediating factor between developmental feedback and performance. This is important in understanding how leaders may have developmental discussions with employees without the negative impacts that have previously been assumed.

There has also been research conducted within the workplace setting to better understand how autonomy support and external rewards influence intrinsic motivation. Deckop and Cirka (2005) found that merit-based programs led to decreased feelings of autonomy and intrinsic motivation, indicating that external rewards can undermine intrinsic motivation. Deci, Connell, and Ryan (1989) found that when managers acknowledged others' perspectives, provided information in an open way, and encouraged self-initiation, this led to increased satisfaction, a sense of autonomy, trust, and positive work-related attitudes. Shamir, Zakay, Breinin, and Popper (1998) showed that transformational leadership was more likely to support autonomy and allow for the satisfaction of the basic psychological needs outlined in SDT. This is especially relevant when the individual contributions and commitment influence the outcomes of a project. In conclusion, studies of SDT and leadership indicate that need satisfaction and intrinsic motivation lead to "persistence, effective performance, job satisfaction, positive work attitudes, organizational commitment, and psychological well-being" (Gagne & Deci, 2005, p. 346).

SDT and Engineering Leadership. Engineers are, in general, highly autonomous and achievement oriented (Van Der Molen et al., 2007), and both concepts are relevant to SDT. Due to the high desire for autonomy, the creativity required for their work, and the influence of meaningfulness of work, SDT will provide a valuable lens for understanding how project leadership influences engineers. This places the importance on understanding the role of autonomy, competence, and relatedness. This orientation will provide valuable insights into the connection of project leadership, creativity, and project outcomes. The research findings will support the further development of SDT by applying it to project leadership within the context of engineering.

Although engineering leadership has not been directly studied through SDT, there are existing studies that inform how SDT applies to leadership within an organizational setting. Hon and Chan (2012) studied the role of leadership on creative work within the hospitality industry. They found that when the level of task interdependence was high, empowering leadership had a strong, positive relationship with creativity (Hon & Chan, 2012). Empowering leadership was associated with autonomous motivation, supporting SDT's assertions that autonomous motivation was important for creative work (Hon & Chan, 2012). Importantly, task interdependence appears to be a mediating factor of this relationship. Although this was a quantitative study, it provides insights into the role of leadership in creative, interdependent work. Considering engineering project teams require multiple experts to execute projects, this is supportive of the current study.

The Kovjanic et al. (2012) study sought to identify how the needs outlined in SDT mediated the positive impacts of transformational leadership. They studied a broad population in Germany and Switzerland, and found that each of the needs outlined in self-determination theory were significant mediators of positive outcomes (Kovjanic et al., 2012). Specifically, autonomy was significant across all factors investigated, competence was related to occupational self-efficacy, and relatedness was related to commitment (Kovjanic et al., 2012). They suggest that further research be conducted to identify other contextual factors and how they influence the mediating role of the needs outlined in SDT (Kovjanic et al., 2012). The current study will use a qualitative approach that will identify these potential contextual factors by learning how engineers experience the process.

There were two additional articles that investigated SDT and its role in mediating leadership outcomes with results that relate to engineering leadership. Janz et al. (1997) indicated that autonomy and task interdependence influenced team effectiveness for knowledge workers. Considering the work of engineers is highly interdependent, this is relevant to the current study. Trepanier, Fernet, and Austin (2012) investigated how positive workplace relationships influenced autonomous motivation, and how that influenced the self-report of transformational leadership behaviors. This research looked at leadership behavior influences rather than the impact on followers, which made it a unique study. Importantly, the findings support the current study by indicating that the factors of self-determination theory influence the behavior and experience of the leader.

Social Identity Theory of Leadership

Social identity theory explains how people conceptualize themselves in intergroup contexts (Hogg, 2001). Furthermore, because groups only exist in relation to other groups, the focus is on identification of in-group and out-group differentiators. These social comparisons serve to build group identification and establish positive distinctiveness for the group. Positive social identity is driven by the individual's identification with the group's distinctiveness, and self-esteem is supported by the strength of group membership. This leads to the enhanced support of prototypical behaviors, where the group members are supportive of the most prototypical member (Hogg, 2001; Hogg & Terry, 2000).

Important to this study is the social categorization that creates in-groups and out-groups. The focus on the group prototype is based upon the attributes that define the attitudes, feelings, and behaviors that characterize the group and distinguish it from other groups (Hogg, 2001; Hogg & Terry, 2000). This social categorization allows individuals to sort others into in-groups and out-groups based on how they meet the prototypes of the group. This drives a sense of depersonalization where prototypicality, rather than individuality, is the focus of attention. This may influence how the individuals in the group view other members, how they work with members of other groups, and how they work through conflict (Hogg, 2001). It also influences how individual group members are perceived, namely placing a value on how they meet the group prototype (Hogg et al., 2006). It also may influence the thinking of the group, and could limit the individual's motivation to go against the dominant group, cognitively or behaviorally.

Prototypicality is an important concept for this theory. Group members conform to, and are influenced by, the prototype developed. The more salient the group, the more profound the effect (Hogg, 2001). Individuals are more likely to comply with individuals who embody this prototype. Individuals who best fit the prototype are perceived to have influence over the individuals who are less prototypical. These prototypes change based upon the context in which they exist and influence how individuals evaluate, support, and endorse the leader (Hogg et al., 2006). This helps to translate perceived influence into active leadership (Hogg, 2001). Furthermore, as group members identify more strongly with the group, the support of the leader, perceptions of the leader, and endorsement of the leader become increasing more tied to how prototypical the leader is perceived to be (Hogg et al., 2006).

Social identity theory of leadership (SITL) describes leadership as a group process that is generated from social categorization and prototype-based processes (Hogg, 2001). These prototype-based processes are derived from the group prototypes created by accentuating similarities and differentiating from other groups. The theory asserts that as the prototype is developed, members cognitively and behaviorally conform to that prototype. The group members are drawn to the prototypical leader, which further empowers the leader and enhances the prototype (Hogg, 2001). It also creates an attraction toward individuals who meet the positive group prototype, with the strongest liking towards the more prototypical members. This is motivated by self-enhancement as well as a desire to reduce the subjectivity and uncertainty of others.

The shared social identity requires leaders influence followers through their group membership (Graf, Schuh, van Quaquebeke, & van Dick, 2012). As a benefit, when the leader acts in the best interest of the group, the group members tend to act decisively (Steffens, Haslam, & Reicher, 2014). This willingness to adopt the social identity can either reinforce or hinder each other's ability to achieve project goals (Steffens et al., 2014). In leadership situations, this also means that the leader represents the group and exerts this influence upon the organization (Racine, 2015).

Prototypical behaviors can be effective in their ability to create cohesion (Hogg, 2001), and the more prototypical the member the more they are perceived as trusted and effective (Hogg, van Knippenberg, & Rast, 2012). They also serve as a foundation for a sense of belonging. However, they can also create larger divides between leaders and followers, decrease diversity, and leave the group driven by the norms in place. This may result in competitive intergroup behaviors, abuse of power, leader dominance, marginalization of less-prototypical group members, and sub-optimal decision-making (Hogg, 2001). It may also create identity conflicts when the leader needs to fit the prototype of the discipline, project-group, and organization. The fluidity of identity in these situations can lead to identity struggles (Sveningsson & Alvesson, 2003). Furthermore, the needs of the various groups that they serve may create difficulty in remaining authentic while being perceived as a good leader (Nyberg & Sveningsson, 2014).

SITL posits that groups are most supportive of leaders who best emulate the group prototype because of enhanced likability, reduced dissonance, and the confirmation of the positive aspects of the group prototype (Hogg, 2001). However, there is support that leadership preference may be based on personality dimensions (Emery, Calvard, & Pierce, 2013). In groups with no designated leader, leaders who emerged tended to be higher on the personality dimensions of extraversion, openness to experience, and conscientiousness. Followers who were more conscientious were more likely to follow task-oriented leadership. Similarly, individuals with more agreeableness and less openness to experience were less likely to follow relationship-oriented leaders. Difference in agreeableness levels of leaders and followers influenced the preference for similar or complementary leaders. This offers some question to SITL and introduces aspects of personality theory that may be relevant.

SITL helps to explain how self-definition as a group member can create a strong sense of prototypical behaviors, and membership to the group defined as how closely the individual fits the group prototype. This may be most powerful in groups that are defined in terms of their identity rather than in terms of the task at hand (Hogg, 2001). Considering engineers are a group that can be defined by their education, training, and positions, this theory may be drawn upon to explain how prototypical behaviors drive group dynamics and influence how engineers lead groups.

The engineering discipline carries with it a sense of belonging to a group, where there is a strong sense of social identification and connection with other engineers (Racine, 2015). They tend to define themselves in terms of their role (Slush & Ashforth, 2007), and the relationship between the individual, their peers, and the discipline create a shared social identity. It may also explain any struggles between serving the group, and serving the organization. Therefore, evaluating engineering project leadership through the lens of SITL may provide insights into the leadership behaviors and experiences of engineers. It can be used to better understand intergroup dynamics, the influence of group prototypical behaviors, and how leadership is valued.

Engineers tend to identify more closely with their discipline rather than with the organization. This places an importance on maintaining the organizational needs in the context of engineering projects. Additionally, Racine (2015) found that a solid understanding of the situation and successful adaptation of a sociotechnical identity supported the transition of engineers into leadership roles. This means that successful engineering leaders develop a sociotechnical identity. As a result, leadership development should focus on holistic development (Racine, 2015). This study will seek to understand how these engineering leaders manage their social identity, and how group and organizational prototypes influence their approaches and experiences.

Review of the Literature

The engineering profession is unique in the context and requirements of their work, the typically high desire for autonomy, and the strong achievement orientation (Van Der Molen et al., 2007). Their work is by nature creative and complex, requires a wide range of skill and expertise, requires the investment of substantial resources, and often occurs in project teams (Robledo et al., 2012). Although much is known about the drive for autonomy, the intellectually challenging nature of the work, the requirement to work with other technical experts, and the ambiguity and risky nature of projects, there is little known about how to best lead these teams. Therefore, it is important to understand how this population experiences project team leadership.

Research suggests that education, experience, and training do not prepare engineers for leadership positions. This may be because of the seemingly contrary demands of engineering and the needs of the organization (Gibson & Whittaker, 1996). Additionally, engineers prefer to be managed by other engineers, which suggests that technical credibility is an important factor for leadership respect (Gibson & Whittaker, 1996). In today's business environment, it is important for technical leaders to have technical expertise as well as business acumen (Farr & Brazil, 2009). These leaders also need to be proficient in individual work, project needs, and the organizational context (Racine, 2015).

Contemporary leadership models have been implemented with mixed results (Mumford et al., 2002). Furthermore, research suggests that leadership of engineers is more complex than in other disciplines (Racine, 2015). This may be because of the unintended consequences of typical leadership approaches. For example, Mumford et al. (2002) found that organizational visions can restrict autonomy and creativity, whereas Engwall, Kling, and Werr (2005) found that teambuilding practices can obstruct the need for individual creativity. This is further complicated by engineers tending to identify more with their discipline than with the organization (Racine, 2015).

Research Related to Engineering Personality and Profession

Williamson et al. (2013) found that engineers tended to be characterized by their openness, flexibility, cognitive complexity, self-confidence, dominance, and introversion. These characteristics, coupled with the investment in their knowledge and profession, allow for the complex manipulation of knowledge to solve new problems (Smith & Paquette, 2010). Engineers also tend to be loyal to their peers and organizations (Singh & Singh, 2009). Additionally, Williamson et al. (2013) found that engineers tended to score higher than other groups on tough-mindedness and intrinsic motivation (Williamson et al., 2013). This finding is especially relevant to this study and its focus on SDT. Interestingly, Moscoso and Iglesias (2009) did not find a correlation between any Big Five personality dimensions and job experience.

Williamson et al. (2013) found that engineers tended to score lower on customer service orientation, emotional stability, extraversion, image management, optimism, visionary style, and work drive. These findings are troublesome when looking at engineering leadership within the context of known leadership theories. Potential personality factors and their influences on how the leadership process is experienced will need to be kept in mind and incorporated into the thematic analysis.

It is typically assumed that engineers are more interested in technology than people (van der Molen et al., 2007). Although the stereotypes of engineering personality are quite well adopted, there is little research into the personality traits of this profession. In general, the findings indicate that engineering students tend to be more conscientious and goal-driven than other groups, with slightly less of an orientation toward others. However, there were no significant differences between engineering students and other groups in extraversion or agreeableness, which are particularly important to interpersonal relations.

Van der Molen et al. (2007) studied working engineers and found that, in general, they were more drawn to working with others. They were also more extraverted, autonomous, conscientious, and emotionally stable than the general population. However, they were also found to be less agreeable, and less friendly. Importantly, Singh and Singh (2009) found that most working engineers were predominantly concerned about the interests of others, including the other engineers with which they worked, the organization, and the recipient of their work. This may indicate that the care and respect shown to the engineers that they lead may look different from the care and respect demonstrated in other professions. These findings indicate that interpersonal skills are valuable for engineers, but that the ways that care and respect are demonstrated may differ for this group. It is important to learn how this dynamic exists within an engineering project context.

Research Related to Project-Based Engineering

Engineers are a specific subset of knowledge workers who work to develop solutions that solve problems. Problem solving is perpetually unpredictable and lacks clear structure (Anderson, Courter, McGlamery, Nathans-Kelly, & Nicometo, 2010). They work under high degrees of uncertainty to manipulate knowledge in order to apply them to new situations, often with high risks (Garcia-Chas et al., 2015). This requires engineering project leaders are competent in coordinating technical teams, negotiating systems, and solving problems (Anderson et al., 2010). Although there is specific technical training, engineers rely heavily on the development of experience-based knowledge to develop solutions to problems (Anderson et al., 2010). High-performing engineers have high task proficiency, are adaptive to changes, are proactive, and can balance the social and technical nature of their work (Emison, 2011; Garcia-Chas et al., 2015). This unique combination, coupled with the strong professional identity, creates a unique leadership requirement.

Task proficiency refers to the ability of the engineer to carry out the core tasks of their role properly (Garcia-Chas et al., 2015). Technical competence is a requirement for this dimension, which serves as a basis of ability as an engineer. Adaptivity is the engineer's ability to cope with changes to work scope based on environmental conditions, economic conditions, and technical findings, all of which are part of the dynamic environment within which an engineering project exists. Unique to the engineering profession is the expectation that they have mastered the technical understanding required, can adjust to and incorporate new technology, and be able to adapt to the changes and complexities that are encountered. In recent times, engineers have also been expected to interface with customers, which places an additional demand on their social interaction skills and adaptivity (Emison, 2011; Garcia-Chas et al., 2015).

Another requirement of engineers is that they work in a proactive manner, referring to a self-starting, change-oriented, and future-focused approach to their work (Garcia-Chas et al., 2015). This is critical to engineering work as the tasks associated with the work cannot be laid out ahead of time and adhered to. Engineers need to identify the relevant elements of the situation and proactively apply their knowledge to identify the adaptations required to successfully execute the work required by the situation. This is heavily influenced by an engineer's declarative knowledge, procedural knowledge, and intrinsic motivation. Intrinsic motivation increases curiosity, interest in learning, openness to complexity, and willingness to take risks. This leads to proactivity, creativity, and adaptivity, which are necessary to successfully execute projects with the level of unknowns and uncertainties that are common in engineering projects. These findings are aligned with SDT.

The needs of engineering projects vary, as does the leadership that is required. In idea development, there is a heavy reliance upon group and organizational skills (Robledo et al., 2012). Through technical development, more technical aptitude and knowledge is required (Robledo et al., 2012). Although throughout the process there is a reliance upon technical aptitude and socio-organizational skills, the extent to which each is required varies. Therefore, it is essential that engineering leaders possess both technical aptitude and socio-organizational skills. Additionally, the ability to differentiate workforce requirements is key to successful strategy implementation and organizational performance.

Many engineering projects are complex because they have a number of uncertainties at play. These uncertainties can be regarding the goals, methods, perspectives, time available, clarity of scope, risk, availability of resources, experience with stakeholders, newness of the ideas of technology, trust in the project team, and internal support availability (Bosch-Rekveldt, Jongkind, Mooi, Bakker, & Verbraeck, 2011). The objective is to work through the uncertainties to continue to define and work toward the outcome, and not to minimize the complexity.

A key attribute to engineering leadership effectiveness is the ability to work with and influence others (Emison, 2011; Garcia-Chas et al., 2015). These abilities make it easier to obtain information, leverage resources, and overcome obstacles required to meet the objectives of the project (Garcia-Chas et al., 2015). Additionally, creating a strong social network amongst engineers facilitates knowledge sharing, which supports the growth and development of engineers within the network.

Engineers experience challenges when becoming leaders (Racine, 2015). These have been attributed to limited knowledge of leadership, social development, and the leadership situations in which they are placed. Furthermore, technical aptitude does not necessarily lead to leadership success. Mentoring is the most common method for developing engineering leadership skills (Russell & Nelson, 2009). This mentoring should include developing soft skills, experience with strategy development, and constructive feedback on technical skills (Farr, Walesh, & Forsythe, 1997). Within an engineering context, the situations and projects are often complex, involve intra-organizational social dynamics, and require the individual to be effective in areas outside of the technical aspects of their work. This includes skills in economics, communication, social, and management science (Emison, 2011). Leaders need to support the intrinsic motivation of the project team members, which supports the development of the skills required to be successful engineers (Garcia-Chas et al., 2015).

Research Related to Engineering Leadership

A thorough literature review was conducted to identify completed studies on engineering leadership, project leadership, self-determination theory, and engineering personality traits. The most relevant articles were reviewed for contribution, and the reference list of each article was reviewed for additional articles to incorporate. Foundational research articles that were relevant to the theory and population were also obtained. This resulted in a literature base of about 90 articles. A small number of these studies are similar to the research topic. The remainder of the studies inform a component of the research, provide background information on the population, provide information on the nature of engineering projects, or inform the theory that is being used as the orientation for the study. There were four articles that were most similar to the current study; each will be reviewed in-depth.

The most similar study is a grounded theory study by Rottman et al. (2014). The researchers sought to understand the processes engineers recognize as leadership in order to address a desire for additional leadership training (Rottman et al., 2014). Using focus groups and individual interviews, the researchers learned that engineers are largely resistant to the dominant views of leadership, instead leading in ways that are more aligned with their professional identities and that incorporate recognized forms of influence (Rottman et al., 2014). The findings of this study are especially relevant, providing the foundation for the theoretical orientation for the current study. Rottman et al. (2014) found that the key orientations to engineering leadership were technical mastery through mentorship, optimal collaboration, and organizational innovation. The further discussion of these concepts bore similarity to the psychological needs that formulate self-determination theory.

There are two major differences between this study and the current study. For one, the Rottman et al. (2014) study is intended to address the request for direction of engineering leadership education. The second major difference is the study design. Rottman et al. (2014) sought to understand the process of leadership whereas the current study sought to understand the experience of project leadership. A key learning from the Rottman et al. (2014) study is that when interviewing engineers, there was a strong resistance to the word leadership, which will be key in formulating the questions for the current study. It was important to ask questions to gain the largest amount of information, and using the language of the population was an important component. They found that leadership was demonstrated through passing on experiential knowledge, building connections across organizational groups, and operationalizing ideas (Rottman et al., 2014).

Another key study is Robledo et al. (2012), which presents a model of scientific and engineering leadership. One of the key focuses is fostering creativity and innovation in order to foster economic growth for organizations (Robledo et al., 2012). The authors assert that existing models don’t address technical leadership because the unique application has not been studied (Robledo et al., 2012). Although the model presented was different from Rottman et al. (2014), it is not completely dissimilar. Key aspects of the model are mission definition, resource planning and acquisition, expertise, creating the desired climate, and bridging the gap between the group, the work, and the organization (Robledo et al., 2012). This article provides a foundation for key contextual factors to investigate in the current study: the group, the project, and the organization.

Additionally, the article provided a strong context for the work and personality of engineers. It presented the need for creativity, specifically in response to complex, and often ill-defined problems (Robledo et al., 2012). The intellectually-demanding nature of the work, including the requirement of novel ideas in an uncertain environment, draws upon a wide range of skills and knowledge, and often requires the formation of project groups (Robledo et al., 2012). These projects are dynamic, and the stage-based framework of project work provides an ideal framework for investigating engineering project leadership (Robledo et al., 2012).

The next article reviewed was Mumford et al. (2002), which provided a foundation for leadership behaviors that lead to creativity and innovation. This article focused on creative work and the situational requirements of leadership for this work. Mumford et al. (2002) found that leaders that were successful in this capacity were influenced by the expertise of the team members, the complexity of the task, professional expectations, and the cross-level requirements of the work. They determined that the leadership of creative work should be studied individually across professions rather than in combination and that it is not likely to be understood through the application of traditional leadership models (Mumford et al., 2002). Attention was also placed on autonomy, including the role of leadership in providing autonomy, rather than viewing leadership and autonomy as mutually exclusive (Mumford et al., 2002). In conclusion, they suggest further research to better understand the integrated model of leadership that "permits the leader to orchestrate expertise, people, and relationships" in order to bring "new ideas into being" (Mumford et al., 2002, p. 738). The current study will further investigate the leadership of engineering projects to understand how they experience the facilitation of these processes in service of organizational needs.

The last article that was similar to the current study was a quantitative study that sought to associate transformational leadership with various leadership constructs (Laglera et al., 2013). This article provided a compelling argument to study engineering leadership independent of other professions. It studied the relationship of transformational leadership with various output measures such as trust, job performance, job satisfaction, and organizational commitment (Laglera et al., 2013). The findings indicated a positive relationship between transformational leadership and each of these constructs for the engineering sample (Laglera et al., 2013). However, this study does not provide insights into how the engineers experience these leadership qualities, or how these qualities and outcomes relate to complex problems or innovation.

Research Related to Engineering Leadership Training

About engineering leadership research, the focus has been on integrating leadership skills into engineering education (Rottman et al., 2014) and integrating commonly accepted leadership theory or soft skills training into engineering training (Balaji & Somashekar, 2009; Elegbe, 2015; Farr & Brazil, 2009; Rambe & Modise, 2016). However, there is little research to direct the training, evaluation, and development of engineering leaders (Robledo et al., 2012; Rottman et al., 2014). Furthermore, these approaches may not be most supportive to how engineers gain experiential knowledge, assimilate prior learning into current problem-solving projects, and develop through mentoring.

Leadership development is fundamentally an individual endeavor, and so often programs will not address this need (Farr & Brazil, 2009). Engineers understand the commitment to learning, and so developing an understanding of the need for a blend of hard and soft skills can support the development of a balance of skills. Furthermore, although integrating soft skills into educational systems and business training will support the development of early engineers, much of development occurs through experience and mentorship over the course of the individual's career (Farr & Brazil, 2009). As a result, the emphasis should be placed on building experience and developing mentor relationships.

Research Related to Leadership of Temporary Project Teams

Engineering project leaders are tasked with balancing the cost, schedule, and quality constraints to meet the expectations of a project. Engineering project groups require both individual task completion and group work. These projects are complex, involve multiple stakeholders, and require multiple disciplines (Shane, Strong, & Gransberg, 2011). The project leader influences the development of the individuals in the group and their individual and group motivation. Although individual motivation is a factor in team performance, which is discussed in relation to SDT, in a team setting it is also important to understand how team members motivate or demotivate one another (Latham, 2012). To maintain focus on the research question, the review of the literature focused on leadership as a small group process rather than project management.

A unique aspect of these project teams is that the teams form and disband as projects are identified and completed. The individuals on the team may, or may not, be members of a project team together in the future. Although this is an important aspect of project-based work, there has been little attention paid to the temporality of project teams (Bakker, Boros, Kenis, & Oerlemans, 2013). Bakker et al. (2013) found that the temporality of project teams influences the process and outcomes of projects, and that the time expectations of the project significantly influence these. Teams with expectations of collaboration for extended periods of time behave differently than teams with a shorter expectation of time. These differences are due to the predetermined scope and time, dictated by the project outcome and deadline that is central to the formation of a project team. Teams with a shorter time frame were less immersed in their tasks, likely because they were more focused on task completion than on the process that leads to it. Teams with a longer time frame were also less likely to be negatively impacted by conflict. These findings indicate that teams with a longer timeframe follow a deeper, more systematic approach to processing task-relevant information. The temporality of project teams, as well as the associated influence of time expectations are relevant to the current study.

The purpose of project leadership is to coordinate the team's efforts to achieve the project goals. As a relational process, project leaders influence the individuals working on the project through motivation and enabling. The team effectiveness is influenced by the leader, and changes in project leadership are often followed by changes in team performance (Thomas, Martin, & Riggio, 2013). As a social process, the more salient a group membership becomes, the more strongly the members identify with the group (Hogg, 2001). Furthermore, the leader is categorized in terms of how prototypical they are of the values and norms of the group (Thomas et al., 2013). This was discussed in the review of SITL. Considering engineering project leadership is a relational process, SITL is aligned with this view of project leadership.

Often, the project leader needs to build partnerships both within and outside the organization in order to successfully complete a project (Shane et al., 2011). An individual's role in the group may change over time, and the dynamics of the group change over time. However, the individual is operating within a group process. Social identity theory, discussed previously, specifies under what circumstances an individual sees themselves as part of a larger group rather than as an individual entity (Latham, 2012).

The project leader relies on subject matter experts to work together to develop solutions to problems in a cost-effective manner. This results in the need for interdependent work, placing an importance on individual performance and group dynamics. Individual empowerment is most effective when an empowering climate is created for the team, and is a strong predictor of work engagement and innovation (Bhatnagar, 2012). Additionally, when individuals are provided more autonomy and responsibility, individual and team performance both increase when the work of the individuals is interdependent (Chen, Kirkman, Kanfer, Allen, & Rosen, 2007). The focus on SDT is further supported by these findings.

Group Process as a Social Process. Although the research question investigates leadership, project teams are by nature social processes. Leadership largely focuses on social interactions and group effectiveness. The project leader influences the behaviors of the group, the interactions between individual group members, and the objectives of the group. As a result, it is important to understand the social processes that influence these group processes. This section will briefly present social facilitation and group process as it relates to project leadership.

Social facilitation. According to Zajonc (1968), the presence of others influences individual performance. It first creates arousal which energizes behavior. The individual is then driven to respond with the reaction that is more quickly and easily given based on the task at hand. When the task is either simple or well learned, the dominant response is usually successful. When the task is difficult or not familiar the response is typically incorrect or unsuccessful. As a result, the quality of the response varies by the type of task and the individual’s level of competence. Others have built upon this theory by positing that the presence of others only influences behavior in this way when they are in a position to evaluate the individual’s performance (Geen, 1991). Considering engineering projects require the input and evaluation others, and the work involves complex tasks, it is important to understand how this social process will influence performance. It is also important for the project leader to align individual roles with their skills and abilities and influence the group norms so that they are most supportive of individual and group performance.

Tasks, roles and responsibilities. One of the defining features of a group is the establishment of tasks and roles, rules of conduct for group members, and a shared objective, goal, or vision. These elements are present in engineering project groups. The identification of the required tasks and the assignment of roles creates a foundation for the individuals to act. Clear roles support individual performance (Tubre & Collins, 2000) and help the group organize the work based on individual skills and abilities. The more congruence between assigned roles and individual abilities, the better individuals function within the group (Chen, Langner, & Mendoza-Denton, 2009). Considering engineering projects rely on both individual expertise as well as the interconnections of their work products, role assignment and congruence is an important aspect of engineering project dynamics.

Group norms. The rules of conduct, or norms, for the group establish the expected behaviors, communications, and rules of conduct. Team-level norms and the ability to self-regulate emerge from the social processes, individual efficacy beliefs, group efficacy beliefs, and group goals. These group processes are influenced by the group members and the leader (Latham, 2012). The norms that are developed, formally or informally, create the sense of what it means to be a part of the group and the expectations for ongoing behaviors. In addition to the theory that individual output may be diminished in a group setting where the individual has less experience or competence, shared responsibility may also diminish individual output through social loafing (Karau & Williams, 1993). However, when the individuals feel that their individual efforts will be important, relevant, and meaningful, it tends to enhance individual contributions (Karau & Williams, 2001). These findings place an emphasis on both self-efficacy and the alignment of group goals to individual and organizational growth.

Group cohesion. Group cohesion was discussed in relation to SITL. It is important to note that strong group norms and cohesion may make it difficult for a group member to break group norms due to the fear of social consequences. This desire for a sense of belonging can create groupthink as well as situations where group members do something that is clearly against their judgement and ethics. Individuals with high self-esteem are less susceptible to group influence and less reliant upon group interactions for high performance (Mossholder, Bedeian, & Armenakis, 1982). Drawing upon SDT, this relates to the need for competence, a belief in one's ability to achieve desired outcomes. Competence supports individual efforts and one's ability to maintain performance with less group interactions. It also places an importance on peer group interactions when individual team members have low self-esteem. This is another area where project leadership plays a large role.

Role congruence, autonomy, and cohesion support individual performance within a group. Additionally, when individuals think that their efforts will help them achieve outcomes they find personally valuable, individuals will work harder to fulfill their roles and achieve group goals (Karau & Williams, 2001). These aspects, which are aligned with SDT, support group performance. The following section will explore the literature on the role of the leader in these group processes.

Group Process and Leadership

Leadership can be described as the ability to influence others to adapt the values, attitudes, and goals of a group and to exert effort on their behalf to transform individual action into group action (Hogg et al., 2006). This is influenced by the social processes that have been discussed and the needs of the project group, among other factors. Specifically, the interrelated nature of engineering work and the complexity of the projects pose a unique leadership situation. Looking at engineering projects through the lens of group process places an importance on understanding the social processes, roles, norms, and cohesion of the group. These aspects can either enhance individual and group performance or lead to damaging unintended consequences. It is important to understand the role that leadership plays in group process, and how the competence, autonomy, and meaningful individual and group outcomes can be supported to enhance the performance of these groups, support speaking out, and minimize the likelihood of diminished individual performance.

Small group leadership can also be viewed through the lens of systems thinking. For a project team to be successful, it must understand the explicit tasks as well as the group's process (Kaspary, 2014). This is because each individual team member is the expert for a particular situation, and collectively the group members gain a more comprehensive understanding of their work situations by gaining these perspectives. The work of the individuals is both interrelated and interdependent, and so the work of the other individuals is constantly influencing the work of the others. This supports the need for a systems perspective because each individual part constantly influences the other individual parts as well as the project as a whole. Within the system, as new information or needs arise, the team needs to adapt to most effectively respond. This complex system places a value on autonomy, dependency, and interactions. The role of leadership is thus ensuring that the information is available to the group, that roles are aligned to skills and abilities, and that enough autonomy has been provided to allow for the necessary adaptations to occur. This requires constant reflection on what is happening and what is influencing what is happening, for both individuals and the team as a whole.

Synthesis of the Research Findings

Articles were reviewed that investigated the project-nature of organizations, engineering project requirements, group process, and the transition of engineers from technical experts to leaders. Much of the engineering project management research is based on model implementation (El-Sabaa, 2001; Hodgson et al., 2011), transition struggles (Hodgson et al., 2011), required skills for effective managers (El-Sabaa, 2001), and team processes (Rahman & Kumaraswamy, 2005). Considering the traditional models of leadership may not fully apply to the unique situation (Mumford et al., 2002), how engineers experience leadership remains largely unresearched. Additional information is needed to understand how engineers leading projects experience the structural and organization contexts in which they work, how they experience the transition into project leadership, and how they support the creative, collaborative work required of their project teams (Hodgson et al., 2011).

Additionally, there is criticism that the research largely focuses on the intrinsic properties of leaders, with little emphasis on the social systems within which leadership exists (Hogg et al., 2006). Considering this need, the current study places a focus on the social context within which project teams operate. Focusing on a specific population and placing the concept of leadership within a project team context will support this focus.

The majority of articles identified were quantitative articles that investigated various aspects of leadership theories and their application to SDT. Additionally, two grounded theory articles on engineering leadership and quantitative studies that sought to understand engineering leadership education, engineering personality, knowledge sharing behaviors, and motivation were identified. However, it is not known what leadership approaches are most effective for this population (Laglera et al., 2012; Rottman et al., 2014). The current study steps back from training and implementation to gain an understanding of how this group experiences leadership.

It is interesting to note that although much of the research in this arena is focused on training and educating engineers in leadership skills, leadership approaches have not been studied within this population (Robledo et al., 2012). As a result, it is unknown how effective the existing models of leadership may be in these situations. One of the trends in the research is qualitative studies to better identify the contextual factors, potentially relevant theories, and interpretations that influence engineering leadership. This research builds upon the foundation being created.

Transformational leadership is one of the most frequently studied forms of leader behaviors. A PsychARTICLES database search of transformational leadership yields 785 articles. However, including *engineer* or *engineering* in the abstract produced 2 results. As Robledo et al. (2012) stated, existing leadership theories have not been well tested within the context of engineering leadership. However, elements of transformational leadership have been shown to be supportive of learning climates (Hetland, Skogstad, Hetland, & Mikkelsen, 2011), knowledge sharing behaviors (Wang & Hou, 2015), and autonomy (Den Hartog & Belschak, 2012). These constructs are related to self-determination theory, and have been noted as important elements in engineering studies. Additionally, Berson and Linton (2005) found that transformational leadership was significantly related to positive quality management in R&D organizations. Raja and Palanichamy (2011) found that engineering leaders tended to be more transformational than transactional, which also correlated to higher levels of organizational commitment which are beneficial to engineering projects.

Furthermore, although there is a large body of research to establish the benefits of transformational leadership, there is little known about how this approach influences the leader (Lanaj, Johnson, & Lee, 2016). It would be valuable to understand how engineers experience the leadership process to determine if they are engaging in behaviors that lead to need fulfillment. It would also be valuable to understand if they are engaging in behaviors similar to transformational leadership, or another existing leadership model, or if the leadership process does not support their need fulfillment.

Transformational leadership has been related to proactive behaviors and speaking out, notably when there is variety in the work (Wu & Wang, 2015). These projects tend to require a broad range of expertise and collaboration, and so this finding may be especially relevant to the subject group. However, the leadership approach has not been studied within the target population. Overall, the engineering leadership literature review identified that there is little basis for determining the leadership constructs, practices, and training that would most benefit this group. This demonstrates the importance of beginning with a qualitative inquiry to understand what factors may play a role in the leadership process, which will begin to provide the direction for future research.

Critique of Previous Research Methods

The previous engineering leadership studies that were especially relevant were either grounded theory or quantitative studies. The grounded theory studies sought to identify the leadership process the engineers use within organizations. Rottman et al. (2014) identified that engineers desire leaders who have technical mastery, can optimize the work of an interdisciplinary team, and can foster creative ideas that can strengthen the company. Robledo et al. (2012) presented a model of scientific and engineering leadership that incorporates the elements of team formation, climate creation, planning, evaluation and feedback, resource acquisition, and expertise. This study provided more specific factors associated with engineering leadership associated with product development. Laglera et al. (2012) was a quantitative study that sought to identify the relationship of contextual variables on the outcomes of transformational leadership. The major limitation of these studies is the breadth of information gathered. The current study differs in that the focus was on gathering in-depth information about the experiences of these engineers. The themes and findings inform future research by identifying the potential variables, relationships, and the role of mediating factors. Considering the early stage of the research, it is appropriate to focus on gathering a depth of information prior to deeply investigating proposed relationships.

Summary

Rottman et al. (2014) found that although engineers tend to reject traditional models of leadership, they do in fact lead others effectively. Although there have been some studies of engineering leadership completed, understanding how engineers experience project leadership would add to the literature base. Understanding how they view and experience leadership will provide a foundation for further research to build and measure new models of leadership. Using the theoretical orientation of SDT rather than an existing leadership model will provide a new perspective on engineering leadership that would widen the scope of understanding how this population experiences leadership. This study adds to the literature by providing qualitative research within an organizational context, focusing on an understudied population. This adds to both the engineering leadership literature, project leadership literature, and SDT literature. The qualitative data provides insights into the project leadership experiences of engineers, and how the psychological needs of SDT impact these leadership experiences.

CHAPTER 3. METHODOLOGY

Purpose of the Study

This study examines engineering leadership within the context of project-based teams. Engineers are a unique population in terms of education and training, personality, and functions within organizations. They often serve in consequential roles through organizations, influencing the innovation, creativity, economic success, and organizational sustainability (Robledo et al., 2012). Although the information will be valuable to organizations, there has been little research exploring how engineers lead (Rottman et al., 2014), and specifically how engineers lead project teams (Hodgson et al., 2011). Additional information is required to understand how engineers experience these leadership roles, how they successfully transition into project leadership, and how they support the innovative, complex work of engineers.

The purpose of this study is to describe how engineers experience the leadership of project teams. Therefore, the research question involves an exploration of these leadership experiences: What is the experience of engineers leading project teams? This study contributes to the literature base as well as provide practical implications for the education and training of engineers in leadership skills and provide leadership insights to organizations that employ engineers in this capacity. Understanding how engineers experience these project leadership roles informs engineering leadership research as well as project leadership, small group leadership, and how self-determination theory applies to engineering leadership. Furthermore, the more engineering leadership is understood, the better positioned education institutions and organizations will be to effectively support the development of the needed leadership skills for engineers to effectively transition into and perform these roles.

Research Question

The research question is: What is the experience of engineers leading project teams? Investigation of this question developed an understanding of how engineers experience these project leadership positions. Currently, there is little research to direct the training, evaluation, and development of engineering leaders (Robledo et al., 2012; Rottman et al., 2014). Additional research is required to more fully understand how engineers successfully lead project teams so that effective practices can be identified, researched, and put into practice.

Research Design

For this study's research question, a qualitative approach was appropriate. This was based on the minimal understanding of how leadership concepts are experienced within an engineering population (Langlera et al., 2013; Robledo et al., 2012). Specifically, generic qualitative methodology was utilized. Generic qualitative research requires that the focus remain on the external situation rather than the internal psychology of the participant (Percy et al., 2015). One assumption was that engineers in these roles have not conceptualized the leadership roles that they play. Focusing on the external situation rather than the internal psychology of the leadership situation will yield more in-depth data with this population. This methodology was selected based upon the focus of the study, the content desired, the type of data to be collected, and the sample being studied. The interviews were semi-structured and focused on the situational context and actual experiences, opinions, and reflections of the participants.

This approach was based on a constructivist paradigm that assumes truth is relative as it depends upon an individual's perspective (Baxter & Jack, 2003). This social construction of reality places an importance on gaining an individual's understanding of reality when investigating a phenomenon. This was aligned with the research question and purpose. The basic methodological assumption underlying generic qualitative methodology is inductive logic. This assumption places an importance on understanding the unique experiences of each individual, as these experiences create the reality for that individual. As a result, the individual interviews needed to focus on broad questions that allowed the individuals to share their experiences, reflections, opinions, and interpretations (Creswell, 2013). The objective of the data analysis was to identify the themes and potential generalizations that emerged within the context of the individuals in the study and the sample.

The research question was studied within its real-life context using generic qualitative methods. Generic qualitative inquiry focuses on the participants' reports of their subjective opinions, attitudes, beliefs, and reflections on their experiences (Percy et al., 2015). This was valuable in gaining an understanding of how engineers experience these leadership positions, within the actual context in which it exists. The generic qualitative approach also allowed for the further study of the experiential knowledge gained by the researcher in previous work with engineering leaders. It also allowed for previous research to influence the additional information that was sought (Percy et al., 2015). Although there was minimal research to draw upon, the themes and components discussed in the previous research were used to develop the interview questions.

For this study, the target population is engineering project leaders in for-profit enterprises in Ohio. In generic qualitative studies, data collection typically occurs through structured methods as the methodology is focused on the actual events and experiences rather than the inner thinking of participants (Percy et al., 2015). Data collection methods include semi- and fully-structured interviews, surveys, and observations (Percy et al., 2015). This study utilized an initial demographic questionnaire and in-person, semi-structured interviews to generate the data.

The interviews lasted about sixty minutes. During the interview process, it was essential to ask the questions in an unbiased manner, focus on the participant, and continue the conversation to gather rich information (Yin, 2014). To focus on the conversation, the interviews were audio recorded for transcription at a later date. Questions were phrased in a way that made them accessible to the participant, remained open-ended, and care was taken not to create defensiveness (Yin, 2014). This approach enabled the gathering of rich information in relation to the research question.

The data was analyzed through inductive analysis following the process outlined by Percy et al. (2015). Inductive analysis allows for themes to emerge from the data rather than attempting to fit the data in preexisting categories. The minimal existing research on this topic supports the use of inductive analysis as there is little support for pre-determining categories for the data.

Following the process for inductive analysis outlined by Percy et al. (2015), the data was analyzed for each participant individually in order to identify the patterns and themes for that participant's data. This was done through noting sentences, phrases, and paragraphs that appeared to be meaningful and relevant to the research question. These themes and patterns were then transcribed into clusters of information that were coded for each theme. A phrase that sums up the information associated with that theme was then created for each theme that emerged. This required multiple reviews of each individual's data. Once data for each participant was reviewed, coded, and clustered individually, the data as a whole was reviewed to determine the overarching themes. Once the analysis of all information was completed, the items were arranged into a matrix along with their code. Each theme was then reviewed and synthesized to allow for an abstract to be created for each theme. The data consistent across the participants' data was interpreted in regard to the meaning and implications for the research question to create a synthesis of the research as a whole.

Researchers need to ensure that the research question is substantiated, that the design is appropriate for the research question, purposeful sampling strategies have been applied, data is collected systematically, and that data is analyzed correctly (Baxter & Jack, 2008). This ensures the credibility, dependability, and transferability of the research. These elements are all relevant to the study at hand and have been addressed for this study. The principal investigator has minimal training in generic qualitative methodology, limited to the academic study of the approach. As a result, the dissertation mentor and committee mentors will be drawn upon to review the execution of the methodology and make recommendations to enhance the data analysis process.

The research methodology and approach are appropriate for answering the research question, which has been discussed in this chapter. In order to ensure the dependability of the study, the data was systematically collected using semi-structured interviews with guiding questions. These guiding questions ensured that the breadth of the topic is discussed with each participant. To support credibility, the interviews were audio-recorded to substantiate the themes identified, quotes utilized, and the analysis as a whole (Braun & Clarke, 2006; Yin, 2014). One way to increase the credibility is to utilize member checking, where the interpretations of the data are shared with the participants to allow for discussion and clarification, to verify the interpretation, and to contribute additional perspectives (Baxter & Jack, 2008). However, this was not completed for this study. A remaining concern is the restriction of data collection to the interview process (Baxter & Jack, 2008) which does pose a limitation to the breadth of information gathered.

One way to enhance transferability was to thoroughly discuss the context within which the data was gathered and the assumptions of the research approach (Baxter & Jack, 2008). This is evident in the literature review, the discussion of the methodology selection, the data collection procedures written, and the discussion of the contextual factors of engineering leadership. For this research, using participants who are actively involved in these roles allows for the data to be collected within the context being studied. The sample population represents the target population by limiting participation to bachelor-degreed engineers in for-profit organizations that have project leadership responsibilities, ideally those that are leading mixed groups. Additionally, individuals will be recruited from multiple organizations. Although the sample size is small, it is representative of the larger population and will provide for a variety of experiences to be considered.

The research protocol is documented in a way that allows it to be repeated, which supports research dependability (Creswell, 2013). This study provides a thorough review of the research methodology, descriptive instructions for data collection, and an outlined approach to data analysis which all enhance the dependability of this study. Additionally, the researcher used double-coding to ensure that the data was reviewed consistently (Baxter & Jack, 2008). This involved the data being reviewed and coded, then after a period of time the same raw data set was reviewed and coded again (Baxter & Jack, 2008). Overall, the explicit overview of the methodology, data collection procedures, and data analysis procedures have been documented to support the dependability of the study.

Target Population and Sample

The population of interest was engineers employed by for-profit organizations in project leadership positions. These individuals have completed bachelor-level degrees in one or more of the disciplines of engineering and are currently employed by a for-profit organization with project leadership responsibilities. These project teams included other engineers as well as other professionals. It is important to note that there was a high likelihood of similarity in gender, race, and socioeconomic status of the group being studied. This study's sample consisted of engineers who worked in various enterprises in Ohio.

The intent of qualitative research is to gain an in-depth understanding of a complex issue (Yin, 2014). In order to achieve that objective, individuals that best represent the issue are studied (Creswell, 2013). Random sampling would not meet the needs of qualitative research and so, qualitative research uses non-probability sampling (Baxter & Jack, 2008; Marshall, 1996). Additionally, in order to reach data saturation, it is important for the sample to be more alike than different. For the generic qualitative study presented, a purposive sampling strategy was utilized. This strategy indicates that individuals will be selected to participate based on the depth of information they can provide in regard to the research question (Yin, 2014). The intent is to explore the phenomenon thoroughly, using a variety of data sources, to ensure that multiple facets have been understood (Baxter & Jack, 2008).

The inclusion and exclusion criteria will help to ensure a sample that is similar in characteristics (Yin, 2014). Inclusion criteria ensured that the individual held at least a bachelor's degree in an engineering discipline, was currently employed by a for-profit organization, and had project leadership responsibilities with at least one year of leadership experience. The project groups being led included both engineers and other professionals. Exclusion criteria included lack of a bachelor's degree in an engineering discipline, less than one year of experience in a project leadership role, and indications that they were compelled to participate in the study. These will be based on self-reports. Engineering project leaders from the targeted organizations were invited to participate. The first 10 engineers who meet the inclusion criteria without meeting the exclusion criteria and sign informed consent will be selected to participate in the study.

Procedures

Potential participants were recruited from organizations where the president was a member of a regional organization. Although the potential study was discussed with these sites and there was expressed interest in participation, formal permission was obtained prior to recruiting participants. An email was sent to the regional group in order to recruit potential sites for participation. Interested sites contacted the primary investigator via email to indicate their interest, providing the potential participant's contact information. None of the sites had their own IRB.

The potential participants then received an email that provided an overview of the study, inclusion and exclusion criteria, and a request to discuss participation. This provided enough information for the individual to determine if they met the study criteria and if they had an initial interest in participating. If an individual was interested in participating, they were able to call or email the researcher to indicate their interest, clarify inclusion and exclusion criteria, and if appropriate, set-up an interview time. If the potential participant did not meet the criteria, the reason they did not meet the requirements of the study were noted and the potential participant was thanked for their time and interest. The interview session began by reiterating informed consent criteria. If the participant remained interested, the informed consent process was followed. It was anticipated that this approach would provide enough participants for the study.

Individuals who signed informed consent to participate in the study completed an initial demographic survey and the semistructured interview. The initial survey gathered educational, positional, and organizational information. The second step of data collection was the completion of the semi-structured interview. The objective of the semistructured interview was to gather in-depth information about the participant's project leadership experience, which allowed for the themes to emerge during analysis (Yin, 2014). The semi-structured interview was completed face-to-face, and an interview guide was used to facilitate the conversation. These meetings took place in public places where privacy of communication could be maintained. Ideally, this was a meeting room in a restaurant or library in a location convenient for the participant. Based on the responses to the guiding questions, additional probing and clarifying questions were asked to gain in-depth information. The interviews were audio recorded so that full attention could be paid to the participant, and accurate data could be obtained (Yin, 2014). During the interview, anything that was observed that wouldn't be captured in the audio recording were noted (Yin, 2014).

Data Analysis

Data analysis was completed for each participant individually until patterns and themes emerge for that participant (Percy et al., 2015). This allowed for the themes to emerge from the data rather than through preconceived notions of the potential themes. Data that was not relevant to the research question was set aside. Each individual data set's patterns and themes were coded, and the supporting data was organized to support that theme. Once that was complete for the first participant, the same process was followed for additional participants. The result was a set of patterns and themes coded for each participant with supporting information attributed to that pattern or theme.

The data was then reviewed as a whole to identify the overarching patterns. These were coded, and the supporting themes and patterns attributed. This lead to the identification of the major themes that described the experience being investigated. The objective of the analysis was to build an explanation in regard to how engineers experience project team leadership. The narrative created out of the coded data was then connected to psychological theories, discussed in terms of the context and situational factors, potential relationships were identified, and recommendations for future actions were made. The output was a narrative of the experience, the overarching themes, and the data that supported the findings.

Instruments

Considering the work of engineers is closely tied to the economic drivers of organizations (Robledo et al., 2012), this research is valuable to organizations that employ these individuals. Furthermore, there has been a recent push to incorporate leadership skills in engineering education (Rottman et al., 2014). These are built upon assumptions that leadership that has been effective in other contexts is best suited for this profession. Without an understanding of how engineers lead, the education may not emphasize a process that has proven to work with this population. As we learn the elements of effective engineering leadership, training and implementation programs can be developed to ensure that the practice of engineering leadership is aligned with research. In order to address the research question, the following questions were used to guide the semi-structured interviews:

1. How would you describe your experience as a project leader?
    a. What do you value in leadership? What is important to you?
    b. Is there a model or theory that guides your leadership?
        a. Where did you learn this?
        b. What attracted you to this?
    c. How did the organization influence your experience as a project leader?
    d. In your opinion, how important is leadership for the engineering profession?
2. How have you seen leadership influencing project outcomes and organizational success?
    a. How has your leadership impacted engineers in your organization?
    b. In your experience, what needs to be in place for engineers to be successful in teams?

   c. In your experience, what has been most supportive of creativity, innovation, and collaboration?
3. How have you balanced the technical, people, and organizational needs of project leadership?
   a. What differences are there in leading engineers vs. other professionals?
   b. How do you constructively handle conflict and disagreement?
   c. In your experience, how do the organizational structures support or detract from the work of engineering project teams?
4. What was it like for you to transition into this role?
   a. How did you come to be a leader in your organization?
   b. What transition struggles did you have?
   c. How did you develop your leadership skills?
   d. What training or development did you receive?
      a. What was really helpful?
      b. What was not?
   e. Where do you go for support?
5. What else do you think is important that others know about engineering leadership?

The Role of the Researcher

It was anticipated that the research would describe the experiences of engineers leading project groups, providing insights into the essential elements of leadership and factors of successful transitions, leadership skill development, and organizational support. Previous work experience in an engineering project environment has driven the interest in the population and leadership context, however it has also created biases. The biases and expectations of findings are detailed here, but were set aside when investigating the topic to ensure that a breadth of information was gathered. It was important that these expectations did not influence the collection of data or its analysis.

One expected finding was that engineers have spent little time thinking about their role as a leader and the complexity and influence of that role. This is based on previous research that indicates that engineers do not often recognize themselves as members of the leadership profession (Rottman et al., 2014). This bias was addressed through the initial interview questions that focused on the experience of leadership, the value of leadership, and its importance to the engineering profession. The beginning interview questions were intended to create the context for the engineer to think about their leadership before asking questions about specific approaches, outcomes, and transition experiences.

In general, there is an assumption that the normal approach to leadership does not best support the work of this group (Robledo et al., 2012). Additionally, it was anticipated that engineers are typically resistant to existing models of leadership, but that they do lead in ways that are aligned with their professional identities (Rottman et al., 2014). This is also based on the personality factors of engineers including cognitive complexity, flexibility, openness, dominance, and self-confidence (van der Molen et al., 2007; Williamson et al., 2013), which influences how they relate to others in order to manipulate complex information to solve problems (Smith & Paquette, 2010). This expectation was mediated through the questions asked of the participants. There was not a focus on particular models or their evaluation, but instead on gaining knowledge of what methods and elements have been most successful. This information could then be mapped back to existing models if there is congruence.

It was also expected that these engineers have struggled with the transition from technical mastery to leadership. This was also supported by previous research (Hodgson et al., 2011; Racine, 2015). In order to explore this element, questions regarding leadership transitions, struggles, skill development, and support structures were asked. Lastly, there was also an expectation that the leadership factors associated with supporting the creative collaboration required of engineers would be aligned with the elements of self-determination theory.

Additionally, there was a bias that engineers are more adept at leading other engineers due to the congruence of their professional identities and their leadership approach (Rottman et al., 2014). Specifically, the focus on the concepts of self-determination theory influence how the researcher views engineering leadership. However, this population has not been specifically studied in terms of leadership theory or the concepts of self-determination theory. Each of these assumptions were set aside when investigating this topic to ensure that a breadth of information was gathered. Specifically, the interview process was structured so that these biases were not evident in the questions and did not limit the breadth of the information gathered.

Ethical Considerations

One ethical concern for psychological research is potential harm to participants. The targeted population for this study was not a vulnerable population, and there was minimal harm from participation. The other possible ethical challenges with this study are compulsion to participation, confidentiality, and privacy. The following paragraphs will describe how these challenges will be addressed.

An important element of ethical participation is informed consent. The informed consent form and process shared all information about the study that a potential participant would need to know in order to weigh the risks and benefits of participation, allowing them to make an informed decision to participate. Participants were also informed that they can skip questions if they desire and decide not to participate at any time. The sessions were recorded to support the validity of the data collected. Considering site permission was needed to recruit participants, permission was also obtained from the facility. A company officer was provided the information required to make a determination that they were willing to provide contact information for potential participants.

Considering individuals were recruited with permission from organizational leaders, it was important that their participation was not compulsory. In order to minimize compulsion to participate, the actual participation by individuals was kept confidential. Considering the information gathered could contain negative perceptions of organizational leaders or support, it was especially important to maintain confidentiality. Confidentiality and privacy were especially important to ensure that all individuals would be safe from retribution. To keep names separate from data, each participant was assigned a code that appeared on all data sheets. In the presentation of data, care was taken to ensure that all thematic data and quotations were scrubbed of identifying information.

All records were stored in a locked filing drawer for the duration of the study and for seven years following the study's completion. After the seven years, the data sheets will be shredded. All electronic files are stored securely on a password protected computer. Once the study is complete, the data will be stored on an external device in the locked filing cabinet. Following seven years, the electronic data will be destroyed according to the same standards as paper files. In the collection of data, interviews will take place in public places where conversation can be kept private such as a meeting room at the library or similar location.

Summary

This chapter presented the methodology of the study along with the rationale for its selection. This approach resulted in a breadth of data relevant to the research question. Chapter 4 will present the data and its analysis. Chapter 5 will provide a summary and discussion of the research findings as well as how they relate it to the literature review. Additionally, Chapter 5 will provide the interpretation of the findings, the implications of the results, and recommendations for further research.

CHAPTER 4. PRESENTATION OF THE DATA

Introduction: The Study and the Researcher

This chapter summarizes the findings of the study and outlines the process taken to collect and analyze the data for this research project. The chapter begins by describing the researcher's involvement in the study as well as the participants of the study. The next section will discuss how the research methodology was applied to the data analysis. Next, the qualitative data is presented followed by an analysis of the themes and patterns that emerged. The intent of this section is to tell the story of the themes and key findings. This chapter will serve as a foundation to the discussion of results and conclusions presented in the following chapter.

Interest in the study topic was strongly influenced by working for an engineering organization. Despite the stereotypes of engineers, there has been personal observation of effective communications and planning, constructive disagreement, and thoughtful resource utilization that seems to be contrary to the assumed norm. The ability of these individuals to recognize the strengths and knowledge of others and to bring them into projects in a way that ensures the desired result sparked an interest in their leadership experiences. Specifically, the researcher has had an interest in learning how these individuals experience these project leadership roles, and how the work looks and feels from their perspective. These experiences influenced the design of the questions as well as the interviews conducted by the researcher.

This background strengthened the study by providing an experience-based perspective on the topic. It also influenced the theoretical orientation of the study, which in turn influenced the literature review and design of the interview protocol. Previous experiences working in psychological research and testing supported the researcher's ability to conduct the study. These experiences enabled consistent, planned data collection procedures and organization.

Methodological understanding specific to this study has been gained through coursework and research. Previous data analysis experience has been limited to quantitative studies, although the researcher does have experience with the importance of data accuracy and appropriate representation. These experiences support the researcher's ability to analyze the data, draw conclusions, and relate it back to the literature review.

The researcher played a significant role in this study, developing the interview questions, recruiting participants, and executing the interviews. These biases may have influenced the development of the questions, interfering with the objectivity of the data collected. Additionally, when a participant brought up a point that resonated with the literature review previously completed, more interest and follow-up questions were asked of the participant. Although the interview questions were developed in order to minimize bias, these biases may have influenced the focus of the interview as well as the theoretical orientation from which the data are interpreted.

Description of the Sample

Purposeful sampling was accomplished using a regional organizational president organization. A request to participate in the study was emailed to members of an Ohio organization. Organizational presidents who were interested in the study identified engineering project leaders within their organizations that they felt would provide a valuable perspective to the study. This request was sent to ten organization presidents, with six organizations expressing interest in sharing the information with potential participants. This group produced ten potential participants from six organizations. Of these ten potential participants, eight met the target sample criterion and expressed interest in participating. Two did not respond to two attempted contacts and were eliminated from the recruiting list. Contact was made with the engineers who expressed interest in participation, and interviews were scheduled. All eight interested participants were interviewed. The two additional participants were informed of the study by a participating engineer and expressed interest in participating. Both met the sample criterion and expressed interest in participating. This approach provided the required ten participants. This approach to recruiting likely identified engineering project leaders who were effective in their positions, with leadership qualities that are valued by the organization. Although this may have somewhat biased the sample and resulting data, it also likely resulted in participants who would provide a depth of experience.

Ten engineers with project leadership responsibilities were interviewed. All ten engineers obtained bachelor's degrees in an engineering discipline, are employed by a for-profit organization in Ohio, and have at least one year of project leadership experience. Two participants worked for engineering firms while the other eight worked in manufacturing organizations. The participants in this study were from diverse engineering disciplines: biomedical, chemical, civil, electrical, mechanical, and polymer engineering. There was only one female engineer included in the study. Six of the participants held a master's degree, either in business administration or their engineering discipline. Seven of the participants had completed formal leadership training. Years of experience in project leadership ranged from two to over twenty years, with only one with less than five years' experience. See Table 1 for a summary of the ten participants' demographic information.

Table 1. Participant Demographic Information

PSEUDONYM	DISCIPLINE	MASTER'S DEGREE	FORMAL LEADERSHIP TRAINING	YEARS' EXPERIENCE AS LEADER	ORGANIZATION SIZE
P1	Chemical	MBA	Yes	15+	500+
P2	Chemical	MBA	Yes	15+	500+
P3	Civil	MBA	Yes	15+	150-499
P4	Mechanical		Yes	15+	150-499
P5	Biomedical	Biomedical Engineering	No	5-10 years	150-499
P6	Civil		Yes	15+	500+
P7	Electrical	Electrical Engineering	Yes	1-4 years	100-149
P8	Polymer		No	5-10 years	150-499
P9	Polymer		No	11-15 years	150-499
P10	Mechanical	MBA	Yes	15+	100-149

The informed consent process provided each participant with the purpose of the study as well as the expectation, risks, and confidentiality issues possible in the study. After reviewing the informed consent, no participant had concerns regarding study participation, and all signed the form. All participants agreed to participation as well as audio recording of the interview. Participants were identified on data collection forms by a designated number rather than by identifying information to maintain confidentiality.

Description of Participants

Participant P1. Participant one (P1) is a chemical engineer in his fifties with over fifteen years of project leadership experience. P1 obtained an MBA and has participated in various formal sales and leadership training. He also studies philosophy and leadership independently. His current position is the VP, Engineering in an organization that has over 500 employees. P1 gains satisfaction and pride from his leadership experiences and his ability to become familiar with the individuals on the team to understand their strengths, abilities, and personal motivations. P1 cited leadership theories such as servant leadership and the concept of flow, as well as the importance of trust, purpose, and self-learning. It was evident from the interview that P1 has spent considerable time conceptualizing leadership, self-reflecting on experiences and growth, and developing his leadership approach. Compared to the majority of interviews, P1 went into considerably more depth in terms of the motivation and leadership theories and practices that he found to be most relevant to the questions.

Although the themes presented by P1 are similar to the themes presented by other participants, the interview with P1 provided considerable depth to the data gathered. He discussed in-depth the need to be able to flex to the needs and preferences of the individuals being led, and the importance of helping people to self-actualize. He discussed that part of the leadership role is to help people learn about themselves and to grow their capabilities. It was clear that P1 feels that being focused on both the project outcomes and the growth of the individuals are key to successful project leadership, and a successful organization. Throughout the interview he discussed helping individuals realize their potential, the importance of self-reflection, and the project and organizational gains realized from focusing on building individuals into their best self. The themes were similar to those from other interviews, however the language and depth of discussion was unique to P1.

Participant P2. Participant two (P2) is a chemical engineer in his forties with over fifteen years of project leadership experience. P2 received his MBA and has also participated in formal leadership training. His current position is a senior program manager for an organization with over 500 employees. He has a very broad sense of engineering project leadership, and it was apparent in the interview that he had spent considerable time reflecting upon his approach and experiences to continue to grow and develop over time. He was thoughtful in his responses to questions and appears to be practiced in self-reflection. It was apparent that he enjoys these leadership experiences and has a pride and sense of importance to the role he has played in team members' careers and lives.

P2 discussed the importance of the engineering project leadership role to the organization and the responsibility to the individuals on the team. He remarked how the challenging nature of projects, the collaboration required, and the importance of leadership to the careers and development of the engineers on the team combine to make project leadership an "awesome" experience. P2 also discussed engineering projects within the context of the business mission, the importance of individual ownership, and the importance of growing the individuals on the team. He repeatedly discussed the importance of trust, professional empathy, and communication. He discussed in detail how each of these can be built and sustained through the work of an engineering project leader. A great depth and breadth of information was gathered from this interview.

Participant P3. Participant three (P3) is a civil engineer in his forties with over fifteen years of project leadership experience. P3 completed his undergraduate degree in engineering and is currently pursuing an MBA. He participated in formal leadership training as part of his military training. His current position is the Director of Corporate Development in an organization with over 150 employees. He appeared to enjoy the conversation and reflection points in the interview. He provided a comprehensive answer to each question, and although it was evident that he had spent time reflecting on his experiences, the interview appeared to provide him with new insights into his experiences.

It was apparent that P3 had spent time conceptualizing leadership, reflecting on his experiences, and working to improve his approach to benefit himself, his team members, and the organization. He discussed how the engineering mindset, developed through education and training, has proven to be valuable in leadership situations. This engineering mindset was described as the ability to understand how something works, identify what factors are influencing it, focus on the desired result, identify the resources and capabilities available, and then determine how to leverage them in order to achieve the result. He also discussed the need to individualize his approach, act decisively, and leverage the strengths on the team in order to maximize the group output. He also discussed engineering projects as business projects, repeatedly connecting the outcomes of the project to the mission and needs of the business.

Participant P4. Participant four (P4) is a mechanical engineer with over fifteen years of project leadership experience. He does not have a graduate degree, but has participated in leadership development seminars and workshops. His current position is senior engineering manager for an organization with over 500 employees. P4 remarked at the joy that he finds in not only reaching the finished product, but also the opportunity to influence teams of people to get there. He has not had training to provide him with leadership theories to remark on or draw upon, but instead has learned from mentors and experience.

P4 also discussed the engineering mindset and how this systematic thought process supports not only the development of a product, but also leadership situations. He also discussed the importance of trust, providing clarity, and making good decisions from incomplete information as keys to successful engineering project leadership. He quietly reflected upon each question prior to answering. Although he did not have the terminology and awareness of leadership theories present in many other interviews, it was clear that he has spent time reflecting upon his experiences to continue to grow in his role.

Participant P5. Participant five (P5) is a biomedical engineer in her forties with five-to-ten years of project leadership experience. She has a Master's in biomedical engineering. Her current position is a program manager in an organization with over 500 employees. P5 described her experiences as fairly successful, remarking on the differences in experiences between large and small projects. She seems to enjoy the quicker pace of small projects and the coordination required in larger projects. She is most comfortable leading other engineers, because she can relate more to their approach. Interestingly, she emphatically said she did not have a leadership theory that guides her style, and added that "too many leaders read too many books." Instead, she looks for a clear vision of the expectations and then determines her approach based upon the work required to meet them and the individuals and resources available to the project. When discussing how she individualizes her approach, she did not go into as much depth as most other participants. She discussed the importance of acknowledging the expertise available and knowing who to involve, when, and to what extent. She attributes her growth and success in project leadership to mentoring, stating that it "changed my entire career."

P5 remarked a few times that engineering groups can struggle without a clear vision and project scope. She also discussed the importance of listening to understand and make decisions. She seemed most engaged when discussing how she balances the needs of individuals, the project, and the organization. She enjoys the coordination, problem solving, and connecting aspects of engineering project leadership most. She most commonly focused on the importance of communications, clear vision, listening, and the importance of mentorship in her development.

Participant P6. Participant six (P6) is a civil engineer in his fifties with over 15 years of project leadership experience. Although he has not pursued a graduate degree, he has completed formal leadership training focused on emotional intelligence and appreciative inquiry. Neither of these focuses were referred to in other interviews. He is the local lead for a national engineering firm with over 150 employees. He described his experiences leading engineering projects as challenging and opportunistic. He repeatedly referred to listening as a key aspect of leadership, and developing listening skills a key to success for engineers. He noted the importance of being willing to listen and understand where someone is coming from before jumping in to solve a problem. He also discussed the importance of taking advantage of opportunities to grow.

P6 enjoyed talking about his leadership experiences, and it was evident that he has taken considerable time reflecting on his approach and experiences. Notably, he has spent a lot of time thinking about how taking a positive mindset changes the conversation. This was unique to P6. He discussed listening more than any other participant, and continued to stress the importance of listening to solving problems, being innovative, retaining customers, improving morale, and successfully completing projects throughout the interview. It was clear that he enjoys these leadership experiences and the great sense of satisfaction and fulfillment that they provide him.

Participant P7. Participant seven (P7) is an electrical engineer in his twenties who has been working as an engineer for five years, but only for two years in a project leadership position. He described his leadership experiences as rewarding, and remarked at how much he enjoys working as part of a team. He has a graduate degree in electrical engineering and discussed how his teaching experience through this program helped him to learn how to support others in solving problems. He also discussed how the senior design portion of schooling taught him how to coordinate work and pull a group together to complete a large group project, preparing him for engineering project work. He has completed a formal leadership training program and remarked that the value from this was learning a few principles that could be taken back to see how they fit within his project group. His current position is division supervisor in an organization with 100-149 employees.

P7 was the youngest engineer interviewed, in the early stages of career development. He discussed his early learning and what he has identified as keys to project leadership success. Although he does not have the depth of experience as others interviewed, he was able to provide a comprehensive response to each question. He was one of three other interviews that focused more on structures and process than the other participants. He discussed keys to success as communications, knowing the expertise available, individualizing your approach, being able to bargain for resources, and knowing how the project fits within the priorities of the organization. Although he is early in his career as a project leader, he realizes the importance of mentorship and gaining a breadth of experience as keys to development. P7 also discussed empathy in terms of learning more about the experiences and needs of individuals in other departments. He has found that learning what is important to them and why to be key to leading cross functional teams. Although P7 was very early in his development and experience, he had very similar reflections to those with greater experience. The difference was the depth in discussion around these key points.

Participant P8. Participant eight (P8) is a polymer engineer in his thirties with five-to-ten years of project leadership experience. His current position is Engineering Project Manager in an organization of over 150 employees. He described his project leadership experiences as fulfilling, adding that it provides a great sense of accomplishment when a project is successfully completed. The questions were initially answered much more focused on project management and the associated work required, but gradually transitioned into discussing the nuances of bargaining for resources, how styles can influence project outcomes, learning how to take different perspectives, and the importance of mentorship and trust. It did not appear that he had spent as much time reflecting on his experiences as others in the study. He has not pursued a graduate degree and has not participated in any formal leadership training. He did not feel that his undergraduate program prepared him for what was required for a leadership position.

P8 presented the importance of trust throughout the interview. He discussed that without positional authority, bargaining for resources only works over time when team members trust that you are providing them with real information, that they understand the importance of that work to the company, and that you treat them with autonomy and respect. Similar to other interviews, he discussed mentorship as a key to development and his successful transition to project leadership. Two skills that he developed, and discussed in more detail, were perspective taking and learning how to manage different personalities. He discussed transitioning a devil's advocate approach into perspective taking, allowing for a more positive conversation to be had around concerns and disagreement. This was a key to his success in project leadership. He discussed learning how to leverage the strengths on the team, building each individual's self-confidence, and becoming very familiar with the team members. These are a source of pride for P8.

Participant P9. Participant nine (P9) is a polymer engineer in his forties with 10 to 15 years of project management experience. He has not pursued graduate education and has not completed any formal leadership training. His current role is Engineering Project Manager in organization of over 150 employees. He described his experiences as both stressful and rewarding. Although he was more focused on project management than the other interviews, much of what was gleaned from the interview was not dissimilar to the others. He had a matter-of-fact nature that almost seemed contrary to the way he approached leadership situations. Most questions were answered thoroughly, although he had difficulty in fully answering questions that were meant to understand how individual needs and personalities may influence a project. This was the only interview that did not, at some point, discuss the importance of becoming familiar with the individuals on a team and adjusting the approach based on this information.

P9 seemed to be focused on the importance of communication and autonomy, with communication being noted as his biggest area of growth. Communication was discussed in terms of the need for clarity and the importance of keeping people informed so that they can plan and make decisions, “because they know what impacts them better than anyone.” This also included communicating with those in higher positions to ensure that the priorities of the organization are understood. He also discussed the importance of forcing a discipline of communicating in order to keep people involved. P9 also discussed the importance of providing autonomy, allowing individuals to make decisions, the importance of having people who are self-motivated on the team, and allowing people the room to get what they know needs to be done, done. He also discussed the importance of empathy, appreciation, acceptance, and honesty.

Participant P10. Participant ten (P10) is a mechanical engineer in his fifties who has completed his MBA. He felt that his MBA supported him in broadening his perspective and prepared him for leadership. He has over fifteen years’ experience in project leadership. P10 has completed formal leadership training, a formal mentoring program, and project management training. His current position is Engineering Manager for an organization with over 150 employees. He looks at his style as that of a “player-coach”, knowing that deep down he is an "engineer much more so than a manager." He enjoys playing an active role in the technical side of a project, allowing him to lead by example and retain an active role on the team. It was apparent that he has spent time reflecting on his experiences, learning from them, and adjusting to his approach. As a result, this interview provided a great depth and breadth of information. He discussed the importance of listening, humility, comradery, credibility, including different perspectives, mentorship, learning to take a broad perspective, and keeping the business needs in mind throughout a project.

He discussed, similar to some other interviews, that the engineering mindset can be related not only to components, but also to projects and people. He also discussed the importance of perspective taking in order to depersonalize conflict and better understand what the root of a disagreement may be. It is also important to note that he has a very broad perspective on project leadership, and takes the responsibility of developing engineers and their careers seriously. He discussed mentorship in a broad sense, focusing on how it builds "better engineers, better managers, better people." It was evident how deeply he appreciates the mentoring that he has received. It was clear from this interview that P10 takes great pride in his experiences, understands the responsibility that he has to develop the engineers on his team, and has spent time reflecting on his experiences in order to learn from them and continue to grow.

Research Methodology Applied to the Data Analysis

The methodology was selected based upon the focus of the study, the information to be collected, the state of the literature, and the sample being studied. The generic qualitative inquiry was appropriate for a study seeking to discover the themes emerging from the participants' interviews in an area that has not been thoroughly studied. Additionally, generic qualitative research focuses on the external situation rather than the individual psychology (Percy et al., 2015), which would provide the desired information regarding the experiences of the individuals.

The data analysis process used in this generic qualitative study was inductive analysis, which resulted in recurring patterns and themes. Inductive analysis allows for themes to emerge from the data rather than attempting to fit the data in preexisting categories. This minimizes bias and does not require pre-existing knowledge in order to identify the themes, patterns, and relationships (Percy et al., 2015). Instead, the data related to the research question emerged from the participant responses. Additionally, the researcher used the principles of Self-Determination Theory and Social Identity Theory as the theoretical framework and lens to analyze the data.

Presentation of Data and Results of the Analysis

Systematic Process

The ten participants completed a demographic data sheet and participated in a semi-structured interview. The interview started with the informed consent process to ensure consent to participate, and each participant signed the form. Rapport was established with each participant by reviewing the purpose of the study, an overview of the interview process, and the intended use of the data. The responses from the in-depth interviews were audiotaped and transcribed by the researcher to maintain the richness of the data gathered. These transcriptions were then reviewed individually to identify themes and relationships within each participant's data, and then reviewed holistically to identify the overarching themes, relationships, and patterns.

Participants were asked to share their experiences leading projects, what has worked for them, what they have learned, and how they experience the role. They were then asked to discuss the role that they see the project leader playing, what they value in leadership, share any models or theories that have helped to guide their leadership, and share how the organizations that they have worked for have influenced their approach. The interviewee was then asked to discuss how they have experienced leadership influencing the outcomes of projects, how they have impacted other engineers, and what has been most supportive of innovation, creativity, and collaboration. Following this discussion, the interviewer focused on how experiences differed when leading engineers and other professionals, how they have learned to constructively handle disagreement, and how organizations can support or detract from the work of engineering project leaders. The last section of the interview focused on the transition into the project leadership role, how they came to be a leader, what they needed to learn and develop in order to be successful, how they experienced the transition, and where they received the most valuable support.

Coding Process

The data will be analyzed through inductive analysis following the process outlined by Percy et al. (2015). Each participant's data was reviewed individually following transcription, identifying relevant information and recurring ideas. During review, sentences, phrases, and paragraphs that appeared to be meaningful and relevant to the individual question were highlighted. Following this process, the participant's data was reviewed in whole to identify common themes across questions. This identified the coding to be used for the interview.

Throughout review, as new insights or themes emerged, the coding process was refined by adding or expanding upon the codes, and the data were reviewed again. This process identified recurring words and supporting information across the individual data set. The frequencies of these codes were then tabulated. Each individual data set was reviewed in the same manner to identify the codes to be included. These codes were compiled to create the master list of codes. The frequency of each code within the individual participant data set, as well as their overall frequency are displayed in Table 2.

Table 2. Code Frequency

Code	P1	P2	P3	P4	P5	P6	P7	P8	P9	P10	Frequency
Motivate	12	0	0	1	4	1	1	1	3	0	23
Individuals	1	0	3	9	2	2	3	2	4	2	28
Responsibility	1	1	2	5	1	0	6	4	2	3	25
Reflect	3	0	0	2	0	1	0	1	0	1	8
Communication	0	7	1	0	3	2	5	1	7	0	26
Trust	11	9	3	3	1	2	0	6	0	2	37
Collaboration	7	1	0	1	0	1	0	1	0	0	11
Expert	1	1	1	1	3	0	1	0	0	2	10
Clarity / Clear	2	5	0	4	5	0	3	0	7	2	28
Decisive	0	0	5	4	2	0	2	2	1	0	16
Empathy	2	5	0	0	0	0	0	0	1	0	8
Appreciate	3	1	1	1	0	5	0	0	1	7	19
Mindset	3	0	4	3	0	3	0	1	0	0	14
Learning	5	3	5	3	0	18	13	10	5	10	72
Listen	3	3	1	0	3	11	0	1	0	4	26
Mentor	0	3	0	3	5	1	8	4	0	5	29
Context / Circumstances	1	5	2	1	0	1	0	0	1	0	11
Understanding	25	9	5	2	6	6	8	6	2	6	75
Open	0	3	0	2	1	1	5	1	0	1	14
Aligned	1	2	0	4	0	1	0	0	0	0	8
strengths	1	4	2	1	0	0	0	0	0	2	10
Commitment	0	2	0	2	2	0	0	0	1	2	9
Vision	0	0	1	1	3	0	0	0	0	3	8
Systematic	1	0	1	2	3	0	0	0	2	0	9
Solutions	0	4	2	4	5	0	2	4	0	7	28
Problems	2	5	4	0	9	5	2	9	3	11	50
Share	1	0	0	0	1	3	2	3	0	0	10
Skill	0	4	3	0	0	3	6	1	0	9	26
Experience	7	5	4	7	2	4	9	3	4	8	53
Humility	0	3	1	0	0	1	0	0	0	3	8
Feedback	0	6	0	1	1	1	0	2	0	1	12

This first round of coding provided the general framework for the data review. There were several codes that were repeated in the data set five or less times, and these were only present in two or less interviews. There were codes that were present eight or more times, and these were present in three or more interviews. This disparity between the frequency of eight consistently occurring in three interviews compared to the five occurring in two or less indicated the cut-off to be included in the coding. As a result, any codes that were repeated across interviews eight or more times were included in the coding. The individual codes were reviewed within the context of the data set to identify the themes that were present. These themes were then arranged into a matrix along with their code, displayed in Table 3.

Table 3. Sub-themes Associated with Individual Codes

Sub-Themes	Codes
Authentic Approach	Trust Humility Listen
Motivate Individuals	Appreciate Motivate
Individualize Approach	Individuals Context / Circumstances Expert Strengths Empathy Skill
Understand Variables	Understanding
Align to Vision	Aligned Vision
Focus on learning	Learning Reflect Mentor Experience Feedback
Commit to Team	Responsibility Commitment
Engineering Mindset	Mindset Solutions Systematic Problems
Offer Clarity and Direction	Clarity / Clear Decisive
Open Communications	Communication Open Collaboration Share

The interviews were then reviewed to place the sub-themes within the context of the meaning and implications for the research question. These sub-themes were then reviewed within the data set to understand the context within which the sub-themes existed. Each theme was reviewed and synthesized to allow for an abstract to be created for each theme. This analysis indicated five major themes: developing trust-based relationships, commitment to the team, perspective taking, learning from experiences, and applying an engineering mindset. These major themes are the elements of engineering project leadership that best describe the experiences of the individuals interviewed. The individual codes were then associated to the major themes that they supported. These major themes, and the individual codes related to them, are displayed in Table 4.

Table 4. Major Themes and Individual Codes

Major Theme	Individual Codes
Develop Trust-Based Relationship	Listen Trust Humility Open Share Communication
Commitment to Team	Appreciate Commitment Vision Motivate Responsibility Aligned Collaboration
Perspective Taking	Individuals Expert Strengths Empathy Skill Understanding
Learn from Experiences	Learning Experience Feedback Reflect Mentor
Engineering Mindset	Solutions Mindset Clarity / Clear Context/Circumstances Problems Systematic Decisive

Results

In general, the results of this study provided support for self-determination theory to be applied to engineering leadership. This is supported by the focus on competence and relatedness present in the interviews. Most participants discussed the need to understand the skills and strengths of team members, the importance of knowing where the expertise in the group resides, and the appreciation for these individuals. Additionally, the importance of the team approach to a project, the need for collaboration, and the connection of the individuals to the project team, and the project team to the organization were supportive of relatedness. Although autonomy was not directly discussed, the participants did discuss the need for self-directed team members, respecting the skills and expertise of individuals, and the importance of allowing them to make decisions independently.

There was only moderate support of social identity theory of leadership. A strong connection to the engineering profession was evident in each interview, which is supportive of social identification described in the theory. This included respect for knowledge, expertise, and the engineering approach to problem-solving applied to engineering leadership. Although it was common for the participants to indicate that they were more comfortable leading other engineers, the respect for the perspective and skills that other professionals brought to the team was apparent. Most participants remarked on how the project leadership experiences broadened their perspectives outside of the black-and-white mindset of engineering. Although there was a strong commitment to the other engineers, there was also a strong commitment to the project team and the organization. Although each participant identified strongly as an engineer, they were drawn to the breadth and people-orientation of leadership beyond the prototypicality of engineers.

Presentation of the Data and Results of the Analysis

This generic qualitative inquiry was guided by the research question: What is the experience of engineers leading project teams? The data collected from the ten interviews provided the information regarding the experience of engineers leading project teams. Five major themes were identified from the data collection and analysis process: developing trust-based relationships, commitment to the team, perspective taking, learning from experiences, and applying an engineering mindset. Each participant's code frequencies were reviewed to determine if they were generally supportive of the theme. This was determined by totaling the frequencies from the codes that comprised the theme, with a minimum total of seven to be considered supportive of the theme. There were several participants that had a frequency of five or less, with less than half of the codes from that theme being present. When the frequency was seven or higher, half or more of the codes for that theme were represented by the participant's data. As a result, the cut-off to assume support of the theme was seven.

All participants' perspectives supported the themes of perspective taking and applying an engineering mindset to project leadership. The themes of developing trust-based relationships and learning from experiences were both supported by all participants other than P9, while the theme of commitment to team was supported by all participants other than P3, P8, and P9. The theme of learning from experiences was the dominant theme in five of the interviews, while using an engineering mindset was the dominant theme in three of the interviews and perspective taking was the dominant theme in two of the interviews. Trust-based relationships and commitment to the team, although supported by interviews, were not the dominant theme in any of the interviews.

Although there were varying degrees of support, in general there was consistency across the interviews in terms of themes. Seven participants were supportive of all themes. P3 and P8 were supportive of all themes except for commitment to team. For P3, he was more focused on the aspects of trust, listening to understand others, and using his technical training to better understand business and the individuals within the organization. It seemed to be more of a focus on understanding the individuals, with the team aspect of the work being an unstated assumption.

P8 was more focused on the individuals within the project, and the project's place within the organization. This overshadowed the team aspect of the work. P9 was only supportive of the themes of perspective taking and applying an engineering mindset to project leadership. P9 was heavily focused on learning the process and connecting with individuals, with less self-reflection apparent as compared to the other participants. The themes and results from P9 were more reflective of the assumptions regarding engineering personality and training.

Presentation of Questions and Key Findings. The questions asked in the study sought to understand the experiences these individuals had leading projects and how they view and value leadership. This included investigating how they handle disagreement and conflict, how they saw leadership influencing engineers and project outcomes, experiences supporting creativity and innovation, and how they experienced the transition into a leadership role. The questions were structured to put the engineer in a mindset of evaluating leadership, then becoming more specific as they focused on different aspects of leadership, and lastly to how they experienced the transition into this role. In general, the questions were answered comprehensively. The question regarding how organizational structures support or detract from the work of engineering project teams was not answered as expected. The question was asked to learn how the structure of an organization may unintentionally disrupt the work of engineers, as well as how organizations support that work.   Most responses focused on organizational processes from a more tactical standpoint; however, three of the participants answered the question within the expected context. This was the only question that was commonly not answered in a comprehensive manner.

The initial question regarding the experience of leadership was difficult for some participants to answer at first, but was answered comprehensively after some thought. Some participants remarked that they had not spent time thinking about leadership in this manner. However, each participant appeared to enjoy discussing their experiences and gained insights from the reflection. Interestingly, the question regarding conflict and disagreement caused three participants to clarify that these were two different things and remarked at how important disagreement was to a project's success. The breadth of questions was developed not knowing where the depth of conversation would be struck. There were multiple themes that emerged from multiple questions, rather than each question developing independent themes.

During the interviews, the majority of questions were answered in a comprehensive manner. There were a few engineers that were not familiar enough with models of leadership to comment on a specific model that guides their leadership. However, all participants could identify elements of leadership that were important to them. Additionally, the question regarding organizational influence on project leadership and outcomes was answered in two distinct manners. Seven participants reflected upon how the organizational culture influenced their leadership, while the other three reflected upon organizational processes that were followed. This is an important difference and resulted in two different types of information gathered. There was one participant that struggled to conceptualize leadership. However, through discussion the individual did answer most questions comprehensively through the lens of leadership. The following sections will review the themes that were discovered for each question.

Experiences as a project leader. To understand how engineers experience these leadership roles, participants were asked to describe their experiences. They were then asked what they value in leadership and why. These questions provided information regarding how engineers experience these roles and what they value in leadership. These questions also established a leadership mindset for the remaining questions.

These experiences were described as fulfilling, challenging, successful, stressful, fun, educational, and rewarding. It was clear that these experiences were viewed in the context of the value to individual growth, the responsibility to the individuals on the team, and the fulfillment of business objectives. Mentoring others, creating a sense of ownership over the team, and the ability to grow skills and perspectives were sources of fulfillment. P3 discussed the reward and difficulty with leading individuals as "there is nothing more rewarding than working with a great team, bringing all these people together, and the challenges that come with that can be exhausting." It was evident from the interviews that the engineers in these positions enjoyed the complexity and responsibility of the project leadership role. As P9 shared, being in this position "means that people have confidence in you."

The valued aspects of leadership discussed were clear communication, the ability to influence people to achieve outcomes, motivating individuals, listening, being decisive, creating alignment, having empathy, and developing trust. Communication was discussed by six of the participants with P2 stating that "unless you can communicate clearly, and demand clear communication from the other folks in the room, the amount you can work together is going to be limited by how much each other know." This included knowing the expectations and priorities and communicating these to the team. The leader's role is to understand the situation, determine the appropriate path, and work smarter to achieve the outcome. P10 discussed this in contradiction to the typical approach of engineering, which is to immediately jump into the details. It was also shared that it is important to recognize the expertise available on the team, and to be able to make decisions with incomplete information. As P10 shared, the key in this is "consistency in how you solve problems, how you deal with employees, how you collect data." Collaboration was a result of clear communication, influencing others to work together toward a shared outcome, and establishing trust.

Model of leadership. Participants were asked what model or theory guides their leadership. If there was a model or theory, they were asked where they learned it and what attracted them to it. These questions informed the researcher of the awareness of leadership theories and provided insights into what attracted them to a particular model. This information provided additional elements that the participant valued in leadership. Seven had received formal leadership training and four participants had a specific theory to which they ascribed. This question also offered insights into the learning experiences of these engineers when receiving leadership training.

Two participants cited servant leadership as the model that guides their approach. As P1 shared, this model puts leadership in the context of helping team members "figure out who you are and help you to become the best you." P4 shared situational leadership as the model that has guided his leadership. The draw to this theory was the inclusion of the various situational variables that impact an individual and a situation. This is fitting with the engineering mindset discussed previously in this chapter. P6 shared emotional intelligence and appreciative inquiry as the models that have guided his leadership. The draw to these theories was to contradict the typically negative, deficit focused approach of engineering and instead to "help put things in a proper perspective when delivering" so that they "see it as a positive."

Organizational influence. Participants were asked how their organization influenced their experiences leading projects and how this supports or detracts from the work of engineering project teams. This question was meant to expand upon the information gathered when initially talking about their leadership experiences by placing it within an organizational context. This question was important in providing insights into how organizational structures can best support the leadership of engineering project groups. However, the question was not consistently answered. In three interviews, the question was answered in terms of project management structures. In the other seven interviews, the question was answered as intended and provided insights into the role of culture in supporting the work of engineering project leaders.

Five of the participants discussed the priorities and values of the organization influencing the approach to project leadership. Regarding priorities, as P8 shared, "you are trying to get things into the workflow where you are trying to explain and convince them that it is a priority for them because it is a priority for the business." Balancing project needs with the priority of the organization was discussed as a skill that was developed over time, and is coupled with trust-based relationships to gain support.

On the down side, P6 shared that when there is low morale, you "learn to cope with the level of effort you were going to get out of people", and learn how to work within those confines. Additionally, P5 shared that it is difficult when you don't have clear direction from organizational leaders. Furthermore, P3 shared the importance of the organizational message with the consistency of the actions. He shared that "people much more appreciate what the rules are" rather than hearing a happy message. He added that when the actions conflict with the platitudes and slogans that it "instills fear in people, and that hypocrisy turns into mistrust." To support alignment, P4 shared the importance of company values to "keep us grounded in our contract with each other, how we approach things, how we treat each other, and how we go about doing what we do."

Leadership and project outcomes. Participants were asked how they have experienced their leadership influencing project outcomes and how it influences the engineers that they lead. This question was meant to gain the perspective of these individuals regarding the outcomes of their leadership approach. This provided further information as to their leadership experiences and what it may mean to both individuals and the organization. This is important in understanding how the outcomes of their experiences were conceptualized.

P1 shared that leadership within engineering groups is a long-term play, but that the results were a “better product, faster, and more in-tune with the market.” Multiple participants felt that the project leader created alignment. This is best illustrated by P4 who shared that you “run the risk of small groups of engineers developing solutions that aren’t informed by the decisions being made on other parts of the project” and that the result is a “solution that isn’t a good fit.” When the leader is effectively communicating, sharing the priorities, and creating an open environment, the elements of the solution are aligned. This requires the communication skills, trust, and listening that have been discussed. The project leader is effectively acting as a liaison amongst various departments. P2 shared that without positional authority, you become more adept at "persuading and building a team identity that is unofficial but really valuable to getting things done.”

Success, creativity, and innovation. Participants were asked what needed to be in place for engineers to be creative, innovative, and successful. These questions were asked to gain insights from their reflections on success. Additionally, assuming engineers can be heavily task-focused it was important to ask a question that reflected on their experiences that lead to creative and innovative solutions. This broadened the conversation and reflection on leadership. This question was important in understanding what elements of leadership can be most supportive of the creative work of engineers.

When asked about supporting creativity and innovation, concepts that have been discussed previously were discussed in this context as well. These include trust, importance of disagreement, perspective taking, and listening. Engineers are, by nature, problem solvers, and as P8 shared, they "like to be involved in the problem solving and not just in doing the work." Taking a broad perspective to the objectives of the project, understanding how it benefits the organization, allowing time for innovation, and recognizing and validating the expertise available supported these capabilities.

Differences between engineers and other professionals. Participants were asked if they experienced differences when leading engineers or other professionals. This question was asked so that the participant thought about the specific needs of engineers and then compared them to the other professionals on the team. This question was important to gain insights into the specific needs of engineers as well as how engineers experience leading other professionals.

In general, there were no differences noted between leading engineers and other professionals. The importance was placed upon learning about the individual and the expertise that they brought to the team. There was discussion of the individual growth that came from learning more about another profession, what is important to them, and how they use the information to make decisions. This growth was valued by the individuals who discussed it. Two participants noted that they are most comfortable leading other engineers because they have a better understanding of what they do and what they need. Four participants discussed that when leading engineers, it is important to ensure that they do not jump into the details too quickly. This is best illustrated by P10 who shared that "when you are leading engineers, you need to make sure they aren't jumping to a solution before totally understanding the breadth of what you are trying to accomplish." It is important to note that although there was discussion around the need to build context for engineers to broaden out their perspectives, there was also discussion that there was more experience with both the individual contributor engineers and engineering leadership. Other professions appeared to broaden the perspective of the project leader, providing them opportunities to stretch and learn.

Conflict and disagreement. Participants were asked how they have constructively handled conflict and disagreements on projects. This question was asked to better understand how interpersonal relationships were viewed within a project leadership context, and how the engineers evaluated these needs. Interestingly, the discussions often focused on the importance of disagreement. It was beneficial in understanding how disagreement was conceptualized as well as how conflict was proactively avoided and how it was resolved. This was important in understanding how engineers approach disagreement and conflict.

In general, the responses fell into one of three categories: how to avoid interpersonal conflict, how to resolve conflict, and how to benefit from disagreement. To avoid interpersonal conflict, there was focus placed on open communications, clearly identifying roles, and transparency. There was also discussion around decisiveness when interpersonal conflict arose. There appeared to be a strong desire for closure, but also a strong focus on ensuring that people knew why there was conflict. This appeared to be related to the systems approach that was pervasive in the interviews and leadership experiences.

When there is disagreement, there was an unemotional, but personal approach to the resolution. The focus is on the individuals, their perspectives, and what can be learned from each perspective. There was a focus on understanding why each person was thinking about something the way that they were, and to focus the discussion around what was driving their positions. As P2 shared, the objective is to get to the underlying issues that are causing the conflict and to "understand at one level deeper." He also shared that these disagreements can be valuable to project success and new product development because "there are other solutions that the seeds are all there for, but we aren't trying to grow them because we haven't looked at it that way."

Leadership transition. Questions were asked to better understand how the individual transitioned into a leadership role and how that transition was experienced. This included what struggles they had, how leadership skills were developed, and what support structures have proven to be most valuable. This question provided insights into the experience of these transitions. It also provided important insights into the most effective support for a successful transition.

There was no common path to project leadership. As P2 shared, in many ways project leadership is "an accidental career that people evolve into." Most engineers worked as individual contributors prior to working as project leaders, although two began as a leader. Although eight of the engineers transitioned into leadership roles, the path was not uniform. Some were given increasing responsibility, one was sent to graduate school and returned in an internal consulting role that transitioned to product development, and others found themselves in the position and weren't sure how it developed.

Regardless of the transition path, there were new skills required that were not developed in their undergraduate programs. Multiple participants felt that their MBA experience provided them with a broader perspective on the business compared. Mentors and feedback were repeatedly acknowledged as the main method of learning and developing. There was also a strong component of self-reflection. None of the participants shared many difficulties in making the transition; there seemed to be an ease in transitioning the engineering mindset created through education and training and applying it to people and leadership situations. However, a few participants discussed learning and feedback early on in their career that allowed them to adjust their approach to be more supportive of others. There was a genuine value placed on feedback and an appreciation for the mentorship when it was provided. This was coupled with a desire to serve in a broader role rather than remain an individual contributor.

Major Themes

Overall, the engineers interviewed take the role of project leadership seriously and enjoy the process. There was genuine regard for the team members and a sense of responsibility for their success present in the interviews. Additionally, there was a sense of enjoyment from the complexity and challenges associated with project leadership, and a sense of reward and accomplishment from successfully leading a project team. The engineers interviewed related these project successes to organizational success, competitive advantage, and individual career development.

The sense of interdependence was strong, as all interviews discussed learning the skills and strengths of team members, and aligning them to the project work required in order to successfully achieve the desired results. There was a genuine respect for the expertise amongst the teams. There was also an importance placed upon listening, authenticity, and humility throughout the interviews. The level of expertise required in engineering work seems to lend itself to the concept of teamwork.

There was also a strong focus on learning throughout the interviews. Although mentorship was repeatedly reported as a major influence on leadership development, there was also a large focus on reflecting on experiences. The focus on learning also included learning about the individual team members, and looking at individuals as a complex system within a complex system. This is also reflective of the engineering mindset that was present in the project leaders interviewed. This engineering mindset is focused on maximizing the resources available to reach the goal.

The following paragraphs will discuss the major themes that evolved from the data analysis. Each theme will be reviewed individually. Following this review, the data will be reviewed within the context of the questions asked. This section will share the narrative of the data that evolved in response to each question. Together, they will provide a thorough review of the data that emerged.

Developing Trust-Based Relationships. One of the major themes that emerged from the data was the importance of building trust-based relationships. Trust was the fifth most frequent code in the data. This overarching theme enveloped the sub-themes of listening, trust, humility, openness, sharing, and communication. This theme was present in all but one interview (P9). This importance of trust-based relationship is best illustrated by P2, who stated that "you don't have good long-term leadership without authenticity. It just doesn't work. People are smarter than that." This includes trust that the team members have in the leader, and trust that the leader has in the team members, because as P1 stated, "trust goes both ways."

P2 shared that "establishing genuine trust" can be one of the "biggest issues when a new team is established." As he shared, it is important to establish that the team is together because they are "here to do something we are going to be proud of as a team." Trust is also an important component of collaboration. This is best described by P1 who shared:

> A collaborative environment occurs when people see trust and purpose. I would want to participate in a collaborative environment because I know something good is going to come from it, that's the purpose. The trust is that these ideas that we are going to work through and do something. I'm not going to come and have the crap beat out of me. Trust in the form of a safe or secure environment. You know, I'm allowed to go and do crazy things and maybe fail a whole bunch. But I have the trust that I am allowed to fail because they have trust that when I do hit it, I'll really hit it.

Importance of Relationship Building. Multiple participants (P1, P2, P3, P6, and P10) discussed the importance of building these relationships to help people learn more about themselves and grow in their capabilities and confidence. This includes understanding the individual motivations present in the team, which was discussed by seven participants. Additionally, the importance of support of this focus from the organization was discussed. This point was best illustrated by P1, who stated that these relationships are created "when you are allowed to really understand who you are and what motivates you, and you are encouraged to do the same for your people." The role of organizational support was also discussed in regard to the use of peer groups, the support of superiors, and the role of mentorship.

Importance of relationship to individual development. These relationships were discussed not only in terms of their importance to leadership, but also as essential for the individual development required to grow as a contributor and as an individual. P1 discussed this as supporting people in the "process of self-actualizing", creating high-performing individuals and high-performing teams. This was best described by P1, who stated that "by understanding more about themselves, they are going to be more present to the good in their life, and the good work they are doing." This level of focus on the individual, their experiences, engagement, and livelihood was present in seven of the interviews. The depth of focus and care for the individual was not an anticipated finding. P1 discussed the time and trust that the process takes, on the part of the individual and the leader. He discussed that the problems inherent in team project work is that “people have all this garbage that they have collected over their life, and it takes time to strip it away and recognize that it is a different environment.” The project leader’s role is to create an environment that is safe.

Importance of Listening. The concept of listening and its importance in better understanding people, problems, and needs was pervasive. When discussing leadership qualities that he valued, P6 stated that “listening is the biggest thing.” Listening as also discussed in a genuine manner, with a level of importance that was unexpected. It was discussed in different contexts, such as the importance of listening to understand another person’s perspective better. This listening was in service of understanding, so that better decisions could be made, with the importance of listening as a way to gather complete information and to continue to develop the authentic relationship. This was well described by P2: “people don’t always need to have their position adopted, but they need to be heard.” Listening was also related back to better understanding customer needs, learning more about other professions and their needs, and as an effective method to resolve disagreements. P8 shared the importance of listening in solving problems that arise:

> First I want to understand where they are coming from. Take that data, combine it with my data, and come to a solution. I’m not one to jump to conclusions. I have found in my career that there are many engineers that are very stubborn. It’s my way or we aren’t doing it mentality. I’m more, let me know what your thoughts are and why you think we should go this way instead of that way. I think that has earned me a lot of credibility

over the years with my employees. They know I am willing to listen to their side of the story.

Building trust. Trust was another important concept discussed that relates to this theme. There was an understanding of the importance of building trust in order to get most out of people, and that this process takes time. This is well illustrated by P2, who stated that "you can spend a year building up a relationship and throw it away in five minutes." In general, the participants understood the impacts that micro-events and day-to-day behaviors have on the overall environment being created and the relationships being established. There appeared to be a deliberate and conscious effort to establish and maintain these relationships over time. P4 illustrated this point with the statement "people deserve care and respect, and there's a chemistry component to this that is just as important as hitting a milestone." P2 described the leader's responsibility as "providing a forum where they feel safe." In its simplest form, P2 described it as "I don't mean to go all Golden Rule, but the ironic thing is that it's what works."

Additionally, the benefits of a trusting environment were presented as the free sharing of concerns, generation of new ideas, willingness to take risks, commitment to the team, and open, constructive discussion around disagreements that led to improvements, innovation, and further strengthened the trust within the team. P1 stated that "long-term, the benefits to the organization are investment in the organization, and getting better products, faster, and more in-tune with the market." The focus was on building these genuine relationships over time, through creating consistency and aligning the message of the leader with the actual experiences of the team members. P2 discussed consistency in communication more than the others and shared that "there are some simple behaviors that are really powerful in getting folks to work with you, and consistency is the key." Humility was another important quality that supported these relationships. This is best described by P10, who remarked that leadership has "taught me humility, how to be humble, how to benefit from a collective group."

Humility. Along with these concepts, there was a level of humility present in the discussions. Multiple participants remarked at the importance of knowing what you know, and what you don't know. As P10 shared, "you can't be a subject matter expert in everything." There was a genuine respect for the expertise available on any given team, and as P3 shared it was important to "acknowledge their technical savviness but also that they add a lot more in the personal space." Leadership was also reflected upon as an ongoing learning process, evolving from new experiences all the time. Six participants remarked that they were on a path to developing their leadership skills: none of the participants felt that they had mastered leadership. As P2 said, "as soon as you think you're a finished product, you're dying."

Another of the focuses of this theme was on clear, open communications. This was discussed in terms of being open to what is shared, how, and with whom. There was a focus on ensuring that others have the information that they need to complete their work. This was best described by P9 who discussed keeping the information as accessible as possible, because "people know how new information impacts them better than you do." Clear communication was typically focused on the vision, objectives, and roles, with openness left to the individuals to determine how the work would be completed.

Trust-based relationships and the research question. These findings support the research question by creating a context for the experiences of engineers leading project teams. In a broad sense, the foundation of these leadership experiences was the development of authentic, trust-based relationships amongst a team of experts working together to accomplish a goal. Seven participants discussed the importance of this foundation. There was a sense of pride that was prevalent in the interviews as well as a genuine sense of responsibility to themselves, the individuals on the team, and the organization. Not only had most of the engineers in the study spent time conceptualizing their leadership experiences, they had done so in terms of the impacts on, and their responsibility to, project outcomes, organizational benefits, their own growth, and the growth of team members.

Commitment to Team. There was a strong sense of responsibility for the individuals, their success, and the impacts that these experiences would have on their career progression. The commitment is important so that the individuals, as shared by P1, "know that we are in this together." Five participants discussed the impact that a project leader can have on an individual team member's career. There was a genuine and significant sense of responsibility for the experiences and careers of the engineers on the team. This is best described by P10 who stated, "you are responsible for that person; you are affecting their life." Furthermore, P2 stated that it was important that "the leader needs to be willing to take the fall for the team when needed", and "allow the individuals on the team to celebrate the successes." This strong sense of responsibility is supported by social identity theory and will be discussed in chapter 5.

Appreciation. There was also a sense of appreciation for the team members that was present in the interviews. This is best described by P10 who stated, "I need my team more than they need me." This appreciation was focused on the skills, commitment, and the work that individuals complete. It was important that the team members know the importance of the project work. This is best illustrated by P2 in the quote "we're here together to do something that we are going to be proud of as a team." P2 also discussed the importance of continuing this message throughout the project, and to celebrate the success following the project. Demonstrating this appreciation throughout the process ensures commitment on following projects. As P2 stated, "they will answer the phone the next time you call, I promise that." Additionally, showing appreciation after the commitment is completed is a way of maintaining consistency. This was best illustrated by P2 who stated, "do something special for the team so they know their contribution was valued, and do it together."

Learning strengths of the individuals. There was a deliberate focus on learning the strengths and expertise available on the team, and identifying ways to leverage these to best support the project outcomes. This was discussed as a method of appreciation as well as necessary for motivating individuals. This was a source of excitement for some of the participants, perhaps best illustrated by P2 who stated, "getting engineers and other functions to understand each other, well enough to do good collaboration, and good give and take with one another, is the most exciting part of my job."

Motivation. This level of motivation was important considering the lack of positional authority, coupled with the project work being outside the team member's core responsibilities. Five participants discussed this situation. As P2 stated, "without positional authority, people in my position that are successful become adept in persuading others and building a team identity." Furthermore, the importance of understanding individual needs and motivations allows for alignment of the work with the preference and strengths of the individual. As P1 stated, "it's my job to help you figure out who you are and help you to become the best you that you can become, because if you are doing that, you will be energized." This is supportive of self-determination theory, which will be discussed further in chapter 5.

Focus on individuals within the team. The quality of relationships, alignment of the project outcomes to the organization needs, and the project leader's commitment to the team seemed to facilitate these efforts. The focus on becoming familiar with the individuals, including their strengths, preferences, and motivations was discussed in depth by P1, P2, P3, and P10. The quote that best summarizes these findings is from P10 who stated that "In engineering there are so many details, and you really need good people, and you need people who are empowered, and you need champions, so you really need your team." P1 also discussed the need to enroll the entire organization in project work, and to "flex to address the needs of the different individuals involved."

There was an understanding of the project and organizational success that results from the project leader individually motivating team members, resulting in their best efforts. It was also discussed that this required the leader to understand their individual situations and motivations. This requires a commitment to becoming familiar with the individuals on the team at a deeper level. As P1 shared, it is "my job as the leader to take the blockades away, the things stopping my people from being all they can be." This focus was also related to the engineering mindset theme that will be discussed in a following section.

Alignment. Alignment was another concept discussed that was an important element of the commitment to the team. In general, the participants understood that they were not there to provide the answers, but to form cohesion. This is best illustrated by P2 who discussed the importance of creating an unofficial team identity, and to make sure team members "understand what they are doing is important for the organization and its future, and their future here", you can "make it a cause they really want to win." This included alignment across individuals, which is facilitated by a connection to a clear vision. This vision is then able to create the context for prioritizing the work, coordinating resources, and making decisions.

Collaboration and disagreement. Ease of collaboration was the result of the trusting environment and respect and appreciation for the differences and skills of team members. Time was also discussed as a requirement for quality collaboration, as it was in developing trust-based relationships. This was best illustrated by P1 who stated, "a collaborative environment occurs when people see trust and purpose." Collaboration was regarded by five participants as an important element for creativity and innovation.

Furthermore, disagreement was a catalyst of innovation. Six participants discussed the importance of disagreement to product development, team development, or innovation. This point is best illustrated by P2 who stated, "when they do disagree, you are probably looking at some pretty core, important tradeoffs that are the seeds of some real innovation and where some real competitive advantage might be." The key to successful dialogue around disagreement is that there is a focus on listening to understand, a respect for the skills and perspective that another person brings, and a desire to get the best solution.

Perspective Taking. The importance of perspective taking was present in all ten interviews, and the dominant theme in two. As P8 stated, "there are multiple ways to look at everything, and being able to interpret that helps with being able to lead a project." This theme is perhaps best described by what P2 referred to as "professional empathy." This is an important quality, as P6 shared, "as I started managing more people, it caused me to really draw on deeper empathy." This requires that the leader learns what is important to others and why, across the professions that are important to the project. This is best described by P2 who shared:

> You need to be capable, and not just the emotional level of empathy, but professional empathy also. Which requires a bit of cross functional knowledge. I need to be able to put myself in the shoes of the finance rep, the marketing rep, know what they are coming from, where they are coming from, and it really helps you understand why they are asking what they are asking for. And when you find that, it is much easier to find win-

> win solutions. If the project leader can do that, and get people seeing each other's side, that's good. If a project leader can do enough coaching that the team members can do that on their own, and assume each other's roles on their own, as part of their day-to-day working together that's great. You will get trust out of that quickly, and you're going to get project speed and project outcomes out of that quickly.

This perspective taking allows the leader to provide each person with what they need to do their best work, because the work needs to be aligned to their strengths. This also requires the safety and trust of the relationships described previously, as well as a genuine level of respect and appreciation. However, embracing the positive can be a difficult process, as P1 shared "it is much easier to talk about our faults…I find that the hardest thing is to really appreciate the good work that you have done." As shared by the participants, one way to demonstrate appreciation is to draw out and appreciate their perspective.

Focus on individual team members. One of the subthemes present was the focus on the individuals. As P1 stated, it important to be able to "serve the needs of the whole team as well as individual contributors." These project leaders appeared to see the ability to individualize approach as the key to obtaining the individual's best efforts. Furthermore, there was an understanding that getting the best efforts of the individuals was a critical factor in project success. P4 shared that this required that the project leader "influence people to want to work together, to collaborate, to cooperate, to work in the supportive way of each other to get the project done."

Other related themes present were the focus on expertise, skills, and strengths. As previously discussed, there was a respect for the differences in skill, focus, and personalities that comprise a project team. There was an importance in this diversity, and in learning how to leverage the resources available to the team, including the people. As a result, the key was to learn who has what expertise, and to learn how to use it. This was discussed as a separate skillset from engineering, which took time and effort to develop. Leadership talent is learning how to identify the skills and strengths, and how to leverage them in service of project outcomes. As P2 stated in regard to building this type of teamwork, “it isn’t easy to do, but if you can do it, you get really good results, and it’s a lot of fun.”

Recognizing expertise and capabilities. Six participants discussed that leaders don’t have the answers. As P2 stated, it is about “building a team identity” and ensuring that the others on the team “feel just as much ownership of the overall results” as the leader. Instead, these leaders know how to assemble the right people together, with the right focus, to get to the best path forward. To do this, the individual talents and knowledge need to be leveraged toward the project outcome. This was also discussed as a differentiator of an engineer who moved into project leadership from an individual contributor.

What was most striking was the focus on learning individual strengths and the commitment to putting people in positions to be successful. This is related to the level of importance that project experiences, learning, and successes have on the career progression of other engineers. It was evident that these leaders wanted team members to be successful, and that they saw it as one of the responsibilities of project leadership.

Engineering projects require a variety of expertise, not only from an engineering standpoint, but from a business standpoint as well. Five participants discussed how these cross-functional teams broadened their own perspectives. As P2 stated, “engineering projects are really business projects.” This complicates perspective taking due to the diversity of group membership in these cross-functional teams. When broadening out from the engineering group, the focus was on learning what is important to the other professions involved. This is because, as P2 stated, the project leader “needs to understand the business side and different functions.” This included learning what information they needed, understanding how they use it, and learning what they need to do their best.

Learn from Experiences. The focus on learning was pervasive in the interviews conducted. Three of the five most frequent themes were related to the focus on learning from experiences: understanding, learning, and experience. Learning was also the dominant overall theme in five of the ten interviews. This learning was discussed as learning from failures, reflecting on experiences, seeking mentorship, and soliciting feedback. Learning from experiences was discussed as one of the most important elements of development in all ten interviews. The importance of learning is best described by P2 who stated, “as soon as you think you’re a finished product, you’re dying.”

This ongoing learning experience was focused on how leadership impacted individuals on the team, project outcomes, and the organization. This learning orientation was focused on technical, interpersonal, and organizational learning. P3 shared that you “have to make the mistakes to learn”, and that this learning could be “leveraged outside engineering, you can apply it to business, sales, mergers, and acquisitions.” P6 shared that he began to develop strong leadership skills when he “started learning how to understand what others are saying, instead of hearing what I wanted to hear.” This learning also included helping those on the team learn more about themselves, as P1 shared “you are helping them understand what they need, and you help them create the life that they love.”

Role of experience in leadership development. There was a sense of enjoyment that came from the challenge, versatility, and development required to develop these leadership skills. There was a sense of pride and enjoyment that was present in each of the interviews. As P1 described, "you have to live it, experience it, and have a passion for it**."** The development of leadership abilities was discussed as an ongoing process. As P3 described it, "leadership is an evolutionary education." The learning comes from a desire to grow from an individual contributor to be effective in a leadership position. This was best described by P3 who shared that "when engineers get to the ten-year mark, you really see the guys who just want to be at the desk cranking the calculations and then you see the guys that say, 'I want to be involved in business development, or marketing, or go to law school', because they feel that potential for themselves."

Leadership development included learning how to take others' perspectives, create the right environment, bargain for resources, and enroll the entire organization in the project. These concepts relate back to creating trust-based relationships across the organization. A transition point discussed by P6 was to stop being the answer person, and instead to "start listening and staying open to learn from how someone else sees things." It was also discussed in terms of learning when you need to elevate issues to gain support from those higher in the organization. This was done to ensure that the priorities of the project align to the priorities of the organization.

One of the methods of effective leadership development discussed was to learn from experiences. As P10 stated, "you never learn anything when things go well", and so you "do your best learning when you make mistakes." There was a genuine interest in learning from mistakes in nine of the interviews. These mistakes were viewed as learning experiences that should be capitalized upon. This included both reflecting on experiences and soliciting feedback. There was a deliberate effort to learn from the positive and negative experiences. As P2 stated, "when you ask for feedback, it comes with the responsibility to listen to the answer."

P1 added that "each criticism is something that I can learn from." Additionally, P2 discussed the ability to actively solicit, contemplate, and utilize feedback as the ability to "keep confidence paired with intellectual humility."

Leadership transitions. Six participants discussed the growth that was required to transition from an individual contributor to a leader. This experience is best described by P2 who shared, "early on in my career, it was about getting the right answer." P2 continued to discuss the difficult feedback that he received that his approach was hurting his cause, and that it "took me a couple of times to hear that before I understood it. And once I understood it, it was something that I committed to change."

Although the transition paths differed across individuals, it was evident that impactful learning happened through experience. There was one participant that felt that their engineering education prepared them for leadership experiences, although this was a unique experience compared to the others as the education included army leadership training. Three participants discussed how their MBA prepared them for leadership, with P2 discussing that engineers in MBA programs get more from the education than those that went through an undergraduate business program because of the exposure to other areas of the business that they may not otherwise have. In general, although the engineering training didn't prepare for leadership situations, the mindset was created. The development is learning how to apply it.

Role of leadership training. Seven of the engineers received formal leadership training. Leadership skills and project work gained through MBA experiences were valued by the engineers interviewed. Otherwise, formal leadership training was not regarded as the best way to learn the leadership skills required to be successful. However, what was valuable in these trainings was to focus on a couple of key things to apply, and integrate the information to the existing work being done. There was a strong focus on application, and a desire to learn a few things to apply rather than entire models. This was well-described by P4 who shared that, "two or three basic principles that were main and plain" allowed for "the most lasting impact." Instead of focusing on learning tactics, his focus was on elements that needed to be present for success.

Mentorship and leadership development. Another method of learning and development that was discussed was mentorship. This was present in seven of the interviews. Mentorship or seeking support from superiors was present in every interview. As P5 stated when discussing mentorship, "it changed my entire career." Furthermore, there are also organizational influences on learning and approach. As P10 shared, "I've been shaped by all of the companies I have worked for; I really gained exposure and different abilities from each one." P10 also discussed that mentoring "builds better engineers, better managers, and better people." The focus on seeking mentorship opportunities and learning from organizations demonstrated an effort to broaden perspective and refine skills as ways to grow.

Engineering Mindset. Engineers are trained to solve problems and to come up with the best solutions. In order to do this, they need to take multiple contextual factors into consideration and understand the system within which the project is operating. This is best described by P9 who shared:

> The biggest thing for me, and this come naturally in some ways to engineers and not in others, is to understand at one level deeper. Why are we disagreeing? What does marketing think this feature is absolutely have to have? And why does engineering think it can't deliver? Whatever those pieces of disagreement are, let's get down to the whys, and what the root causes that are really driving positions are. Because sometimes there

> are other solutions that the seeds are all there for, but we aren't trying to grow them because we haven't looked at it that way.

Cause and effect thinking can be applied not only to systems and problems, but also to projects and people. Five of the engineers interviewed directly discussed transitioning the engineering mindset to people and organizational processes. The remaining five participants discussed elements of this same concept, but did not directly discuss the engineering mindset. Later in career development, this way of thinking transitions into a systems approach to people and situations. The best description of this application is from P10, "you have to have an appreciation for why their stance is such or why their behavior is such. I try to get back to that cause-and-effect and try to understand what is driving their behavior." P10 went on to discuss how engineers apply cause-and-effect thinking to project leadership:

> Because whether you are managing people or managing programs, the way an engineer thinks is cause and effect. It's always about why something happens, whether it is the design of an item, a program that has slipped and not met budget, or a person who is not conforming or working at their highest level. I think a typically trained engineer has an ability to understand and have a real appreciation for why things happen. The more experienced you are, the more you experience cause and effect. That arms you, and you can carry it into the next problem. Whether that problem is a component or a problem with an employee that you need to deal with. I think engineering gives you an appreciation for why things happen.

In engineering training, there is a strong focus on understanding all variables involved and how each one impacts the system. This creates a level of systems thinking that is required to be successful in engineering. There is also a strong focus on understanding the context within which something exists in order to make the best decision with the information available. As P10 shared:

> When you are leading engineers, you need to make sure they aren't jumping to a solution before totally understanding the breadth of what you are trying to accomplish, what are the deliverables, what are the objectives, and how do you rank them.

This passion for learning how things work was described by P1: "I've always been very curious about how things worked. It's been a passion." This requires that all the factors involved are considered, including external circumstances. As P3 shared, "the world is not black and white, there are mitigating circumstances everywhere." As a result, it is important to know how one change can influence all the way down the line. Four of the engineers interviewed discussed how the technical training or engineering mindset allowed them to naturally transition the focus to people and teams.

However, over-focusing on the right answer can limit thinking. Early in an engineering career, this can lead to right/wrong thinking. As P8 shared, "when I first started, everything was very black and white. This is the way it is. It took a lot to get over." As P10 shared, "we just get into the details and put our blinders on." This approach can create traps that limit creativity and innovation. This is best described by P2, "the biggest thing for me is to understand at one level deeper, because sometimes there are other solutions that the seeds are all there for, but we aren't trying to grow them because we haven't looked at it that way." Over time, the importance transitions from knowing the answer to listening. This was best described by P6, "you have to be willing to sit down, to listen to what he is saying, where they are coming from, before you try to solve the issue."

Applying the engineering approach to project leadership. This thinking can be applied to teams as well as individuals. This systems approach to teams and individuals requires you to look at all the circumstances, capabilities, and influences when making decisions. As P1 shared, "we are dealing with people who have personal backgrounds, and limitations, and baggage, as well as unique strengths and experiences that uniquely suit them to be part of the project team." It is also important for engineering project leaders to understand that there is a multitude of expertise required to successfully complete a project. This is supported by the fact that engineering work requires a variety of disciplines to work together to solve a problem or create a solution. As a result, the transition to leadership is to broaden out that thinking outside of engineering disciplines to better understand other professions within an organization as well as customers. As P3 shared, "I didn't have to be the smartest guy in the room, but I had to know what was smartest, and decisively say this is the direction."

Importance of clarity. Fitting with the engineering mindset, there was also a strong focus on offering clarity and clear direction when possible. As P2 shared, "unless you can communicate clearly, and demand clear communication from the other folks in the room, the amount you can work together is going to be limited by how much each other know." Providing clear communications offers clarity to team members regarding the circumstances and vision, which provides a foundation for the team members to use their judgement to come to best path. This is also supported by P1 who stated that it is important for the leader to "clearly identify what we are trying to do and why we are trying to do it." The leader sets the context and provides the priorities and objectives, and as P5 said, "then let the experts be experts."

Importance of being decisive. There was also a strong focus on being decisive when the team needs a decision. Seven participants discussed the need to be willing to be decisive. The engineering training and mindset also support this as it provided these individuals with the ability to make decisions with incomplete information. It is important to note that when discussing being decisive, there was not a sense of superiority of knowledge or abilities. Instead, as P1 shared, it is important to "make it very clear to the team that you aren't going to choose a perfect path but you are going to choose a path."

Importance of disagreement. Also related to the engineering mindset is the value that was placed upon disagreement. As P2 shared, disagreement often plants the seeds for innovation. Four participants discussed the important role of disagreement in either personal development or product development. Disagreement, in general, was conceptualized as an indication that there is more to be understood. As P9 shared, it's important that there is clarity regarding the outcomes and expectations so that the energy of the disagreement can be focused in the right direction. One of the effective ways to ensure this is clear communications and shared knowledge of what is important.

Multidisciplinary nature of engineering. Leadership requires that this thinking be applied to broader situations and that the thinking behind decision is shared in an effective manner. As P2 shared, leaders need to be able to communicate "what we are trying to do and why we are trying to do it." Five of the interviews discussed the importance of taking a broader business approach to engineering project leadership. As P1 shared, this is because "not one human being is going to be an expert in all of that; you need to pull in more disciplines." This is not without difficulty in learning how to work across various professions.

P3 discussed the ability to find the commonality as a key to enrolling other professions in engineering project work. The following quote best describes this "The multidisciplinality and the ability to find common thread and the commonality, take this hodge-podge of stuff and it forces you to integrate systems quite well." As discussed previously, project success comes from enrolling the expertise available. The engineering approach was also discussed as being perceived as difficult by other professions. Consequently, transitioning the engineering approach to problem identification needs to be transitioned into perspective taking. This was best captured by a quote from P8:

> I tend to play devil's advocate a lot. Early in my career, that would get me in trouble. But, by the same token, being able to look at the different sides of the same coin and understand both sides of the stories, where other people might be coming from, trying to relate that and bringing it all together is a skill that not everyone has.

Summary

In this chapter, the researcher explored the research question of: What is the experience of engineers leading project teams? The sense of interdependence was striking. It was clear from the interviews that the reliance upon others for their expertise, upon diversity to bring about concerns, and upon disagreements to improve project outcomes were important to engineers. Also striking was the focus on becoming familiar with and understanding each individual, and the sense of responsibility for the experiences and careers of the individuals on the team. Considering engineering projects require specific expertise from different disciplines to successfully design a solution, this is fitting with the work required of engineers. Overall, it was clear when discussing these leadership experiences that the participants enjoyed the experience, realized the personal growth that it required and created, and had a sense of pride in the service to others and the organization.

Additionally, the focus on listening, learning, and developing a trust-based environment were predominant in the interviews. Although these were not anticipated focuses, it is supported by the work required of engineers and the engineering mindset focused on understanding all contingent factors to design the best solution. In five interviews, there was discussion of the importance of understanding the root cause of disagreement to reach a resolution. In three of these interviews, the focus was on listening to learn where the other person is coming from and how perspective taking allowed them to identify the best path forward. Learning came in the form of learning from experiences, learning from reflection, and learning from mentoring relationships. These findings are supported by the engineering mindset that is developed through education and training, with the focus on learning all the parts that influence a system, how they influence that system, and how a change or deficit in one impacts the other aspects of the system. Systems thinking was apparent in eight of the interviews.

CHAPTER 5. DISCUSSION, IMPLICATIONS, RECOMMENDATIONS

Introduction

This chapter builds upon the results presented in chapter 4 by relating them to the research question and current literature. This will provide insights into the research problem and present future research as well as practical implications stemming from the research results. This will be done by presenting a summary of the results and study significance, followed by a discussion of the results as they relate to the research question, and then a discussion of the results as they relate to the literature, theory, and implications. These sections will be followed by a discussion of the study limitations and recommendations for future practice and research. This will conclude the dissertation.

Summary of the Results

Engineering is the application of technical knowledge to solve problems and create possibilities. The work of engineers is often completed through project-based teams, requiring cross-disciplinary collaboration and technical expertise (Rottman et al., 2014). In order to be successful in the current market, they also need to function entrepreneurially, drawing on skills and perspectives that are not typical of traditional engineering education and training (Williamson et al., 2013). This assimilation of business knowledge, technical knowledge, and team facilitation needs to be understood within an engineering leadership context.

Considering the impact engineering outcomes have on the economic strength of an organization, this area of study is important to industrial-organizational psychology and organizational leadership. However, there is little research completed on how engineers lead (Rottman et al., 2014). Specifically, how engineering project leaders create and adapt structures to meet the needs of the project, support the autonomous motivation of individual team members

(Mumford et al., 2002), and manipulate knowledge for new applications (Smith & Paquette, 2010) need to be understood. Considering there is little research that indicates how current leadership theories support the engineering profession, it is important to study this population specifically. This study addresses the current gap in the literature.

This study has implications for research, education, training, and organizational leadership. It is important to understand how engineers lead project teams in order to develop research-based approaches to leadership education and training. It is also important to understand how organization systems support this work so that practitioners can begin to understand how to best serve the needs of this unique population. Considering the work of engineers is so closely tied to the economic drivers and competitive advantage of organizations (Robledo et al., 2012), this is an important area of study.

There is a small body of literature on engineering leadership, and less on engineering project leadership. The research has been heavily focused on how to educate and train engineers in leadership skills (Rottman et al., 2014). However, without an understanding of how engineers lead project teams, the education may not emphasize a skills or process that has proven to work with this population.

Additionally, existing models of leadership have not been well studied within the engineering profession (Robledo et al., 2012), and when studied, the results have been mixed (Mumford et al., 2002). Research suggests that leadership of engineers is more complex that in other disciplines (Racine, 2015). Additionally, engineers prefer to be managed by other engineers, which suggests that technical credibility is an important factor for leadership respect (Gibson & Whittaker, 1996). However, engineers experience challenges when becoming leaders (Racine, 2015) which need to be better understood.

Although there is little research regarding engineering project leadership, there are key findings in previous studies that this research expands upon. We know that leadership influences creativity, performance, and engagement (Ghadi et al., 2012). We also know that engineers are uniquely situated within organizations to influence competitive advantage, cost reduction, and profitability (Laglera et al., 2013). Rottman et al. (2014) found that the key orientations to engineering leadership were technical mastery through mentorship, optimal collaboration, and organizational innovation. These have been attributed to limited knowledge of leadership, social development, and the leadership situations in which they are placed. Key aspects of the model are mission definition, resource planning and acquisition, expertise, creating the desired climate, and bridging the gap between the group, the work, and the organization (Robledo et al., 2012).

This study found that developing trust-based relationships, commitment to the team, perspective taking, learning from experiences, and applying an engineering mindset were central to engineering project leadership. Trust-based relationships were essential to creating the environment necessary for collaboration, innovation, and successful project execution. There was also a deep sense of responsibility for the individuals on the team, their success, and their career progression. There was a genuine sense of respect for the individual differences, skills, expertise, and perspectives of the individual team members. The engineering mindset enabled these individuals to understand the variables influencing a project or a person, understand the resources and capabilities available, and design the best path forward based on this information. These skills were developed through personal reflection and mentorship, which required a consistent, conscious effort to learn from experiences.

Discussion of the Results

The study was conducted to answer the question: How do engineers experience project leadership? The interview protocol was developed to investigate these leadership experiences in general as well as in respect to the how they handle disagreement and conflict, how they saw leadership influencing engineers and project outcomes, experiences supporting creativity and innovation, and how they experienced the leadership transition. The questions were structured to put the engineer within a leadership mindset before focusing on different aspects of leadership. The questions were typically answered comprehensively and resulted in five major themes emerging from the data: developing trust-based relationships, commitment to team, perspective taking, learning from experiences, and applying an engineering mindset.

The study findings answered the research question by providing a full description of these experiences, describing the influence of leadership on the work of engineers, and describing how this role supports their professional identity. The engineers interviewed provided a depth and breadth of information related to the research question, resulting in rich data to describe these experiences. The major themes identified provide a foundation for understanding these experiences and the elements of project leadership that have best supported them in these roles, as well as through the leadership transition. The research question intended to gain insights into how engineers experience leadership that can inform theory, and provide guidance for the education, training, and development of future engineering leaders. The research study answered this question and resulted in the information required to provide this guidance.

The selection of engineers interviewed likely influenced the results. The potential participants were selected by their organizational executive, which likely resulted in a sample of engineers that were considered exemplary leaders in their organization. Although this sampling likely influenced the results, it is beneficial to learn from engineers who are exceptionally effective in their project leadership roles. Additionally, the topics investigated by some questions were influenced by both SDT and SITL. SDT influenced the development of questions around motivation, autonomy, and skill development. SITL influenced the development of questions around leading engineers and other professionals as well as questions around technical and team dynamics. The questions asked were broad, and as a result, it is not expected that this led to a bias in the information gathered during the interviews.

The major study limitations of the study are the small sample size and limiting the collection of information to the interview process. Additionally, generic qualitative inquiry, although valuable in gathering a depth of information, is not intended to provide generalizability of the findings. It is important to note the sampling method likely resulted in a group of engineers identified by their organizational leaders as highly effective. Although this will have influenced the findings, it likely had a positive impact on the results as they were gathered from individuals who were regarded as highly effective.

Conclusions Based on the Results

Engineering work is often completed through project-based teams, requiring cross-disciplinary collaboration and technical mastery (Rottman et al., 2014). This places a heightened importance on intrinsic motivation, influence, and facilitation skills (Williamson et al., 2013). Although there has been little research into how engineers lead project teams (Hodgson et al., 2011), research suggests that leadership of engineers is more complex than in other disciplines (Racine, 2015). This may be due to the high level of both diversity in expertise and depth of individual expertise required, as well as the combination of technical and socio-organizational skills needed to successfully complete these complex projects. It is also important to note that there is a high level of task interdependence (Robledo et al., 2012).

This study investigated how engineering project leaders viewed and valued leadership, and how they experienced these project leadership roles. This was completed by investigating their leadership practices, learning practices, transition experiences, experiences influencing outcomes and individuals, and experiences with how their organizations have influenced their leadership and project outcomes. These findings can be used to determine the leadership constructs, practices, and training that most benefit this group. This will provide guidance to researchers and practitioners as they navigate engineering project leadership.

Major Themes

The major themes identified through this research were: developing trust-based relationships, commitment to team, perspective-taking, learn from experiences, and engineering mindset. There was a strong focus on appreciating the individuals on the project team. Most participants discussed the need to understand the skills and strengths of team members, their expertise, their needs, and the importance of their individual commitment to the success of the team. The sense of interdependence was strong, amongst the work of team members and the alignment of the project work to the needs and competitive advantage of the organization. The focuses on listening, humility, and developing strong relationships were pervasive. Interestingly, there was a very strong focus on the people-side of project work, and a sense of importance in creating a safe environment that allowed for open sharing and disagreement. Although this profession is assumed to be technically focused, most of the discussions, and the participant's excitement, were regarding the people-side of project work. This genuine interpersonal focus was facilitated by the need for individual expertise and the respect for the fellow engineers.

These findings foster a connection of leadership models and soft skills needed for effective leadership to forms of influence that are valued by the profession. The engineering mindset that is developed through education and training enables these individuals to take a systems perspective to the organization, the project, and the individuals within the team. Additionally, the focus on learning creates a growth mindset for the leaders, and allows for their thinking and approach to continue to be developed over time. It also places a focus on the growth and advancement of the individuals on the team. Combined, these enable the leaders to perspective take in order to better understand the complexities within the project, learn from the other experts available, and effectively communicate when there is disagreement. These leaders understood that they needed to leverage the individuals available in order to successfully complete the project.

Develop trust-based relationships. According to Van der Molen et al. (2007), engineers are more drawn to working with others. Additionally, Singh and Singh (2009) found that most engineers are predominantly concerned with the interests of others. Both of these were supported by the study's findings. Although at first glance it doesn't seem that engineers are focused on the soft-skills associated with leadership, the findings indicate that they show great care and respect for their team members; it just looks different. These engineers went through great strides to create trusting environments and genuine relationships. This was done through respecting expertise, providing autonomy, openly sharing information, perspective taking, listening, building trust, and maintaining both humility and decisiveness. These trust-based relationships were an intentional focus of these engineering project leaders. These relationships were important to both individual and project success. They made it easier to obtain information, leverage resources, and develop a sense of ownership across the project team.

These relationships created a trusting environment which facilitated open communications, which created the foundation for collaboration and creativity.

The research of Robledo et al. (2012) supports these findings, which indicated that climate creation, team formation, and follower interactions were the leadership elements important to the group. Additionally, the focus on individuality supports research by Harter (2000) that found that a supportive environment that compliments individuality helps grow strengths. However, the current study indicated a stronger focus on these same areas and elaborated upon the drivers of, and method to, create the environment, team, and interactions desired for a successful project. These included modeling constructive disagreement, creating a safe environment for open discussions, listening to understand, expressing humility, and forging relationships based upon respect and value of the individuals.

Disagreement played a large role in building trust and creating an open environment. Disagreement was viewed as a way to enhance relationships and outcomes, not as a derailment or negative. Individual expertise, the unknowns in a project, and technical trade-offs were the main drivers of disagreement. The participants discussed the importance of this disagreement, including the need to create an environment where disagreements are openly discussed, so that the underlying differences in thinking could be better understood in order to make the best decisions. This was valued for its role in bringing people together to utilize their experience and expertise, and in creating a trust-based environment. This was also discussed as a source of creativity and innovation. The complexity of the project work and the leaders embracing this complexity to work through the various social and technical aspects of the projects supports the literature.

Engwall et al. (2005) found that teambuilding practices could obstruct the need for individual creativity. No participants brought up teambuilding practices; however, all participants had a strong focus on building relationships amongst team members. These relationships were created through respect for individuals and their expertise, open communications, autonomy, and a focus on the results. The relationship building process appeared to serve the same function as teambuilding, but within the context of the project. Engineering work may provide a good foundation for real-time teambuilding. It is unique in that the work requires a variety of experts to come together to create something, and the projects have a more clearly defined success than many other professions.

Commitment to Team. Singh and Singh (2009) found that most engineers are predominantly concerned with the interests of others, which is supported by the study findings. The sense of responsibility the leader has for the success and careers of the individuals on the team was pervasive. This loyalty may support the focus on creating trust-based relationships and the ability to have constructive disagreements without interpersonal concerns. The leaders provided opportunities for these engineers to be successful. They were able to do this because they understood their individual strengths and weaknesses, and could align those to the needs of the project and the organization. Social identity theory of leadership (SITL) may provide an explanation for these findings, which is discussed in a later section of this chapter.

Rottman et al. (2014) found that one key area of engineering leadership is collaborative optimization, which refers to the skilled facilitation of group process by bringing out the best in everyone. This is also supported by the study findings. The findings indicated that leaders were able to achieve this through learning the individual's strengths and expertise, identifying how to motivate individual team members, and focusing on aligning the individuals with the needs of the team. These are similar findings to Rottman et al. (2014). The need for this approach was discussed in terms of the inter-disciplinary nature of these projects that prohibit one individual specialist from being able to deliver the results (Rottman et al., 2014), which was also found in this study. This study builds upon these findings by exploring specific elements of this facet such as appreciation, motivation, alignment, and disagreement. It also expanded upon these findings by connecting the individualized approach to the success and career progression of the individual engineers, not just in service of the project outcome. The current study found a sense of responsibility on the part of the project leader to support the technical mastery and career progression of the individuals on the team.

Perspective Taking. With the safety, trust, and commitment that was previously discussed, the project leaders were able to perspective take throughout the course of a project, enabling flexibility and adaptability over time. This included technical reviews, understanding other's concerns, understanding resource constraints, understanding the organizational needs, and evaluating technical trade-offs. This adaptivity is important to engineering projects because of the level of uncertainty present in these projects (Garcia-Chas et al., 2015). As new information is evaluated, the project outcomes need to be adapted to meet the evolving needs of the project. Perspective taking also allowed for the project leader to make decisions with incomplete information. The individuals in this study identified the ability to evaluate something from various perspectives and interpret the information to make the best decision as a valued leadership skill. This is supported by the focus on recognizing expertise and experience, and being able to leverage the knowledge and resources available. Valuing other's perspectives also contributes to the trust-based relationships developed and shows a commitment to the team.

This is another aspect of leadership that is aligned with the engineering profession. Similar to other aspects already discussed, the need for a diverse set of experts to come together to accomplish a goal requires the ability to understand these various perspectives in order to drive collaboration to achieve the project outcomes. Although it is not contrary to the findings in Rottman et al. (2014) or Robledo et al. (2012), they did not specifically discuss this aspect of leadership. Robledo et al. (2012) discussed the need for engineering project leaders to create a shared mental model amongst the team members by explaining the plans and the different expertise that was relevant to creating the plan. The ability to perspective take would support the leader in understanding the various expertise, the factors that may influence each portion of the project, the likelihood of those factors, and then make decisions that best suit the situation. In this regard, the findings support the other research and expand upon it by identifying the methods and experiences associated with the higher-level elements of engineering project leadership.

Learn from experiences. The study results included a strong focus on learning. There was a humility and a sense of continued growth when discussing leadership approaches and outcomes. This indicated that this was an ongoing learning process. This concept was not discussed in the articles on engineering leadership that were reviewed. This may be because the focus in the previous research was on a model of leadership whereas the current study sought to understand the experiences of engineering project leaders. The focus on learning was not only relevant to the topic of leadership development, but also in terms of how new information was assimilated to continue to direct the path that a project is on. Similar to the discussion around perspective taking, it is important that engineering project leaders continually take in information to evaluate the project's outcomes and course of action, and make adaptations when necessary.

Remaining focused on learning may safeguard the completion of a project where the outcomes are no longer relevant to the problem or business need that initially created it.

In terms of learning approach, mentorship and reflecting on experiences were the predominant approaches. The focus on mentoring was supported by previous research (Farr & Brazil, 2009; Russell & Nelson, 2009). Although some of the participants had attended training seminars, these were noted as valuable for learning a few elements that could be taken back and assimilated into their existing approaches. Significant changes and learning were a result of mentoring and reflection. This included processing feedback, seeking mentoring, and intentionally focusing on learning and development. This will be discussed further in the section on training engineering leaders.

Similar to previous findings (Racine, 2015), some of the engineers experienced challenges when transitioning into leadership. However, the experiences were quite dissimilar across the participants. For many, the challenges came prior to the new role. These included challenges stemming from taking a negative perspective to things, difficulty in connecting with others, overly focused on finding the correct answer, and a lack of business perspective outside of engineering. Interestingly, once the engineers understood the difference between being an individual contributor and the multi-faceted needs of engineering leadership, there weren't any that discussed transition struggles. It seemed that once the difference was understood, they were able to draw upon mentors, reflect on experiences, and continue to refine their approach. These findings indicate that it is important that engineers have a leadership context prior to learning these soft skills. Without understanding how they apply to leadership situations and facilitate results, they may not integrate the learning into their approach. This will be further discussed in the section on training engineering leaders.

Engineering mindset. Engineers are relied upon for their technical expertise, creativity, and their ability to work with other experts to accomplish a goal (Robledo et al., 2012). These leaders discussed the need to have both technical aptitude and socio-organizational skills to be effective. They tend to be drawn to working with others (Van der Molen et al., 2007), which was discussed by all participants at some point in the interview. They also work under high degrees of uncertainty, which likely influenced the focus on providing information and autonomy to the other experts, perspective taking to understand positions, and being decisive. They were not focused on minimizing the uncertainty, but instead upon continually gathering information in order to continue to define the problems and solutions, while getting closer to the outcome. These leaders could draw upon organizational knowledge, technical aptitude, and systems thinking to solve problems and identify solutions. They also tend to rely heavily on experience-based knowledge (Anderson et al., 2010), which was a major theme identified in the results.

The systems thinking that is developed in engineering education and training is utilized not only for solving technical issues, but also to better understand people. Many of the participants discussed the individual engineers in terms of being unique systems, with strengths, weaknesses, influencers, being impacted by outside factors that all need to be understood. This appeared to be a new application for the passion for learning how things work. This same mindset is also applied to teams to understand the dynamics present within the group, the outside factors influencing the group, and how the group fits into the organization and the larger market. These leaders were then able to take all of this information, and offer clarity, decisiveness, and direction to the team members so that they knew what they were working towards and how they would work towards it. These approaches are embedded in the engineering mindset and facilitate professionally-recognized forms of influence.

Engineering personality. Engineers are predominantly concerned with the interests of others (Singh & Singh, 2009), which was present in multiple major themes in the results. This included concerns for the organization, the other project team members, and the recipient of the project work. These leaders demonstrated great care and respect for the team members and for the organizations for which they work. This was present in the focus on developing trust-based relationships, commitment to the team, and the ability and desire to take different perspectives to make the best decisions. These approaches, combined with the listening, autonomy support, open communications, humility, and respect for expertise demonstrated genuine care and respect for the members of the team through these actions. These soft-skills and interpersonal focuses were demonstrated through the project work, with intentionality.

Engineers tend to score lower than other professions on emotional stability, extraversion, image management, optimism, visionary style, and work drive (Williamson et al., 2013). They tend to score higher on openness, flexibility, cognitive complexity, self-confidence, and dominance (Williamson et al., 2013). Although these dimensions were not measured in this study, the discussions with the participants provided some insights into these dimensions. In general, the participants preferred to work on teams rather than alone, discussed the need to keep their cool in difficult situations, and were committed to their work, which are contrary to these previous findings. However, the individuals in the sample may not be representative of engineers as a whole. Therefore, it may be important to understand the personality dimensions of engineering leaders. Other findings appear to be aligned with the impressions from the individuals interviewed, most notably self-confidence, dominance, and image management. There was a strong focus on being decisive when needed, which was commented on in previous research.

Engineering Leadership Models

The leadership approach may be unique to engineering project leadership because of the combination of technical competence required, the adaptivity required of projects, and the dynamic environment within which these projects exist. Previous research indicated that they need to work in a proactive manner, acting as self-starting, change-oriented, and future-focused leaders (Garcia-Chas et al., 2015). This is because the task associated with the work cannot be laid out ahead of time, and the path must be adapted as new information is gathered. The leader is not focused on minimizing complexities, but to continue to define them and work towards the outcome. This study found that this places a heighted importance on autonomy, perspective taking, and openly information sharing. The ability to integrate information to make good decisions over time was enabled by the systems thinking of an engineering mindset and the open sharing that resulted from the trust-based relationships created.

Robledo et al. (2012) indicated that the key aspects of the engineering leadership model are mission definition, resource planning and acquisition, expertise, creating the desired climate, and bridging the gap between the group, the work, and the organization. This study supported the tactical approaches to engineering project leadership that were discovered through this research. The participants in this study did discuss the need to define the outcomes and work required in a project, the ability to determine the resources required and then engage them in the project work, the need to value and respect the expertise on the team, the need to balance the individuals, team, and organization needs, as well as the need to create the right team atmosphere. However, the current study expanded upon these findings by discussing the experiential elements that were woven through these tactical approaches to engineering project leadership. These differences are due to the intent of the two research studies. Robledo et al.'s study (2012) was a grounded theory study that sought to identify the model of engineering leadership. The current study sought to understand the experiences these individuals had leading project teams. As a result, the current study adds a depth of information to the research base and identifies effective elements of engineering project leadership.

Rottman et al. (2014) indicated that engineers lead in ways that are more aligned with their profession, incorporating recognized forms of influence. There was a focus on supporting other engineers in their technical mastery, providing mentoring, openly discussing disagreements, being decisive, and focusing on the results required. The current study supports these findings. The current study identified the major themes associated with engineering leadership, all of which were grounded in the mindset, project complexity, and professional identity of engineers. This offers further support for Rottman et al. (2014) who asserted that engineering leadership models should be grounded in their professional identity. The current study builds upon the previous work by providing essential elements for effective engineering project leadership.

The current study found that these engineers viewed themselves as leaders and that they had spent time thinking about, and refining, their approach. This contrasts with the Rottman et al. (2014) research which found that the engineers studied were resistant to the term. This may be explained by the differences in geographical region between the studies, Canada instead of US, and the data gathering methodology. The Rottman et al. (2014) study utilized focus groups, and the group presence may have influenced the information shared. Drawing upon SITL, it is possible that the social influences created a resistance to the idea of leadership that may not have been present individually.

Lastly, the Rottman et al. (2014) research found that there were three orientations to engineering leadership: technical mastery, collaborative optimization, and organizational innovation. Although the current study identified leadership aspects that support each of these areas, they did not appear to be three separate approaches to leadership. Instead, there was a sense of balance between the support of individuals, the collaboration of the team, and the connection to the larger organization and market. This is a significant difference. It is possible that the leaders interviewed in the current study had a depth of experience that allowed them to encompass this broader approach to project leadership.

Interestingly, the literature indicated that with this population, organizational visions can restrict autonomy and creativity (Mumford et al., 2002). This had mixed support, with some participants indicating that organizational visions and values could help create a common language for team members, whereas others commented that when they were not fully committed to, they could have negative impacts. It is possible that the alignment of organizational visions and actions is a mediating factor for this relationship. Additional research would need to be completed to understand this relationship. However, it was not a major theme that was identified in the research.

Leadership as a social process. Considering leadership of groups is largely a social process, it was also important to relate the research to group process. As a relational process, project leaders influence the individuals working on a project through motivation and enabling. Individual empowerment is most effective when an empowering climate is created for the team as a whole (Chen et al., 2007). The trust-based relationships and commitment to team that the engineers established would support this individual empowerment. Furthermore, alleviating demands, stimulating learning and growth, and supporting them in achieving work goals would serve to reduce the stress that may result from the complex work that they need to complete (Bakker, Hakanen, Demerouti, & Xanthopoulou, 2007).

The current study found that project leaders saw themselves as most successful when they aligned the individual roles with the skills and abilities of the individuals on the team. They also aligned the group's work so that it was most supportive of the current individual and group needs. This supports existing research regarding social facilitation such as Chen et al. (2009) and Karau and Williams (2001). However, it differed in the extent of the focus on establishing rules of conduct and tasks. In the current study, the leaders focused on establishing project needs, individual roles and responsibilities, and setting the direction, while providing open communications and information, so that individuals could act autonomously in achieving those goals. This may be explained by the high group salience present in these projects, and the expertise required to determine how to accomplish incremental goals.

It appeared that the group norms were established through the creation of trust-based relationships, the creation of a safe environment where information could be openly shared and discussed, modeling effective disagreement, and maintaining a focus on project outcomes. Listening, humility, and respect for the team members likely influenced the way that the team members interacted with the leader and each other. Although establishing behaviors for others was not a strong focus of the discussions, it was implied that setting an example of behavior influenced the resulting behaviors and that creating an environment of respect, autonomy, humility, and trust would also support the establishment of norms.

Training Engineering Leaders

There is a recent focus on increasing the leadership training of engineers (Rottman et al., 2014). However, there has been little research conducted to indicate how to best support this development (Robledo et al., 2012). There was no common path to project leadership. Those in leadership positions desired a role beyond being an individual contributor. They needed to learn more about the business and organization, how to enlist resources to achieve goals, how to motivate individuals, and to balance the technical, individual, and organizational needs. Often, they gained this perspective through mentoring and receiving critical feedback.

The most common methods discussed as effective training for leadership were mentoring and feedback. This included seeking mentorship, learning from mistakes, and soliciting feedback. The study found that many of the leaders had received critical feedback on their approach and limited perspective early on in their careers. It was interesting to hear how this negative feedback was reflected on, understood, and accepted. They took away from that feedback that if they wanted to become more than an individual contributor, that they needed to change their approach. This may have been supported by the desire to progress in their career, the desire to be a better engineer, and the desire for their thinking to be heard and appreciated. There was a deliberate effort to learn from both positive and negative experiences, to understand not only what was done, and what the result was, but also to understand the context within which it existed and what factors influenced the behaviors and results. This reflective practice enabled these leaders to refine their skills, gain confidence in their leadership, and incorporate their learning into their models of leadership.

Although the participants did not feel that their undergraduate programs prepared them for these roles, those who had received an MBA felt that this program had provided them with a broader perspective on the business. Specifically, the cross-functional nature of the MBA program and the team-based work required were seen as the foundation for learning how to be an effective member of a team. These experiences also exposed them to diverse areas of the business, and they learned more about what other professions need to do their work, and how that work relates to engineering projects. It seems that the broadened perspective from the cross-functional learning and teams is an effective way of building the constructs for learning leadership skills grounded in the engineering profession.

Formal leadership training was not regarded as the best way to learn the leadership skills required to be successful. This may be because the trainings lacked the real-world context that these individuals valued learning from. It may also be contrary to the way that engineers learn and assimilate new information. Primarily, the engineers embarking upon leadership training need to understand the work of project teams, the importance of collaboration and teamwork, and the business context within which these projects exist. This would create the leadership context within which the information is required. Without this foundation, the leadership approaches, soft skills, and motivational training don't have existing mental models to be incorporated into.

Mentoring. Similar to Russell and Nelson (2009) and Rottman et al. (2014), mentoring was identified in this study as the most beneficial method for developing engineering leadership skills. This relates to the way that engineers gain technical knowledge, by assimilating prior learning into existing mental models in order to solve new problems. This also draws upon the respect for the expertise, providing these individuals with the opportunity to learn from respected, effective leaders. It also draws upon the respect and commitment that engineers tend to have with the profession.

This approach to skill development is aligned with the engineering profession, and draws upon the pride, respect, and commitment that engineers have for successful engineers. The focus on ongoing learning, and the reflection that these engineers practiced appear to support the success of the mentoring relationships. The key element was exposure to various areas of the business and different perspectives, along with critical feedback when the individual was taking actions that the mentor could see were not working toward the result desired.

The research regarding the role of mentoring in the development of engineers with leadership skills is minimal. The current study found that individuals feel that these relationships, both formal and informal, enabled the development of a broader business perspective, developed self-awareness, and developed the leadership approaches and skills required to be an effective project leader. This was supported by the cause-and-effect thinking that engineers apply to systems and problems, applied to projects and people. This was also supported by the focus on understanding the variables involved in a situation and how they come together to influence the system. This desire to understand how things work, why they worked, why they didn't work, and what adjustments are required to reach the desired results can be drawn upon to facilitate self-reflection within a leadership context. This appeared to be a natural approach, for the participants in the study.

The self-awareness was an important component to the reflective practice that was found in many of the participants. Similar to the findings of Finlayson (2016), this involved reflection on past events as well as real-time reflection. There was a focus on the outcome desired, and reflection was used to determine the best approach to meet that outcome, at that time, under the specific circumstances. This practice over time seemed to refine the skills and reinforcements of the mentoring process, while using all leadership situations as learning experiences. This indicates that there is opportunity to support the profession through real-time learning, reflection, and mentorship.

Comparison of Findings with Theoretical Framework and Previous Literature

Self-Determination Theory (SDT)

SDT assumes that people are active and growth-oriented, with a desire to pursue connections with others and achieve optimal functioning (Gagne & Deci, 2005). This is facilitated by the fulfillment of the psychological needs of autonomy, competence, and relatedness (Gagne & Deci, 2005). The engineering profession aligns well with self-determination theory. For one, there is a sense of respect for the other individuals within the profession. There is also a requirement that others work together to achieve an outcome, since multiple disciplines are required for projects. Additionally, there is a heightened focus on technical competence, and a requirement to continue to refine skills and build capabilities over time. This focus on respecting individuals, continued learning, and a sense of needing others aligns with SDT.

Autonomy was an important component of the leadership approach discovered. This included the sense of autonomy that the leaders had in their project leadership roles as well as the autonomy that they afforded the team members. This autonomy supported the relationship development and individual growth that was discussed by these project leaders, which is similar to the findings of Gagne and Deci (2005). The leaders created an environment that was founded on respectful, personal relationships where individuals were provided the information that they needed so that they could act autonomously in service of the team. The leaders discussed the sense of ownership that team members had over the project and its outcomes, which is supported by the findings of Deci et al. (1989). Furthermore, because of the task interdependence present in engineering projects, this approach would also support creativity (Hon & Chan, 2012), which was also discussed by the participants.

These engineering leaders were focused on learning and development. This is supported by Hetland, Skogstad, Hetland, and Mikkelsen (2011), who found that autonomy and responsibility facilitated the development of a learning climate. Additionally, the perspective taking ability and willingness to share information also supported the sense of competence on the team by allowing them to control the outcomes of their actions. The learning orientation present in the engineers interviewed, as well as the focus on respecting expertise on the team, also supports the focus on competence. Additionally, engineers tend to be highly autonomous and achievement orientated (Van der Molen et al., 2007), which also supports these findings.

Considering the work of engineering project leaders requires multi-disciplinary work, there is also a focus on relationships and connections to others. Relationship building was a strong, and intentional, focus of the participants. These relationships were in service of project outcomes, and built out of the genuine respect for the team members and the individual expertise that they bring to the project. These were created from a foundation of perspective taking, listening, respect, open sharing, and humility. There was an understanding that the leader needed the team more than the team needed the leader, and that the leader’s role was to get the best output from the individual contributors to achieve the project results. This respect for the individual contributors, the requirement for collaboration and effort, and the sense of ownership over the project outcome across the team, created a shared sense of purpose. These relationships and the requirement of multiple experts to come together to achieve a result, would fulfill the need for relatedness.

Based upon previous research, it could be assumed that this approach to leadership would support the job satisfaction, well-being, and high performance associated with need fulfillment when the work requires creativity, cognitive complexity, and conceptual understandings (Gagne & Deci, 2005). This is aligned with the reports from the participants that they were effective in bargaining for resources, building a sense of ownership over the project, and a willingness to put in extra effort when the project responsibilities were outside of the individual's core role. This may be a result of the autonomous motivation that would result from need fulfillment. These results seemed to be related to the trust-based relationships created, the leader's apparent commitment to the team, and the focus on taking perspectives, which indicated genuine respect for the team members.

Autonomous motivation. Autonomous motivation is a self-perpetuating cycle of engagement in an activity. Relevant to engineers, autonomous motivation has been correlated to creativity, innovation, enthusiasm, and heightened engagement (Gagne & Deci, 2005). These results are aligned with the findings of the study. This may be because the approach of these project leaders supported the satisfaction of the team member's needs for autonomy, competence, and relatedness. This supported the individuals in integrating their project roles into their sense of self. The results indicated that the project leaders identified themselves within their profession and role, which supports the findings by Deci and Ryan (2008) regarding intrinsic motivation. It seems that unintentionally, the work of these engineering leaders supports the need fulfillment outlined by SDT.

Autonomous motivation is especially important in engineering project work where individual experts know what information they need, how it impacts their work, and how to evaluate technical tradeoffs, and the leader is far less able to make those individual determinations. This results in a reliance upon the technical experts to act autonomously, share information with the other experts, and act in the best interest of the project outcomes. The satisfaction of the psychological needs of autonomy, competence, and relatedness result in autonomous motivation, and heightened performance, as discussed by Baard et al. (2004), Gagne and Deci (2005), and Gagne et al. (2000). With greater understanding of these relationships, and the mediating factors involved in need satisfaction, the engineering profession appears to offer a natural fit for SDT as it applies to leadership theory.

Feedback. Feedback has been shown to negatively impact need satisfaction as defined by SDT (ten Cate, 2013). This is contrary to the findings of this study. Most of the participants sought out feedback, including critical and difficult feedback. The participants sought this information from trusted mentors to learn from experiences and improve their outcomes. Guo et al. (2014) found that intrinsic motivation was the mediating factor between developmental feedback and performance, which may explain why this feedback was sought by participants, valued, and integrated into their learning. This further supports that the engineering project leaders were intrinsically motivated.

These findings also support the role of mentoring in developing engineering project leaders. It also places a heightened importance on intrinsic motivation so that the feedback process adds value for the learner and doesn’t unintentionally create a negative impact. For the mentoring process to be successful, the individual needs to be autonomously motivated. This study provides insights into the elements of engineering project leadership that support the autonomy, competence, and relatedness of the project leaders and team members. These relationships need to be understood to create a model that would best support the elements of SDT and enable an effective mentoring process.

Social Identity Theory of Leadership (SITL)

The engineering discipline carries with it a sense of belonging to a group, where there is a strong sense of social identification and connection with other engineers (Racine, 2015). Engineers tend to define themselves in terms of their role (Slush & Ashforth, 2007), and the relationship between the individual, their peers, and the discipline create a shared social identity. This was present in the current study; participants identified strongly with the engineering profession. This sense of social identity was present in the respect and trust in the other engineers, the engineering mindset and how it was applied to engineering project leadership, the focus on learning from experiences and other engineers serving as mentors, and the commitment to the success and career progression of the other engineers.

SITL describes leadership as a group process that is generated from social categorization and prototype-based processes (Hogg, 2001). The theory asserts that as the prototype is developed, members cognitively and behaviorally conform to that prototype. The current study didn't appear to support the assertion that the leader would be a prototypical member of the team. Instead, the leader had a broader perspective, was relationship oriented, and had a sense of how to capitalize on the experts and resources available to achieve the desired results from the project. However, it was important that the methods of building relationships, leveraging resources, and motivating individuals were aligned with the engineering approach. The relationship building, listening, and sharing were directly in service of the other engineers and the project needs. They did not appear to be valued in-and-of themselves, but instead for their role in achieving success and supporting others in progressing in their careers. In this manner, they are aligned with SITL considering the shared social identity requires leaders influence followers through their group membership (Graf et al., 2012).

SITL is further supported by the comfort that the engineering leaders expressed in leading other engineers. Multiple participants discussed this comfort, and felt that although they felt they were very effective project leaders, they were effective because they knew how to lead engineers. The effectiveness of traditional, professionally accepted methods of leadership supports SITL in that it relates the effectiveness of leadership to the social identity of the leader. It is important to understand the professional foundation upon which the leadership experiences were discovered. This was not a direct focus of the current study. However, the current study has identified that SITL provides insights into the engineering foundation upon which the major themes were discovered. It also provides insights into the need to integrate leadership development into engineering in a manner that is aligned with the profession.

Limitations

One of major limitations of the study is the small sample size from one geographic region. Only ten participants were included in the study, and although the intent of generic qualitative research is not to generalize the findings, the smaller sample size limited the perspective gained. This was a large enough sample for the research methodology, and the resources available for the study did not support a larger sample. The sampling method to obtain participants could have biased the group to be more representative of a group of engineering project leaders belonging to organizations that valued leadership, and these leaders were identified as highly effective. Although this may have biased the results, gathering information from leadership who are highly effective was not likely a detriment to the data collection process. Instead, it served to ensure that participants were selected who would provide a depth and breadth of information.

Additionally, the data collection was limited to one sixty-minute interview. If additional forms of data collection were enlisted, a broader picture of the experiences of these project leaders could have been gained. Alternatively, if longer interviews, or repeated interviews over time were utilized, then a greater depth of information and reflection would have been gained through the process. The data collection process was appropriate for the methodology selected, and extended involvement for participants in the study would have most likely diminished the ability to recruit organizations and participants.

This study did not seek to measure engineering personality dimensions. Engineering personality dimensions presented in the literature review were generally supported by the findings of the study. Additionally, many of the engineers interviewed discussed the differences between their development and those that have remained individual contributors. However, this was not a specific focus of the study. Additional knowledge may provide insights into the differentiation of engineers who remain individual contributors compared to those that become engineering leaders.

The study also did not seek to measure the relationships between various engineering leadership dimensions and follower satisfaction, leadership models, or project outcomes. However, numerous aspects of engineering leadership were discussed. This study has served to identify the elements of engineering project leadership, and the aspects and skills required for effective leadership of these project teams. Further research to gain an understanding of the relationships between these components, and to discover mediating factors would build upon these findings.

Implications for Practice

Ongoing leadership training is needed within organizations. Additionally, the undergraduate coursework needs to be reviewed to determine how to best supplement the technical training with leadership, communication, and soft-skill training (Graham, 2012; Rover, 2006). Considering the objective of talent development should be to achieve its strategic objectives (Kim, Williams, Rothwell, & Penaloza, 2014), it is important that this training is completed within the context of engineering project work.

Within undergraduate education, the effectiveness of cross-functional project teams should be studied. These groups should reflect the work that lies ahead of them, and include non-engineering disciplines that would likely be a part of project teams such as marketing and finance. Engineering teams, such as senior design projects, have been integrated into undergraduate education. Furthermore, research has shown that problem-based learning can help to develop these soft-skills (Kumar & Hsiao, 2007). Establishing engineering projects and teams reflective of those found in organizations would benefit from research to determine if this is an effective method of integrating leadership, collaboration, and soft skills into the curriculum.

Teaching leadership constructs that the engineering leader doesn't already have an expressed need to understand doesn't appear to be effective. Engineers who sought out particular training to address a current problem valued and integrated the learning into their leadership approaches. Those that attended leadership trainings without a specific, individual purpose did not get value out of the training. They also sought and integrated feedback from respected peers and mentors, which supported their ongoing development. This places an importance upon the need for any training and development to serve a specific leadership purpose, solve a current problem, or develop a desired skill. The situation and experiences drive the future learning.

Previous research on reflective practice (Finlayson, 2016) and mentorship can be drawn upon to begin to create models for ongoing leadership development. Based upon the current research, these are effective methods of developing and refining leadership skills over time. A model of reflective practice that is based upon the engineering professional should be developed to enable this ongoing learning. Considering the focus on ongoing learning, systems thinking, and cause-and-effect thinking, this process would likely support this profession. Additionally, research is needed to identify the mentorship models and factors that best suit this profession and provide for the most effective development of engineering project leaders.

One practical implication from this research is the need for organizations to support mentoring initiatives, if the organization desires to build effective engineering leaders. These mentoring relationships enabled effective feedback, placed a focus on growth and development, and provided a foundation for developing leadership skills. These included internal and external relationships, informal mentoring, formal mentoring, and formal coaching. It is also important that mentors are trained in how to effectively both orient and develop leaders (Locurcio & Mitvalsky, 2002). Most participants discussed the benefits of these relationships, and were valued more so than outside training. Based upon the study, mentoring is an important foundation for developing engineering project leaders.

Recommendations for Further Research

As Rottman et al. (2014) shared, if leadership theory is filtered through a pre-existing identity lens, it may be more legitimate to engineers. This places an importance in studying engineering leadership specifically, drawing upon professionally recognized forms of influence, and utilizing a language that is familiar to the profession. The current study identified five major themes related to engineering leadership: develop trust-based relationships, commitment to the team, perspective taking, learn from experiences, and applying an engineering mindset to leadership. These findings indicate a need to understand the relationships present between these themes, the components of these themes, and leadership outcomes. This information will build an understanding of the soft-skills required for engineering project leadership, what facets of leadership they support, how they impact individuals on project teams, and how they relate to project outcomes. This information will enable educational institutions and organizations to support the development of these skills. It will also provide researchers with insights into engineering personality, leadership skills development, and leadership models that are effective with this population.

There are facets of leadership that were discovered through this study that need to be further investigated. This includes how relationships are established and the role they play in project outcomes, as well as how leader commitment and perspective taking may mediate this relationship. These relationships were discussed in a genuine regard, with a strong focus on openly sharing information and respecting the individuals on the team. It is important to understand how these engineering leaders develop these trust-based relationships, and what role these relationships play in contributing to open sharing, individual motivation, and commitment. Additionally, it is important to understand how these facets support leader satisfaction and follower satisfaction.

This study discovered many leadership attributes for engineering project leaders. It would be valuable to understand which of these attributes are important to engineering leaders, and which are important to members of engineering project teams. The list of major themes and associated codes in Table 4 could be researched in a quantitative fashion to identify the key variables important to the engineering leadership approach. This would provide a foundation for the key attributes of engineering project leadership. It would also build an understanding of how engineering project leadership relates to motivation theory and existing models of leadership.

The engineering mindset, which encompasses a systems approach, cause-and-effect thinking, and an orientation to learning and mastery should also be researched. A deeper understanding of how this engineering mindset relates to project leadership and people would provide additional insights into how engineers lead. It would also provide insights into how engineers apply this type of thinking to people situations, the effectiveness of this approach, and how educators can leverage the critical thinking developed through technical training to leadership situations.

There were similar findings between the Rottman et al. (2014) aspects of leadership and the current study, including the role of mentorship, technical expertise, aligning individual skills with project needs, constructive disagreement, leveraging resources, making decisions on incomplete information, and aligning the project outcomes to organizational needs. However, the current study did not support the differentiation of three different orientations to leadership. Instead, the leaders appeared to draw upon all of these facets over time, similar to the findings by Robledo et al. (2012). It is important to understand what accounts for these differences in findings. Further research into these leadership facets is needed to understand their presence in engineering leadership and the role they play in individual development, team collaboration, and organizational value creation.

Recommendation: Theory Research

The study provided support for SDT research, with many similarities between how engineers lead these project teams and the needs of autonomy, competence, and relatedness. The multifaceted nature of the work, the complexity present, the cognitive complexity, and collaboration required align well with SDT. Previous organizational research into the role of SDT in engagement, extra-role behaviors, job satisfaction, and creativity should be repeated with this population. Additional research could be completed to identify the relationships between leadership approaches and the satisfaction of the needs for autonomy, competence, and relatedness. This would provide insights into the role of need fulfillment in achieving project outcomes as well as the leadership approaches that lead to need fulfillment. It is also important to understand how SDT may mediate the relationship between feedback and performance for engineering project leaders.

Recommendation: Engineering Personality

Engineering personality was a delimitation of this study. Although it was not studied, it is related to the research findings. It is important to understand if there are personality differences between engineers that desire to remain individual contributors and those that seek leadership opportunities. It may be that the engineers studied have fundamental differences from the engineers that they lead. This could lead to identification of potential engineering leaders as well as provide insights into engineering followership. Additionally, it is important to understand how engineering personality may support the leadership facets identified to align engineering leadership approaches to both leader and follower personality traits.

Conclusion

The current study provides insights into engineering project leadership. The study answered the research question and provided a depth and breadth of information related to how engineers experience leading project teams. The major themes identified provide a foundation for the development of a leadership model and leadership development approaches. It also identified facets of engineering project leadership that relate to how engineers establish trust-based relationships and draw upon their technical training to apply systems thinking to teams and individuals. As a qualitative study, there were many recommendations for future research. The information and perspectives gained provide a strong foundation for future research to identify the relationships amongst the potential variables discovered.

It appears that engineering project leadership is as complex as engineering project work. There was a surprising focus on interpersonal aspects of leadership, and the recognition of the value that this adds to individuals and to project outcomes. The results of this study provide insights into how engineers develop these trust-based relationships and the depth of commitment that they had toward the project outcomes and the individual team member’s success and career progression. There was a strong focus on both the soft skills associated with engagement and relationships and the professionally-valued approaches of being decisive, optimizing resources, and developing solutions. These engineers experienced pride and excitement through their leadership experiences, established genuine relationships with team members, and had a keen sense of how to listen to, value, and respect individuals. It is important to continue to build upon this understanding in order to create a model of leadership that is grounded in the engineering profession, supports the unique work that they do, and draws upon the needs and experiences of engineers.

References

Akhavan, P., Ramezan, M., Moghaddam, J. Y., & Mehralian, G. (2014). Exploring the relationship between ethics, knowledge creation, and organizational performance: A case study of a knowledge-based organization. *Vine: The Journal of Information and Knowledge Management Systems, 44*(1), 42-58. doi:10.1108/VINE-02-2013-0009

Anderson, K. J., Courter, S., McGlamery, T., Nathans-Kelly, T. M., & Nicometo, G. G. (2010). Understanding engineering work and identity: A cross-case analysis of engineers within six firms. *Engineering Studies, 2*(3), 153-174. doi:10.1080/19378629.2010.519772

Baard, P. P., Deci, E. L., & Ryan, R. M. (2004). Intrinsic need satisfaction: A motivational basis of performance and well-being in two work settings. *Journal of Applied Social Psychology, 34*, 2045-2068. doi:10.1111/j.1559-1816.2004.tb02690.x

Bakker, A. B., & Demerouti, E. (2008). Towards a model of work engagement. *Career Development International*, *13*, 209-223. doi:10.1108/13620430810870476

Bakker, A. B., Hakanen, J., Demerouti, E., & Xanthopoulou, D. (2007). Job resources boost work engagement, particularly when job demands are high. *Journal of Educational Psychology, 99*, 274-284. doi:10.1037/ 0022-0663.99.2.274

Bakker, R. M., Boros, S., Kenis, P., & Oerlemans, L.A.G. (2013). It’s only temporary: Time frame and the dynamics of creative project teams. *British Journal of Management, 24*, 383-397. doi:10.1111/j.1467-8551.2012.00810.x

Balaji, K.V.A., & Somashekar, P. (2009). A comparative study of soft skills among engineers. *The IUP Journal of Soft Skills, 3*(3/4), 50-57. Retrieved from https://ssrn.com/abstract=1526964

Baxter, P., & Jack, S. (2008). Qualitative case study methodology: Study design and implementation for novice researchers. *The Qualitative Report*, *13*(4), 544-559. Retrieved from http://nsuworks.nova.edu/tqr/vol13/iss4/2

Berson, Y., & Linton, J. D. (2005). An examination of the relationships between leadership style, quality, and employee satisfaction in R&D versus administrative environments. *R&D Management*, *35*(1), 51-60. doi:10.1111/j.1467-9310.2005.00371.x

Bhatnagar, J. (2012). Management of innovation: Role of psychological empowerment, work engagement and turnover intention in the Indian context. *International Journal of Human Resource Management*, *23*(5), 928-951. doi:10.1080/09585192.2012.651313

Bjornson, F, O., & Torgeir, D. (2008). Knowledge management in software engineering: A systematic review of studied concepts, findings, and research methods used. *Information and Software Technology, 50*, 1055-1068. doi:10.1016/j.infsof.2008.03.006

Bosch-Rekveldt, M., Jongkind, Y., Mooi, H., Bakker, H., & Verbraeck, A. (2011). Grasping project complexity in large engineering projects: The TOE (technical, organizational, and environmental) framework. *International Journal of Project Management, 29*, 728-739. doi:10.1016/j.ijproman.2010.07.008

Braun, V., & Clarke, V. (2006). Using thematic analysis in psychology. *Qualitative Research in Psychology, 3*(2), 77-101. doi:10.1191/1478088706qp063oa

Byrne, C. L., Mumford, M. D., Barrett, J. D., & Vessey,W. B. (2009). Examining the leaders of creative efforts: What do they do, and what do they think about? *Creativity and Innovation Management, 18*, 256-268. doi:10.1111/j.1467-8691.2009.00532.x

Caelli, K., Ray, L., & Mill, J. (2003). Clear as mud: Toward greater clarity in generic qualitative research. *International Journal of Qualitative Methods, 2*(2), 1-24. doi:10.1177/160940690300200201

Chen, G., Kirkman, B. L., Kanfer, R., Allen, D., & Rosen, B. (2007). A multi-level study of leadership, empowerment, and performance in teams. *Journal of Applied Psychology, 92,* 331-346. doi:10.1037/0021-9010.92.2.331

Chen, S., Langner, C. A., & Mendoza-Denton, R. (2009). When dispositional and role power fit: Implications for self-expression and self-other congruence. *Journal of Personality and Social Psychology, 96*, 710-727. doi:10.1037/a0014526

Creswell, J. W. (2013). *Qualitative inquiry and research design: Choosing among five approaches* (3rd ed.). Newbury Park, CA: Sage Publications.

Deci, E. L., Connell, J. P., & Ryan, R. M. (1989). Self-determination in a work organization. *Journal of Applied Psychology, 74*, 580-590.

Deci, E. L., & Ryan, R. M. (2000). The "what" and "why" of goal pursuits: Human needs and the self-determination of behavior. *Psychological Inquiry*, *11*(4), 227-268. doi: 10.1207/S15327965PLI1104_01

Deci, E. L., & Ryan, R. M. (2008). Self-determination theory: A macrotheory of human motivation, development, and health. *Canadian Psychology, 49*(3), 182-185. doi: 10.1037/a0012801

Deckop, J. R., & Cirka, C. C. (2000). The risk and reward of a double-edged sword: effects of merit-pay programs on intrinsic motivation. *Nonprofit and Voluntary Sector Quarterly, 29*, 400-418. doi:10.1177/0899764000293003

Den Hartog, D. N., & Belschak, F. D. (2012). When does transformational leadership enhance employee proactive behavior? The role of autonomy and role breadth self-efficacy. *Journal of Applied Psychology, 97*(1), 194-202. doi:10.1037/a0024903

El-Sabaa, S. (2001). The skills and career path of an effective project manager. *International Journal of Project Management, 19*, 1-7. doi:10.1016/S0263-7863(99)00034-4

Elegbe, J. A. (2015). Emotional intelligence: Missing priority in engineering programs. *Journal of Business Studies Quarterly, 7*(2), 196-207. doi:10.1080/21573727.2012.738669

Emery, C., Calvard, T. S., & Pierce, M. E. (2013). Leadership as an emergent group process: A social network study of personality and leadership. *Group Processes & Intergroup Relations, 16*(1), 28-45. doi:10.1177/1368430212461835

Emison, G. A. (2011). Transformative leadership for engineering in a time of complexity. *Leadership and Management in Engineering, 11*(2), 97-102. doi:10.1061/(ASCE)LM.1943-5630.0000108

Engwall, M., Kling, R., & Werr, A. (2005). Models in action: How management models are interpreted in new product development. *R&D Management, 35*, 427-439. doi:10.1111/j.1467-9310.2005.00399.x

Farr, J. V., & Brazil, D. M. (2009). Leadership skills development for engineers. *Engineering Management Journal, 21*, 3-8. doi:10.1080/10429247.2009.1143179

Farr, J. V., Walesh, S. G. & Forsythe, G. B. (1997). Leadership development for engineering managers. *Journal of Management in Engineering, 13*, 38-41.

Gagne, M., & Deci, E. I. (2005). Self-determination theory and work motivation. *Journal of Organizational Behavior, 26*, 331-362. doi:10.1002/job.322

Gagne, M., Koestner, R., & Zuckerman, M. (2000). Facilitating the acceptance of organizational change: The importance of self-determination. *Journal of Applied Social Psychology, 15*, 372-390. doi:10.1111/j.1559-1816.2000.tb02471

Garcia-Chas, R., Neira-Fontela, E., & Varela-Neira, C. (2015). Comparing the explanatory capacity of three constructs in the prediction of engineers' proficiency, adaptivity, and proactivity. *Human Resource Management, 54*(4), 689-709. doi:10.1002/hrm.21639

Geen, R. G. (1991). Social motivation. *Annual Review of Psychology, 42*, 377-399.

Ghadi, M. Y., Fernando, M., & Caputi, P. (2013). Transformational leadership and work engagement. *Leadership & Organization Development Journal, 34*(6), 532-550. doi:10.1108/LODJ-10-2011-0110

Gibson, N., & Whittaker, J. (1996). Rules of thumb. *Journal of Management in Engineering, 12*(6), 34-39.

Graf, M. M., Schuh, S. C., van Quaquebeke, N., & van Dick, R. (2012). The relationship between leaders' group-oriented values and follower identification with and endorsement of leaders: The moderating role of leaders' group membership. *Journal of Business Ethics, 161*, 301-311. doi:10.1007/s10551-011-0997-4

Graham, R. (2012). The one less traveled by: The road to lasting systemic change in engineering education. *Journal of Engineering Education, 101*(4), 596-600. doi:10.1002/j.2168-9830.2012.tb01120.x

Güntert, S. T. (2015). The impact of work design, autonomy support, and strategy on employee outcomes: A differentiated perspective on self-determination at work. *Motivation and Emotion, 39*(1), 74-87. doi:10.1007/s11031-014-9412-7

Guo, Y., Liao, J., Liao, S., & Zhang, Y. (2014). The mediating role of intrinsic motivation on the relationship between developmental feedback and employee job performance. *Social Behavior and Personality, 42*(5), 731-741. doi:10.2224/sbp.2014.42.5.731

Harter, J. K. (2000). Managerial talent, employee engagement, and business-unit performance. *The Psychologist-Manager Journal*, *4*(2), 215-224. doi:10.1037/h0095893

Hettland, H., Skogstad, A., Hetland, J., & Mikkelsen, A. (2011). Leadership and learning climate in a work setting. *European Psychologist, 16*(3), 163-173. doi:10.1027/1016-9040/a000037

Hodgson, D., Paton, S., & Cicmil, S. (2011). Great expectations and hard times: The paradoxical experience of the engineer as project manager. *International Journal of Project Management*, *29*, 374-382. doi:10.1016/j.ijproman.2011.01.005

Hogg, M. A. (2001). A social identity theory of leadership. *Personality and Social Psychology Review, 5*(3), 184-200. doi:10.1207/S15327957PSPR0503_1

Hogg, M. A., Fielding, K. S., Johnson, D., Masser, B., Russell, E., & Svensson, A. (2006). Demographic category membership and leadership in small groups: A social identity analysis. *The Leadership Quarterly, 17*, 335-350.   doi:10.1016/j.leaqua.2006.04.007

Hogg, M. A., & Terry, D. J. (2000). Social identity and self-categorization processes in organizational contexts. *Academy of Management: The Academy of Management Review, 25*(1), 121-140. doi:10.5465/AMR.2000.2791606

Hogg, M. A., van Knippenberg, D., & Rast, D. E. (2012). The social identity theory of leadership: Theoretical origins, research findings, and conceptual developments. *European Review of Social Psychology, 23,* 258-304. doi:10.1080/10463283.2012.741134

Hon, A. H. Y., & Chan, W. W. H. (2012). Team creative performance: The roles of empowering leadership, creative-related motivation, and task interdependence. *Cornell Hospitality Quarterly, 54*(2), 199-210. doi:10.1177/1938965512455859

Hunter, S. T., Bedell, K. E., & Mumford, M. D. (2007). Climate for creativity: A quantitative review. *Creativity Research Journal, 19*, 69-90. doi:10.1080/10400410701277597

Jafari, M., Akhavan, P., & Mortezaei, A. (2009). A review on knowledge management discipline. *Journal of Knowledge Management Practice, 10*(1), 1-23. Retrieved from http://ssrn.com/abstract=2189715

Janz, B. D., Colquitt, J. A., & Noe, R. A. (1997). Knowledge worker team effectiveness: The role of autonomy, interdependence, team development, and contextual support variables. *Personnel Psychology, 50*(4), 877-903.

Joo, B. K., Song, J. H., Lim, D. H., & Yoon, S. W. (2012). Team creativity: The effects of perceived learning culture, developmental feedback and team cohesion. *International Journal of Training and Development, 16*, 77-91. doi:10.1111/j.1468-2419.2011.00395.x

Karau, S. J., & Williams, K. D. (1993). Social loading: A meta-analytic review and theoretical integration. *Journal of Personality and Social Psychology, 65*, 681-706.

Karau, S. J., & Williams, K. D. (2001). Understanding individual motivation in groups: The collective effort model. In M. E. Turner (Ed.), *Groups at work: Theory and research. Applied social research* (pp.113-141). Mahwah, NJ: Erlbaum.

Kaspary, M. C. (2014). Complex thought and systems thinking connecting group process and team management: New lenses for social transformation in the workplace. *Systems Research and Behavioral Science, 31*, 655-665. doi:10.1002/sres.2313

Kim, Y., Williams, R., Rothwell, W., & Penaloza, P. (2014). A strategic model for technical talent managements: A model based on a qualitative case study. *Performance Improvements Quarterly, 26*(4), 93-121. doi:1.1002/piq.21159

Koestner, R., & Losier, G. F. (2002). Distinguishing three ways of being internally motivated: A closer look at introjection, identification, and intrinsic motivation. In E. L. Deci & R. M. Ryan (Eds.), *Handbook of self-determination research* (pp. 101-121). Rochester, NY: University of Rochester Press.

Kovjanic, S., Schuh, S. C., Jonas, K., Van Quaquebeke, N. & Van Dick, R. (2012). How do transformational leaders foster positive employee outcomes? A self-determination-based analysis of employees' needs as mediating links. *Journal of Organizational Behavior, 33*, 1031-1052. doi:10.1002/job.1771

Kumar, S., & Hsiao, J. K. (2007). Engineers learn ‘‘soft skills the hard way’’: Planting a seed of leadership in engineering classes. *Leadership and Management in Engineering, 7,* 18-23. doi:10.1061/(ASCE)1532-6748(2007)7:1(18)

Laglera, J. M., Collado, J. C., & Montes de Oca, J. M. (2013). Effects of leadership on engineers: A structural equation model. *Engineering Management Journal*, *25*(4), 7-16. doi:10.1080/10429247.2013.11431991

Latham, G. P. (2012). *Work motivation: History, theory, research, and practice*. Thousand Oaks, CA: Sage Publications.

Locurcio, R. V., & Mitvalsky, K. (2002). Mentoring: A magnet for young engineers. *Leadership and Management in Engineering 2,* 31-33. doi:10.1061/(ASCE)9742-597X(1994)10:5(16)

Marshall, M. N. (1996). Sampling for qualitative research. *Family Practice, 13*(6), 522-525. doi:10.1093/fampra/13.6.522

Mesmer-Mangus, J. R., & DeChurch, L.A. (2009). Information sharing and team performance: A meta-analysis. *Journal of Applied Psychology, 94*, 535-546. doi:10.1037/a0013773

Miniotaite, A., & Buciuniene, I. (2013). Explaining authentic leadership work outcomes from the perspective of Self-Determination Theory, *Organizacijo Vadyba: Sisteminiai Tyrimai, 65*(5), 63-75. doi:0.7720/MOSR.1392-1142.2013.65.5

Mohammed, Y. G., Fernando, M., & Caputi, P. (2013). Transformational leadership and work engagement. *Leadership & Organization Development Journal, 34*(6), 532-550. doi:10.1108/LODJ-10-2011-0110

Moscoso, S., & Iglesias, M. (2009). Job experience and Big Five personality dimensions. *International Journal of Selection and Assessment*, *17*(2), 239-242. doi:10.1111/j.1468-2389.2009.00466.x

Mossholder, K. W., Bedeian, A. G., & Armenakis, A. A. (1982). Group process-work outcome relationships: A note on the moderating impact of self-esteem. *Academy of Management Journal, 25*(3), 575-585.

Mumford, M. D., Scott, G. M., Gaddis, B. H., & Strange, J. M. (2002). Leading creative people: Orchestrating expertise and relationships. *The Leadership Quarterly*, *13*, 705-750. doi:10.1016/S1048-9843(02)00158-3

Murugesan, R. (2012). Leadership dimensions for engineering project success. *IUP Journal of Organizational Behavior, 11*(4), 7-20. Retrieved from https://ssrn.com/abstract=2185222

Nyberg, D., & Sveningsson, S. (2014). Paradoxes of authentic leadership: Leader identity struggles. *Leadership, 10*(4), 437-455. doi:10.1177/1742715013504425

Patton, M. Q. (2002). *Qualitative research and evaluation methods.* (3rd ed.) Thousand Oaks, CA: Sage Publications.

Percy, W. H., Kostere, K., & Kostere, S. (2015). Generic qualitative research in psychology. *The Qualitative Report*, *20*(2), 76-85. Retrieved from http://nsuworks.nova.edu/tqr/vol20/iss2/7

Racine, W. P. (2015). Social identity development and the situation of scientists and engineers as new leaders. *Journal of Leadership Studies, 9*(3), 23-41. doi:10.1002/jls.21398

Rahman, M. M., & Kumaraswamy, M. M. (2005). Assembling integrated project teams for joint risk management. *Construction Management and Economics, 23,* 365-375. doi:10.1080/01445190500040083

Raja, A. S., & Palanichamy, P. (2011). Leadership styles and its impact on organizational commitment. *Asia-Pacific Business Review, 7*(3), 167-175. doi:10.1177/097324701100700315

Rambe, P., & Modise, D. (2016). Power distribution at Eskom: Putting self-leadership, locus of control and job performance of engineers in context. *African Journal of Business and Economic Research, 11*(1), 45-92. doi:10.4102/sajhrm.v13i1.615

Robledo, I. C., Peterson, D. R., & Mumford, M. D. (2012). Leadership of scientists and engineers: A three-vector model. *Journal of Organizational Behavior, 33*(1), 140-147. doi:10.1002/job.739

Rottman, C., Sacks, R., & Reeve, D. (2014). Engineering leadership: Grounding leadership theory in engineer's' professional identities. *Leadership*, *11*(3), 1-23. doi:10.1177/1742715014543581

Rover, D. T. (2006). Policymaking and engineers. *Journal of Engineering Education, 95*(1), 93-95. doi:10.1002/j.2168-9830.2006.tb00880.x

Russell, J., & Nelson, J. (2009). Completing the circle of professional development through leadership and mentoring. *Leadership and Management in Engineering*, 40-42. doi:10.1061/(ASCE)1532-6748(2009)9:1(40)

Shamir, B., Zakay, E., Breinin, E., & Popper, M. (1998). Correlates of charismatic leader behavior in military units: Subordinates' attitudes, unit characteristics and superiors' appraisals of leader performance. *Academy of Management Journal, 41*, 387-409.

Shane, J. S., Strong, K., & Gransberg, D. D. (2011). A multidimensional model of project leadership. *Leadership and Management in Engineering, 11*(2), 162-168. doi:10.1061/(ASCE)LM.1943-5630.0000116

Singh, A., & Singh, A. (2009). Leadership grid between concern for people and intuition. *Leadership and Management in Engineering,9*(2), 71-82. doi:10.1061/(ASCE)1532-6748(2009)9:2(71)

Slush, D. M., & Ashforth, B. E. (2007). Relational identity and identification: Defining ourselves through work relationships. *Academy of Management Review, 32*(1), 9-32. doi:10.2307/20159278

Smith, S., & Paquette, S. (2010). Creativity, chaos, and knowledge management. *Business Information Review, 27*(2), 118-123. doi:10.1177/0266382110366956

Steffens, N. K., Haslam, S. A., & Reicher, S. D. (2014). Up close and personal: Evidence that shared social identity is a basis for the 'special' relationship that binds followers to leaders. *Leadership Quarterly, 25*(2), 296-313. doi:10.1016/j.leaquq.2013.08.008

Sveningsson, S., & Alveson, M. (2003). Managing managerial identities: Organizational fragmentation, discourse and identity struggle. *Human Relations, 56*(10), 1163-1193. doi:10.1177/00187267035610001

ten Cate, T. J. (2013). Why receiving feedback collides with self-determination. *Advances in Health Science Education, 18*, 845-849. doi:1.1007/s10459-012-9401-0

Thomas, G., Martin, R., & Riggio, R. E. (2013). Leading groups: Leadership as a group process. *Group Process & Intergroup Relations, 16*(1), 3-16. doi:10.1177/1368430212462497

Tremblay, M. A., Blanchard, C. M., Taylor, S., Pelletier, L. G., & Villeneuve, M. (2009). Work Extrinsic and Intrinsic Motivation Scale: Its value for organizational psychology research. *Canadian Journal of Behavioural Science, 41*(4), 213-226. doi:10.1037/a0015167

Trépanier, S., Fernet, C., & Austin, S. (2012). Social and motivational antecedents of perceptions of transformational leadership: A self-determination theory perspective. *Canadian Journal of Behavioural Science, 44*(4), 272-277. doi:10.1037/a0028699

Tubre, T. C., & Collins, J. M. (2000). Jackson and Schuler (1985) revisited: A meta-analysis of the relationships between role ambiguity, role conflict, and job performance. *Journal of Management, 26*, 155-169. doi:10.1177/014920630002600104

Van der Molen, H. T., Schmidt, H. G., & Kruisman, G. (2007). Personality characteristics of engineers. *European Journal of Engineering Education*, *32*(5), 495-501. doi:10.1080/03043790701433111

Wageman, R. (1995). Interdependence and group effectiveness. *Administrative Science Quarterly, 40,* 145-180.

Wagner, B. D., & French, L. (2010). Motivation, work satisfaction, and teacher change among early childhood teachers. *Journal of Research in Childhood Education, 24,* 152-171. doi:10.1080/02568541003635268

Wang, W. T., & Hou, Y. P. (2015). Motivations of employees' knowledge sharing behaviors: A self-determination perspective. *Information and Organization, 25*, 1-26. doi:10.1016/j.infoandorg.2014.11.001

Williamson, J. M., Lounsbury, J. W., & Han, L.D. (2013). Key personality traits of engineers for innovation and technology development. *Journal of Engineering and Technology Management, 30*(2), 157-168. doi:10.1016/j.engtecman.2013.01.003

Wu, C. H., & Wang, Z. (2015). How transformational leadership shapes team proactivity: The mediating role of positive affective tone and the moderating role of team task variety. *Group Dynamics: Theory, Research, and Practice, 19*(3), 137-151. doi:10.1037/gdn0000027

Zajonc, R. B. (1968). Attitudinal effects of mere exposure. *Journal of Personality and Social Psychology Monograph Supplement*, *9*(2), 1-27.

Zhou, J. (2003). When the presence of creative coworkers is related to creativity: Role of supervisor close monitoring, developmental feedback, and creative personality. *Journal of Applied Psychology*, *88,* 413-422. doi:b826kj

STATEMENT OF ORIGINAL WORK

Academic Honesty Policy

Capella University's Academic Honesty Policy (3.01.01) holds learners accountable for the integrity of work they submit, which includes but is not limited to discussion postings, assignments, comprehensive exams, and the dissertation or capstone project.

Established in the Policy are the expectations for original work, rationale for the policy, definition of terms that pertain to academic honesty and original work, and disciplinary consequences of academic dishonesty. Also stated in the Policy is the expectation that learners will follow APA rules for citing another person's ideas or works.

The following standards for original work and definition of *plagiarism* are discussed in the Policy:

> Learners are expected to be the sole authors of their work and to acknowledge the authorship of others' work through proper citation and reference. Use of another person's ideas, including another learner's, without proper reference or citation constitutes plagiarism and academic dishonesty and is prohibited conduct. (p. 1)
>
> Plagiarism is one example of academic dishonesty. Plagiarism is presenting someone else's ideas or work as your own. Plagiarism also includes copying verbatim or rephrasing ideas without properly acknowledging the source by author, date, and publication medium. (p. 2)

Capella University's Research Misconduct Policy (3.03.06) holds learners accountable for research integrity. What constitutes research misconduct is discussed in the Policy:

> Research misconduct includes but is not limited to falsification, fabrication, plagiarism, misappropriation, or other practices that seriously deviate from those that are commonly accepted within the academic community for proposing, conducting, or reviewing research, or in reporting research results. (p. 1)

Learners failing to abide by these policies are subject to consequences, including but not limited to dismissal or revocation of the degree.

Statement of Original Work and Signature

I have read, understood, and abided by Capella University's Academic Honesty Policy (3.01.01) and Research Misconduct Policy (3.03.06), including Policy Statements, Rationale, and Definitions.

I attest that this dissertation or capstone project is my own work. Where I have used the ideas or words of others, I have paraphrased, summarized, or used direct quotes following the guidelines set forth in the APA *Publication Manual*.

Learner name
and date Halle A Horvath, December 4, 2017