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Sales Application Engineer Turnover Intentions: An Exploration of Education, Age and Job Tenure Through the Met-Expectations Perspective

William Kelley

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Through the Met-Expectations Perspective

by

William Kelley

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"Sales Application Engineer Turnover Intentions:
An Exploration of Education, Age and Job Tenure
Through the Met-Expectations Perspective "

a dissertation by William Kelley

____

Emily Martinez-Vogt, Ph.D.
Assistant Professor
Nathan M. Bisk College of Business
Major Advisor

____

Theodore Richardson, Ed.D.
Professor and Dean
Nathan M. Bisk College of Business

____

Christian Sonnenbeg, Ph.D.
Associate Professor
Nathan M. Bisk College of Business

____

Kenneth Pike, Ph.D.
Assistant Professor
School of Arts and Communication

Abstract

Title: Sales Application Engineer Turnover Intentions: An Exploration of Education, Age and Job Tenure Through the Met-Expectations Perspective.

Author: William Kelley

Advisor: Emily Martinez-Vogt, Ph.D.

Keywords: turnover, engineer turnover, job expectations, met expectations, job satisfaction, education level, competitive advantage

Both individually and in combination, globalization and the increasing use of information technology are creating unrelenting competitive pressures on organizations once protected by distance (Porter, 1999; Porter & Millar, 1985; Narus & Anderson, 1985; Boyle, 1996). These once-protected firms, historically operating in competitive landscapes limited to local firms, now compete with organizations located across state lines and oceans. In order to compete and survive, firms must adjust to the new competitive dynamics wrought by these changes (Teece, 2000).

As knowledge has been identified as one of the most important sources of competitive advantage (Drucker, 1999) and profitability (Grant, 1991), this research explored the turnover intentions of a specific knowledge worker employed in the American pump manufacturing and distribution business segments, the application engineer. Through the theoretical lens of met-expectations, the study sought to understand how career and job expectations informed turnover intentions, whether expectations changed with age and what factors, if any, might mitigate turnover intentions. Through a phenomenological research method designed to understand a participant's lived experience, application engineer job and career expectations as well as turnover intentions were explored through one-one-one interviews.

Findings supported the met-expectations theory as a determinant of engineer turnover intentions. When expectations were unmet, expectations primarily centered on the substantial use of engineering knowledge in daily work tasks, ninety-five percent of participants intended to leave the career field for one that met those expectations. Of the total sample of 39, this placed nearly half of all participants at substantial risk of leaving the career and the employer. When expectations were met, expectations that the career is a technical sales position rather than an engineering position, seventy-two percent intended to remain in the career until retirement. When allowed to suggest changes in job duties and work environment (remote work), this group's turnover intentions were nearly eliminated.

The study identified four distinct groups (cohorts), each with unique turnover mechanisms and intents. These groups broadly segmented between

degreed engineers and those without an engineering degree. The propensity for degreed engineers to turnover was driven by whether they entered the engineering career field with a specific desire to design products or manufacturing systems. While most degreed engineer participants attended engineering school and entered the engineering field with a specific desire to design, not all degreed engineers held this expectation. For those that did, the intent to leave the career was nearly absolute and irreversible. For application engineers without engineering degrees, turnover intentions were low, weak, reversible and tended to be driven by organizational factors rather than job factors.

This study identified possible retention strategies as well as explored the centrality of a stable application engineer workforce in the pursuit of competitive advantage. It, then, discussed the implication of the research, elaborated on the study's limitation and recommended areas for further investigation.

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Dedication

This is dedicated to all those non-traditional adult learners who, despite a lack of opportunity to follow traditional education paths, doggedly pursue knowledge under less than ideal conditions. To the single parent making pancakes for the kids while reading one last chapter before going to work. To the adult learner who doesn't allow the challenges in their rear view mirror dictate their enthusiasm and faith that effort, even when failures are ever present, leads to good things. To the active duty military folks who, while deployed to combat zones, continue their education with poor internet connections and instructors ten time zones away. And to the veterans that take the leap to full time college students armed with little more than the self-confidence and discipline that only the military can instill in a twenty something.

Chapter One

Introduction

Overview

Economic globalization has increased competitive pressures such that competition is no longer limited to those firms residing in the same concentrated areas of regionally isolated markets (Bang & Markeset, 2012; Narus & Anderson, 1986). This inter-firm competitive dynamic extends to organizational engineering departments where engineers providing employers with knowledge-based competitive advantages now compete with increasing numbers of engineers employed by firms previously locked out of markets too distant to pursue (Bailey, 2008). Due to advances in information technology and logistics, supplier relationships now transcend geographic boundaries, requiring suppliers once protected by oceans and inter-state distances to become more competitive (Cheraghi, Dadashzadeh & Subramanian, 2011; Porter, 1986). Sources of this increased competitiveness (competitive advantage) reside in technology, innovation, organizational structure, and a firm's human resources (Wang, Lin & Chu, 2011; Barney, 1995), which includes the knowledge possessed by the firm's employees (Grant, 1997; Spender, 1993; Teece, 2000) and the employees themselves (Campbell, Coff & Kryscynski, 2012; Holtom et. al, 2005; Podsakoff, LePine & LePine, 2007). Firms involved in the supplier side of this competitive equation that fail to implement policies focusing on managing their knowledge-based advantages will be less competitive (Teece, 2000; Boisot, 2002).

Managing these knowledge-based advantages occurs within two contexts (1) managing the information itself and (2) managing the possessor of the knowledge, the knowledge worker (Horwitz, Teng Heng & Quazi, 2006). The former lies within the information technology and general management functions in the form of hardware and software solutions (Earl, 2001) while the later resides with the human resource functions of recruitment, retention, and motivation of knowledge workers (Horwitz et al., 2006). The knowledge worker describes individuals who carry knowledge as a powerful resource, which they, rather than the organization, own (Drucker, 1989). They have expertise and high levels of education or experience and the primary purpose of their jobs involves the creation and application of knowledge (Nelson & McCann, 2010). Whereas production equipment was the most valuable asset of the 20th century, knowledge workers and their productivity are the most valuable 21st century organizational asset (Drucker, 1999) and is the most important resource for company profitability (Grant, 1991). Retention of this key organizational member will be critical to organizational well-being (Lee & Maurer, 1997).

Engineers are considered knowledge workers (Lee & Maurer, 1997; Jones & Chung, 2006; Lord & Farrington, 2006; Drucker, 1977) that fall into numerous broad categories segmented by job tasks. Design engineer, production engineer, service engineer, sales engineer, project engineer and sales application engineer (hereafter referred to as application engineer) are common roles in the pump manufacturing and distribution field, this study's industry focus. The application engineer (AE) role, the specific career field of this research, is found across numerous industries ranging from innovative sectors like information technology, software and aviation to legacy industries including valves, electric motors, engines, and pumps.

The AE role, typically located within the sales department, is often the primary customer-facing position in product spaces characterized as high tech or possessing complex engineered designs. Responsible for product selections frequently installed in critical and high-value business processes (oil refinery, data warehousing, pharmaceutical plant, Department of Defense systems…), AE errors result in project cost over-runs, negative profit margins, injury, or death.

In low complexity product environments, the AE role will be referred to as inside sales or customer service, roles identified as providing a competitive advantage in industrial product sales fields (Boyle, 1996), which includes the pump industry, where the technical knowledge possessed by the inside sales force contributes more to customer satisfaction than the services provided by the outside sales force (Boyle, 1996). This advantage extends to inter-firm competition where inside sales functions providing greater customer focus and responsiveness than competing-firm inside sales' functions results in higher relative levels of customer satisfaction (Boyle, 1996). In turn, increased satisfaction corresponds to increased purchase intentions (Maxham, 2001; Williams & Naumann, 2011). It follows that the retention of application engineers should be a key goal of pump manufacturers and distributors.

However, as the AE role does not involve product design or the frequent use of complex engineering principles, the job title's use of the term engineer may cause confusion as to job tasks, potentially leading many engineers to find the job does not meet expectations, resulting in high turnover intentions and turnover rates.

An application engineer's role is not to design products from inception to finished product. Rather, an AE acts as the informational junction point where customer engineering requirements are matched with supplier engineering capabilities with the AE selecting and pricing the appropriate products. The application engineer's focus is more on the customer's process, known as the application, than product design. Hence, the title, "Application Engineer".

The role can be routine and repetitive with AE's exposed to a limited number of non-routine customer inquiries. Before the advent of sophisticated engineering software, all calculations were done by hand, lending an element of engineering to the job. Today, software has replaced manual engineering calculations. AE's spend their time entering data into a desktop PC, thereby removing the few engineering remnants from the AE's daily duties. The replacement of manual calculations with computer data entry deskills this engineering role and creates conditions of over-education, which has been shown to decrease job satisfaction and increase turnover (Baxter, 1990; Alba-Ramirez, 1993; Fleming & Kler, 2008) due to boredom (Zakay, 2014) and possibly a general sense that the role of application engineer does not meet a degreed engineer's vision as to what working as an engineer entails, expectations formed during the high school years (NAE, 2018; Pearson & Miller, 2012).

The AE role does not require an engineering degree, neither by law, regulation, or industry standard. Degreed engineers are preferred as the learning curve required to apply engineering concepts to customer problems is shallower for degreed engineers than the curve of those lacking an engineering degree. Unlike design engineering roles, which require substantial knowledge of engineering concepts, application engineers can learn on the job. While most AE's have engineering undergraduate degrees, many have technical undergraduate degrees, non-technical degrees and a few will have substituted years of experience for a college degree.

The AE role is often filled by recent college graduates with few older AE's remaining in the career field . No published quantitative data segregating AE's by generation or degree type exists but the demographics of those working within the field suggests a common industry turnover dynamic exists. It is possible the disconnect between the rigors of an undergraduate engineering degree and the real-world soft engineering requirements of the AE position lead to job dissatisfaction within the young degreed-engineer cohort. Those without an engineering degree may not experience the same educational disconnect.

Study Background

Research covering engineer and knowledge worker turnover / turnover intentions exists within broad contexts such as job satisfaction and organizational commitment (Bigliardi, Petroni & Ivo Dormio, 2005; Hofaidhllaoui & Chhinzer, 2014; Mulla, Kelkar, Agarwal, Singh & Nalin, 2013). Others identify correlations between supervisor leadership styles (Sherman, 1989), marital status (Post, DiTomaso, Farris & Cordero, 2009), gender (Fouad, Chang, Wan & Singh, 2017), and task characteristics (Igbaria & Siegel, 1992) to turnover and turnover intentions. Fewer studies focus on job satisfaction and turnover within specific engineering fields such as civil engineering (Lingard, 2003), construction engineering (Sun, 2011), software engineers (Ferratt, Agarwal, Brown & Moore, 2005; Wickramasinghe, 2010; Eckhardt, Laumer, Maier & Weitzel, 2016) and aerospace engineers (Applebaum, Wunderlich, Greenstone & Grenier, 2003). Importantly, quantitative research exists showing engineers depart the engineering field at higher rates than other fields requiring a college education (Kennedy, 2009), suggesting cross-discipline turnover dynamics exist.

Employee turnover can be classified as functional or dysfunctional. Functional turnover is viewed positively as unwanted and unproductive employees depart the employer (Abelson & Baysinger, 1984), including moderate levels of knowledge worker turnover (Guidice, Thompson-Heames & Wang, 2009).

Alternatively, dysfunctional turnover occurs when employees the firm would rather retain voluntarily depart the organization (Abelson & Baysinger, 1984). Some research extends the above definitions of turnover from the individual employee to the firm level, suggesting there is an optimal level of turnover in any organization, defined as an optimal point where the costs associated with retaining employees and the costs associated with turnover are optimally balanced with most organizations finding the optimal point of aggregated turnover is greater than zero (no turnover) (Abelson & Bassinger, 1984). In other words, low rates of turnover are better than no turnover.

Human and social capital theories, as individual constructs, suggest the loss of valuable employees reduces organizational performance (Park & Shaw, 2013). Research also demonstrates that both theories, when simultaneously applied to competitive analysis, provide a more powerful source of long term sustainable competitive advantage than each theory applied individually (Holtom, Mitchell, Lee & Inderrieden, 2005; Pfeffer, 1995). While social capital theory focuses on the performance benefits to be derived from the social fabric that forms due to the interaction of employees in the form of shared goals and trust (Leana & van Buren, 1999), human capital theory focuses on individual employees and proposes that more experienced employees perform better because they accumulate the knowledge and skills (i.e., human capital) necessary to perform the job (Strober, 1990).

This accumulated knowledge and skill corresponds to a key source of sustained competitive advantage as every firm's history of knowledge accumulation is distinct (path dependency), ensuring competitors cannot easily replicate the stock of human capital, making any knowledge advantage an inimitable resource (Shaw, Park & Kim, 2013; Barney, 1991).

Estimates of dysfunctional turnover rates vary widely. Aggregated Department of Labor statistics estimate national dysfunctional turnover rates for 2019 were 2.3% (total voluntary quits as percentage of total workforce) with federal government workers demonstrating the lowest rates (.6%) and food service workers the highest at five percent (U.S. Department of Labor, 2019). Park and Shaw's 2013 meta-analysis of 104 peer reviewed articles measuring turnover rates across various sectors revealed a dysfunctional turnover rate range of 1% to 32% (n=309,245) (Park & Shaw, 2013).

In relation to this study, the federally reported 2019 dysfunctional turnover rate in the industrial durable goods manufacturing sector stood at 1.4% and the industrial wholesale trade category averaged 1.35% (U.S. Department of Labor, 2019). Knowledge worker dysfunctional turnover rates vary widely, from 20% using the term knowledge worker generally (Shankar & Ghosh, 2013) to 6% for titled engineers working for the federal government (Iammartino et al., 2016) and

15% within the aerospace engineer cohort (Applebaum, 2013). Of particular interest is a substantial decline in the number of degreed engineers remaining in the career field as they age. Three years after graduation, roughly 30% of degreed engineers no longer work as engineers with the percentage continually increasing thereafter (Frehill, 2010).

Statement of the Problem

Firms are knowledge-integrating institutions where the firm's primary task, in an effort to produce goods and services, is integrating and applying the specialized and tacit knowledge of multiple individuals (Grant, 1996). Of particular concern, in the pursuit of competitive advantage, is a firm's ability to identify, obtain, develop and retain imperfectly imitable resources (impossible to perfectly imitate) (Barney, Wright & Ketchen, 2001). Tacit knowledge, a key element of an AE's knowledge base, has been identified as one such resource (McAulay, Russell & Sims, 1997; Teece, Pisano & Shuen, 1997; Lubit, 2001; Ambrosini & Bowman, 2001).

An application engineer's version of tacit knowledge follows Sternberg's view that tacit knowledge is personal knowledge acquired on the job (Sternberg, 1994), Nonaka's position that tacit knowledge is context specific, rooted in a craft, profession or product market (Nonaka, 1994) and Ambrosini & Bowman's characterization of knowledge learned explicitly but never recorded, either due to a lack of organizational fiat, suitable recording medium (where and how it is recorded) or realization it might be useful later (Ambrosini & Bowman, 2001).

More than eighty percent of employee knowledge is gained through mechanisms other than formal classroom and structured training programs (Johnson, Blackman & Buick, 2018; Carleton, 2011). Similarly, over the course of a career, much of the knowledge an AE acquires is learned outside of formal training. Some AE knowledge is explicit in the form of product manuals, software user manuals and supplier training materials, all stored in a variety of mediums: three ring binders, within software solutions, notes posted on an office wall and informal documents stored on a computer. However, much of the knowledge produced in the engineering field is hard or even impossible to make fully explicit (Nightingale, 2009) and is difficult to extract and transfer inside the organization (Liu, Jiang & Song, 2014) with measures of organizational tacit knowledge estimated as high as ninety percent (Smith, 2001).

Acting as the informational junction point between the employer, sub-vendors and the customer, AE’s develop knowledge-intense relationships formed for the sole purpose of solving customer problems. As an AE is typically assigned to a small group of customers, each AE becomes the sole source of knowledge as to how the organization serves those customers, thereby ensuring only one individual understands the complete scope of a customer’s needs, preferences, idiosyncrasies and history. This division of labor and the dependence upon tacit knowledge to manage relationships creates a risk that threatens firm performance and competitive positioning when an AE leaves, either voluntarily or involuntarily.

The loss of a knowledgeable application engineer is compounded by the documented fact that the U.S. engineering career field operates under conditions of undersupply of U.S. born engineering school graduates in relation to industry needs (Singh, Zhang, Wan & Fouad, 2018) with post 9/11 immigration restrictions reducing the total number of engineers available for hire (Hewlett et al., 2008). The long term trend of manufacturing's relocation to low cost overseas locations has relieved some of the engineer labor force pressures (Bidanda, Arisoy & Shuman, 2006) but the continuing retirement of baby-boomers creates a condition whereby the pipeline of new engineers is insufficient to replace those retiring (National Society of Professional Engineers, 2013).

While the supply and demand curve varies across disciplines with software and computer engineers in critically short supply (ABET, 2020), the engineering discipline most commonly filling the ranks of application engineers, the mechanical engineer, also labors under conditions of undersupply as demonstrated by the increasing pay rates required to hire mechanical engineers at 3% - 5% yearly between 2013 and 2016 (Kasowatz, 2018) and Generation Z's demonstrated tendency to apply for software engineering positions (19% of Gen Z. applications submitted to all job postings) more than other engineering jobs, including mechanical engineering (2% of all Gen Z submitted applications) (Stansell, 2019).

The differential between recent graduates entering the career field and those retiring is exacerbated by the high rate of engineers, narrowly defined as an individual contributor (non-management) directly responsible for design (Tremblay, Wils & Proulx, 2002), departing the field, either as a vertical organizational move into management or departing the field all together. Forty nine percent (n = 900) of surveyed engineers in engineering roles (not management) express a desire to move into positions other than purely technical (Tremblay, Wils & Proulx, 2002) while 60% of degreed engineers that graduated between 1986 and 1993 have moved out of the engineering field. Fifteen percent moved into management positions while the remaining found employment in other sectors or left the work force (e.g., stay-at-home parent) (NAE, 2018).

Organizations employing application engineers may face a multifaceted challenge different than firms employing engineers but not application engineers. Organizations employing AE's not only face the aforementioned challenges associated with conditions of engineer undersupply and the desire of some engineers to move into careers less centered on design work, but also the possibility the AE career operates under conditions of over-education and deskilling. A state where worker skills exceed job requirements, over-education has been shown to lead to low job satisfaction and increased turnover (Alba-Ramírez, 1993). Prior to the advent of desktop workstations, AE's undertook engineering calculations with pen and paper, requiring engineering knowledge to complete a task. Today, AE's enter information into sophisticated engineering software that accomplishes the same tasks in a fraction of the time. The introduction of IT solutions to increase worker productivity also creates conditions of worker boredom, lower job satisfaction and increased turnover (Baxter, 1990; Kass, Vodanovich & Callender, 2001; Zakay, 2014; Velasco, 2017).

The human resource function must not only replace engineers that depart due to factors common to the engineering field in general but also replace engineers that quit due to factors specific to the application engineer field. The recruitment effort is hindered by engineering graduates' preferences to work with either consulting firms (Smerdon, 1996) or manufacturers involved in innovative technologies like those produced by Tesla, Boeing and Space X (Universum, 2020). By comparison, the pump industry, while an "integral part of all modern economic and social development" (Karassik & McGuire, 1998, p. vii), better fits the definition of a mature industry (low demand growth) (Frost, 1983) with low annual growth rates (2.5%) (GMI, 2019) and reliance on productivity innovation rather than product innovation (Thietart & Reyes, 1983).

Small firms are additionally constrained by their ability to recruit and retain employees relative to larger firms (Heneman, Tansky & Camp, 2006) particularly given that they often lose their employees to larger firms (Barber, 2006). The small business challenge is amplified at the college recruiting level where students show a preference for large firms over small with large firms more likely to exhibit at college career fairs (Barber, Wesson, Roberson & Taylor, 1999).

To summarize, while employee turnover is a long standing concern with employers, globalization has created competitive pressures not prevalent during the last and early 21st century. Under pre-globalization conditions, regional pump manufacturers and distributors were protected by distance, resulting in a stable competitive landscape. Now, at little cost, customers can reach across oceans, country borders and state lines to increase competition among suppliers. Given the status of pumps as a mature product and industry, with little to no competitive advantage remaining to be gained through design improvements, a stable AE workforce and the tacit knowledge they possess is one remaining untapped source of competitive advantage.

Purpose of the Research

The purpose of this qualitative study was to examine the factors contributing to turnover intentions and job satisfaction of sales application engineers employed in the pump manufacturing and distribution business segments. The study explored whether application engineers with different education levels and degree types hold different job expectations and turnover intentions and whether those expectations change with age and job tenure. Understanding the job expectations of AE's with and without engineering degrees will guide human resource practitioners as to retention practices developed to retain degreed engineers while providing a better understanding as to whether an application engineering department staffed only by degreed engineers is critical. Study participants consisted of application engineers employed in the pump manufacturing and distribution business segments without regard to age, gender or ethnicity. Target firms employing the application engineers ranged from small family owned firms to large organizations owned either by private equity firms or that operate as publicly traded companies.

Application engineer job expectations were explored using in-depth interviews conducted one-on-one between individual participants and the researcher. The goal was to identify common themes as to why application engineers chose the career, how those reasons informed their job expectations post-graduation and post-hire and whether previously formed job expectations change with age and longer job tenure.

Research Questions

This research study examined the factors contributing to sales application engineer job satisfaction and turnover intentions in the pump manufacturing and distribution business segment. The four research questions that guided the study were:

> **RQ1**: In what way does the type of undergraduate degree held by application engineers impact job turnover intentions and/or job satisfaction?

RQ2: What aspects of an application engineer's workplace role and responsibilities fail to meet employed engineer expectations?

RQ2b: How can failed expectations impact job performance, motivation, and employee commitment?

RQ3: As application engineers age and their job tenure increases, how do job expectations change?

Significance of the Study

As a key organizational member in a firm's efforts to outcompete other firms, understanding the application engineers' motivation to quit is critical. Not only are firms concerned with the financial costs of employee turnover, with direct costs averaging about $14,000 per employee (O'Connell & Kung, 2007) and both direct and indirect costs estimated at nearly twice the departing employee's wage (Tziner & Birati, 1996) but also the loss of intellectual capital that accompanies an engineer's departure from the firm (Hofaidhllaoui & Chinzer, 2014).

To date, dominant research trends on engineer turnover have focused on the career field as if engineers and engineering positions are homogeneous. Most studies identified in this research project refer to engineers in general terms without specifying degree type (Bigliardi, Petroni & Ivo Dormio, 2005; Igbaria & Siegel, 1992; Mulla, Kelkar, Agarwal, Singh & Sen, 2013; Sherman, 1986; Hofaidhllaoui & Chhinzer, 2014) and are quantitative in nature, all identifying correlations between various job and organizational characteristics with turnover but none comprehensively exploring the underlying causes of job dissatisfaction and turnover.

While research finds that engineers exhibit higher rates of voluntary turnover than other careers requiring a bachelor's degree (Kennedy, 2009), there is no published research seeking to understand why application engineers voluntarily quit an organization or leave the career nor has the theoretical framework of met-expectations been used to understand engineer turnover intentions within any engineering career field. Determining whether engineers, particularly young degreed engineers, find the field of application engineer fits their perception of what an engineer job should entail will provide human resource practitioners the knowledge necessary to develop retention and recruitment policies better tailored to the unique engineering role of the application engineer.

Definition of Key Terms

Application: A production or manufacturing process located within a customer's facility. An exchange between a customer and vendor will revolve around the application characteristics and the desired outcome. For example, an application may be transferring acid from one point of the plant to another, extracting irrigation water from a well or mixing two liquids to produce a new compound.

Degreed Engineer: an employee in possession of an undergraduate engineering degree that qualifies them to test for the Professional Engineer license. A Professional Engineer (PE) is an engineer licensed to practice engineering by a state board of registration. Common undergraduate degree programs qualified to take the exam are mechanical engineering, electrical engineering, aerospace/aeronautical engineering, civil engineering, chemical engineering and industrial engineering (National Society of Professional Engineers, n.d.).

Met-Expectations (Theory of): A motivation theory based upon Vroom's expectancy theory. Vroom posited that employee motivation is a causal link between effort and performance and that performance leads to a worthy reward. In turn, the reward will satisfy an important need and is worthy of the effort (Vroom, 1964; Van Eerde & Thierry, 1996). Met-expectations proposes that the more congruent an individual's expectations are with reality once on the job, the greater the individual's satisfaction. The greater the misalignment between expectations and reality, the higher the propensity to exhibit withdrawal behaviors. Met-expectations goes beyond the binary choice of satisfied or dissatisfied by providing an explanation of satisfaction (Porter & Steers, 1973).

Over-education: the possession by workers of greater educational skills than their jobs require (underutilization of workers' education) (Fleming & Kler, 2008; Alba-Ramírez, 1993).

Sales Application Engineer (AE): Commonly referred to as application engineer, the AE is an inside sales role residing within technologically complex or highly engineered product spaces. An AE is the information junction point where customer requirements are matched with product capabilities. For purposes of this study, the AE works in the pump manufacturing and distribution space.

Tacit knowledge: knowledge that is unarticulated and tied to the senses, movement skills, physical experiences, intuition, or implicit rules of thumb. Tacit knowledge differs from "explicit knowledge" that is uttered and captured in drawings and writing (Gascoigne & Thornton, 2014).

Turnover Intentions (intent to turnover): the final step in a cognitive process whereby individuals withdraw from their positions and organizations. It is a predictor of actual turnover (Griffeth, Hom & Gaertner, 2000).

Design engineering: In this paper, the term design engineering relates to either a specific engineering job title (a design engineer), a set of job tasks requiring the use of engineering principles to develop a product meant for commercialization or as a short-hand description intended to capture a generalized description of any titled engineering position requiring the substantial knowledge and use of engineering principles to successfully complete job tasks. For example, manufacturing engineering would be captured by this term.

Outline of the Remaining Chapters

Chapter two is a literature review related to application engineer turnover, its' consequences and competitive advantages to be found by reducing turnover. Chapter three introduces the proposed study's methodology including design, methods, population and sample, data collection procedures and ethical considerations. Chapter four discusses and summarizes the research project's findings while chapter five broadly discusses the project's findings and provides recommendations for further study and practitioner application of the research project's findings.

Chapter Two

Literature Review

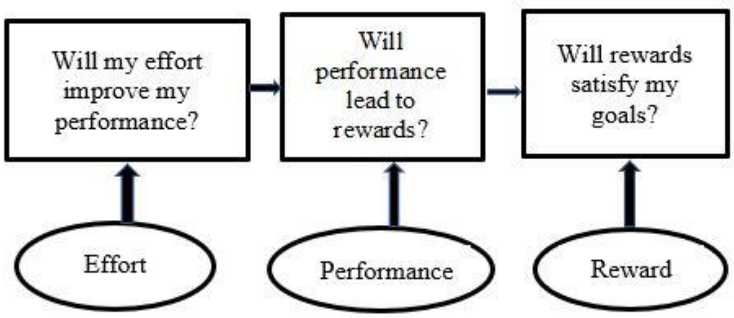
Overview

The purpose of this chapter is to provide an overview of key theories, frameworks and themes relevant to understanding the turnover intentions of sales application engineers in the industrial pump manufacturing and distribution business spaces. Engineers expect their jobs to entail challenging and interesting tasks (Igbaria & Siegel, 1992), that are varied and involve problem solving (Franca, da Silva, Fabio & Sharp, 2020) while providing opportunities for life-long learning (Vassos, & Smith, 2001). For this study, the theory of met-expectations was utilized to explore application engineer perceptions as to how the job aligns with their expectations of an engineer's duties and how those expectations impact turnover intentions. Met-expectations (Porter & Steers, 1973) proposes that the more congruent an individual's expectations are with reality once on the job, the greater the individual's satisfaction. The greater the misalignment between expectations and reality, the higher the propensity to exhibit withdrawal behaviors (Porter & Steers, 1973). This chapter introduces and discusses the theory of met-expectations as well as other relevant theories that explore connected topics pertaining to tacit knowledge, the knowledge view of the firm, the impact of over-education on job satisfaction and turnover, and sales application engineers as a source of competitive advantage.

Relevant Frameworks, Theories and Models

Theoretical Framework: Theory of Met-Expectations

Met-expectations is a motivation theory based upon Vroom's expectancy theory (Porter & Steers, 1973). Vroom (Vroom, 1964) examined motivation from the perspective of why people choose a particular action or behavior (McMenemy & Lee, 2007) and posited that motivation is a causal link between effort and performance and that performance leads to a worthy reward. In turn, the reward will satisfy an important need and is worthy of the effort (Vroom, 1964; Van Eerde & Thierry, 1996). An illustration of this process follows.



(Barg, Ruparathna, Mendis & Hewage, 2014)

Expectancy theory (Vroom, 1964) asserts that human choice and decisions, while not always leading to optimal outcomes, are guided by beliefs as to what is optimal at the time (Vroom, 1964). Employees are rational people whose beliefs, perceptions, and probability estimates influence their behaviors (De Simone, 2015).

Vroom's (Vroom, 1964) contribution was not to establish a link between satisfaction and withdrawal behaviors. This link was previously established through studies investigating correlations between organizational satisfaction and withdrawal behaviors and turnover (Vroom, 1964; Weitz & Nuckols, 1953; Webb & Hollander, 1956; Sagi, Olmstead & Atelsek, 1955). Nor was Vroom the first to establish a cognitive theory of motivation using expectancies and valences as key variables. Lewin (1938) and Towman (1959) had already formulated expectancy theories (Behling & Starke, 1973; Vroom, 1964) under general conditions (Vroom, 1964). Vroom was the first to present a systematic formulation of expectancy theory developed specifically for work situations (Porter, Bigley & Steers, 2003). Vroom's model did not provide specific suggestions as to what motivates employees. Expectancy theory is more concerned with motivation's cognitive antecedents and how they relate to each other (De Simone, 2015).

Porter and Steers (P&S) considered Vroom's (Vroom, 1964) explanation of the withdrawal process insufficient, by itself, to understand turnover (Porter & Steers, 1973). P&S extended Vroom's turnover model by developing the theory of met-expectations as an explanation of worker dissatisfaction and its' tendency to lead to turnover. "Knowing that an employee is dissatisfied and about to leave does not help us determine what must be changed in an effort to retain him." (Porter & Steers, 1973, p. 154).

Met-expectations (Porter & Steers, 1973) proposes that the more congruent an individual's expectations are with reality once on the job, the greater the individual's satisfaction . The greater the misalignment between expectations and reality, the higher the propensity to exhibit withdrawal behaviors (Porter & Steers, 1973). Met-expectations goes beyond the binary choice of satisfied or dissatisfied by providing an explanation of satisfaction. The decision to withdraw may be considered a process of balancing received and potential rewards with desired expectations (Porter & Steers, 1973).

Porter and Steers developed a hypothetical model demonstrating the interaction of expectations and rewards as they relate to withdrawal decisions. This basic model attempted to illustrate that employees with accurate expectations believe more rewards are within reach (illustration on following page - group E_2 views the total rewards R_2 and R_1 yet to be realized but attainable) than those employees who joined the company with unrealistic expectations (E_1 only has one reward R_1 remaining). For these employees, the rewards (not necessarily monetary) are too far out of reach given the reality that exists. From this model, P&S offered three recommendations to practitioners, increase the total amount of available rewards to improve the odds that expectations are exceeded, utilize cafeteria-style compensation plans and accurately communicate job and organizational characteristics (Porter & Steers, 1973). Porter and Steers' (Porter & Steers, 1973) graphic illustration follows in figure one.

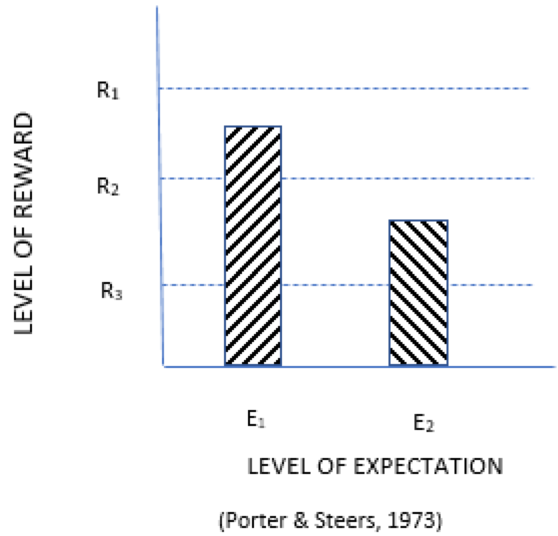


Figure 1. Porter & Steers conceptual expectation's model

Subsequent research found support for the role of job expectations on employee retention (Griffeth, Hom & Gaertner, 2000; Hom, Griffeth, Palich & Bracker, 1999; Bridges, Johnston & Sager, 2007; Wanous et al., 1992; Yang, Johnson & Niven, 2018) while some recommended caution, without completely discarding the theory, due to differences in how researchers measured met-expectations and possible statistical measurement errors overstating the correlation between job satisfaction and turnover intentions (Irving & Meyer, 1995).

Met-expectations is a theoretical tool formulated to predict and explain employee withdrawal behaviors. Not only is it descriptive (job does not meet my expectations) but also prescriptive in its' ability to create a discussion framework (What can be done to ensure a job meets expectations?) capable of moderating employee withdrawal behavior through job, task or work environment modification. It allows the practitioner to identify and solve potential problems early in the withdrawal process rather than later, when withdrawal behaviors and attitudes are more difficult to moderate.

Tacit Knowledge

In this research project, tacit knowledge (TK) literature supports the claim that AE turnover harms organizational performance in a general sense and competitive advantage specifically. Through the competitive advantage literature, tacit knowledge places the AE in a critical position to either gain or lose competitive advantage.

In the field of knowledge management, the concept of tacit knowledge refers to knowledge that is gained through experience, is context specific and resides both within individuals (Fernie et al., 2003), groups and societies (Taylor, 2007). It is difficult to express and formalize, is intuitive and cannot be fully codified (Lam, 2000) or has yet to be codified or explicated (Spender, 1996). It can be explained more easily through verbal and social interactions than through the written word (Polanyi, 2009), is subconsciously understood (Droege & Hoobler, 2003), unobservable by competitors (McAulay, Russell & Sims, 1997), is task-related knowledge applied to specific contexts (Pereira et al., 2016) and has been described as knowing more than we can tell (Gascoigne & Thornton, 2013; Polanyi, 1958). Formalized knowledge management practices attempt to capture employee tacit knowledge by codifying (making explicit) the tacit knowledge for the benefit of the organization (Fernie et al., 2013).

As a general concept, knowledge has been identified as a source of competitive advantage (Eisenhardt & Martin, 2000; Teece, 1998; Kogut & Zander, 1992; Halawi, Aronson & McCarthy, 2005) and is the fundamental resource of revenue (Spender & Grant, 1996; Grant, 1991). As a specific form of knowledge, tacit knowledge has been cited as a source of competitive advantage in general business contexts (McAulay et al., 1997; Lubit, 2001), in professional sports organizations (Berman, Down & Hill, 2002; Yazdani & Kausar, 2013) and online education (Sriwidadi, Prabowo & Riantini, 2018). Tacit knowledge has been found to explain individual differences in management effectiveness (Wagner & Sternberg, 1991), leadership effectiveness (Hedlund et al., 2003), team performance in technology implementation (Edmonson et al., 2003), customer loyalty (Pereira et al., 2016), and has been used to provide a partial explanation as to why measures of academic performance (IQ tests and school achievement) only account for small amounts of the variance (+/-4%) in occupational performance (Wagner, 1987).

The current status of tacit knowledge research continues to be ambiguous, possessing numerous meanings, making uniform operationalization difficult (Taylor, 2007). Tacit knowledge has been placed in numerous categories with no single agreed-upon set of conceptualizations guiding academia's attempt to locate a particular study within a widely accepted framework. Two broad categories, with numerous sub-categories, are collective and individual tacit knowledge (Taylor, 2007; Ribeiro, 2012). Collective tacit knowledge exists broadly within a society or groups where communities of practice share practical knowledge such that an organizational mind is created without having the knowledge explained or codified (Spender, 1996). Individual tacit knowledge is frequently placed within two categories. The first, technical tacit knowledge, relates to an individual's skills and know-how learned through experience and is unlikely to be made explicit through codified means but, rather; is transferred through apprenticeships, mentorship, and observation. The second, cognitive knowledge, describes the mental models used to accomplish tasks that are so ingrained that the knowledge is taken for granted, leading individuals to be unfamiliar with why they take certain actions (Taylor, 2007).

Application engineer tacit knowledge falls into both technical and cognitive areas. Over the course of a career, an AE learns, often through trial and error, what solutions have and have not solved customer problems and how to avoid future failures. They learn customer's unwritten preferences and the internal organizational weaknesses that must be overcome during project execution. This knowledge is rarely introduced into technical manuals and best-practice guides are non-existent. Everything learned remains within the application engineer's brain with little incentive or perceived need to share what has been learned.

Despite difficulty in identifying one majority-accepted definition of tacit knowledge, its' numerous iterations tend towards two concepts. One is easily explained knowledge that has not been written down (shared) in a manner others can easily access and understand, such as how to find a specific file on a computer network. The second is knowledge that is too complex to effectively communicate via traditional knowledge transfer methods, such as the written word or videos. In this second category exists, for example, the manner in which employees determine when bureaucratic complexities may hinder an upcoming project and how best to overcome those complexities. AE tacit knowledge falls into both categories, that which they do not think to share despite the knowledge being uncomplicated and that which is too complex to make explicit via writing, even if the AE believes it to be important.

Turnover, Turnover Intentions and Engineer Turnover

Turnover – General

Employee turnover, the voluntary severance of employment ties, has attracted the attention of both practitioners and scholars for a century (Hom, Lee, Shaw & Hausknecht, 2017; Hancock, Allen, Bosco, McDaniel & Pierce, 2013) with the first empirical turnover study published in 1925 (Bills, 1925; Hom et al., 2017). Early turnover models linked ease of movement to another job and desire to turnover (March & Simon, 1958; Gerhart, 1990) and "emotionally maladjusted workers" (Judge, Weiss, Kammeyer-Mueller & Hulin, 2017, p. 359) measured by

Weitz's "gripe index" (Weitz, 1952, p. 202). Later research focused on attitudinal correlations such as workplace conditions (Hulin, 1966; Hulin, 1968; Hellriegel & White, 1973; Hon et al., 2017), self-actualization (Schaffer, 1953; McGregor, 1957), job expectations (Porter & Steers, 1973), supervisor characteristics (Fleishman & Harris, 1962; Ley, 1966) organizational structure (Porter & Lawler, 1965), job equity (Griffeth & Gaertner, 2001), psychological contract (Salin & Notelaers, 2017) and job embeddedness (Mitchell, Holtom, Lee, Sablynski & Erez, 2001*)*. These models are often referred to as content models of turnover as they limit their focus to the factors that cause employees to quit (Zimmerman, Swider & Boswell, 2019).

Prior to Porter and Steers' (1973) challenge to "more closely examine the withdrawal process" (Porter & Steers, 1973, p. 173), research focused on measuring the impact of various independent variables on employee turnover rather than investigate the process employees undertake when making the decision to quit (Anderson & Milkovich, 1980; Mobley, 1977). March & Simon's 1958 process model represented the first process model mapping how employees decide whether to continue participation with the firm or leave. Based on the evaluation of inducements provided versus employee contributions (March & Simon, 1958), the models' use in empirical studies remained infrequent and did not make a significant mark on the period's turnover literature (Anderson & Milkovich, 1980).

Numerous process models followed Porter and Steers' call (Porter & Steers, 1973) to better understand the withdrawal process. Mobley was the first to respond to Porter and Steers' call by developing a heuristic model referred to as the intermediate linkages model (Moberly, 1977) mapping the cognitive stages that occur during an employee's decision-making process once dissatisfaction was established (Sheridan & Abelson, 1983). Through multiple iterations, Moberly refined and extended his initial heuristic model into a conceptual model consisting of two main effects of satisfaction, expected utility of the current role as relates to expected utility of alternatives and job tension associated with the work environment (Mobley, Griffeth, Hand & Meglino, 1979). Mobley's work has been characterized as "doing more than any turnover theory to further the understanding of the withdrawal process" (Hom & Griffeth, 1995, p. 57).

Sheridan and Abelson (1983) criticized Mobley's model as being an inaccurate representation of the employee decision making process as it "oversimplifies the process as one that is continuous with linear relationships between the different decision stages." (Sheridan & Abelson, 1983, p. 419). However, Sheridan and Abelson did not reject Mobley, rather; they refined and extended it by using its' two main effects, job utility and job tension, to develop a dynamic theory.

Sheridan & Abelson (S&A) drew upon cusp catastrophe theory (CCT) to explain the complex interplay of Mobley's two main factors (job utility and stress) in the turnover decision. Rooted in mathematical models of dynamic change, CCT allowed Sheridan and Abelson to concurrently model each factor's impact on the other. Each factor increases or decreases the other's contribution to turnover behaviors along a discontinuous path until one factor over-takes the others' ability to restrain employee action toward turnover (Sheridan & Abelson, 1983). Unlike linear models that assume incremental change in employee attitude, cusp catastrophe models assume that abrupt and radically different responses are possible from environmental changes that are small and seemingly inconsequential (Wagner, 2010). Linear models serve to estimate relative strengths of turnover variables, albeit weakly, explaining between 7.3% to 21% of turnover variance (Mobley, 1979; Sheridan & Abelson, 1983), while CCT modeling has shown higher predictive capabilities of 55% while also explaining the process as to how continuous variation in these variables lead from states of retention to turnover (Sheridan & Abelson, 1983).

Post Sheridan & Abelson, Lee and Mitchell (1994) developed the unfolding model of voluntary turnover in response to academia's tendency to focus on one particular causative orientation (school of thought) while ignoring others. Placing previous research direction in either a push or pull orientation as determined by whether forces external to the employee pull (labor supply and demand) or push (psychological orientation) the employee towards another organization, Lee and

Mitchell's unfolding model attempts to unify the push and pull models into one model (Lee & Mitchell, 1994).

Lee and Mitchell drew upon a theoretical framework not previously used in turnover research, image theory, to explain the turnover process. Image theory asserts that decisions are based on the compatibility of possible alternatives and existing images (perceptions) of a person's principles, goals, and plans. Whereas previous research viewed turnover as following a single path, Lee & Mitchell proposed five potential turnover pathways determined by the turnover mechanism's push or pull characteristics with turnover decisions made quickly based on single or multiple events, referred to as shocks (Lee & Mitchell, 1994) representing jarring events leading to controlled turnover deliberations (Maertz & Campion, 2004).

Described as a "major advance" (Maertz & Campion, 2004, p. 567), Lee & Mitchell's unfolding model expanded the scope and depth of turnover process theory (Maertz & Campion, 2004). More recently, Lee & Mitchell extended the unfolding model by incorporating job embeddedness theory to explain how embedding forces buffer against shocks (Hom et al., 2017). As with Sheridan and Abelson, Lee & Mitchell viewed the turnover process as non-linear (Steel & Lounsbury, 2009) and recommended catastrophe theory as a way to test and model the unfolding model (Lee & Mitchell, 1994). Current research on turnover process is focused on testing and refining the unfolding model as it is currently the dominant turnover perspective (Hom et al., 2017).

Turnover research continues towards increasingly complex models attempting to explain and predict employee choice in a world where drivers of human behavior remain dynamic. The opposite ends of this research spectrum range from the overly simplistic to the complex requiring theoretical geometry to model employee decision making. In the middle remain the easily digestible content theories, categorizing turnover as being either push or pull oriented, and process theories explaining the cognitive processes involved in the turnover decision. The most comprehensive theories will be those combining the factors creating turnover intentions (e.g. job dissatisfaction) with the mental processes employees undergo when moving from a condition of no turnover intentions to the decision to quit.

Turnover Intentions

Intent to turnover, described as the last in a sequence of withdrawal cognitions, finds its' roots in Porter & Steers' 1973 call for a more complete understanding of the turnover process and has been shown to be the strongest cognitive precursor of actual turnover (Tett & Meyer, 1993). Early research used content models to study the direct correlations of turnover and attitudes (e.g. job satisfaction) and, therefore; did not anticipate the need to inquire as to the intent to quit. (Zimmerman & Darnold, 2009).

Fishbein & Ajzen (1975) provided a theoretical basis of turnover intent through their general theory of attitudes, which postulated that "the single best predictor of individual behavior will be a measure of the intent to perform the behavior" (Fishbein & Ajzen, 1975, p. 369; Zimmerman & Darnold, 2009). Moberly's 1979 (Moberly, 1979) intermediate linkages model of turnover was the first to incorporate a general behavior theory of intent to employee turnover theory (Steel & Lounsbury, 2009).

Turnover intentions is consider a useful proxy for actual turnover not only due to its' predictive ability (Moberly, 1977; Cohen, Blake & Goodman, 2016; Griffeth et al., 2000; Vandenberg & Nelson, 1999) but also for pragmatic reasons. A turnover intent proxy allows for statistical modeling that can be scaled unlike actual turnover behavior, which is dichotomous. It also allows for larger population samples as researchers can locate and evaluate all current organizational employees rather than try to locate the few that have quit (Dalton, Johnson & Daily, 1999). For purposes of this research project, it would have been difficult to locate application engineers that left the career of application engineer. Hence, turnover intentions of current AE's will be used as a proxy for turnover.

Engineer Turnover

Engineer turnover rates are higher than other career fields requiring a college degree yet little information exists as to the reasons (Kennedy, 2009). Engineer turnover literature tends to focus on the engineering field in general more so than individual career fields or gender and age cohorts. As in other career fields, research finds a negative correlation between engineer job satisfaction and turnover intentions and identifies numerous job and organizational factors driving dissatisfaction.

Numerous studies focusing on design engineers exist. Bigliardi, Petroni & Ivo Dormio (2005), through the theoretical framework of career anchors, found turnover intentions are lower when high levels of organizational socialization and a broad range of career opportunities exist (Bigliardi, Petroni & Ivo Dormio, 2005). Igbaria & Siegel's (1992) integrated model of engineer turnover intentions identified a direct negative correlation between high levels of organizational commitment and turnover intentions when job tasks where described as being challenging and varied and when the difference between expected job performance metrics and actual metrics was low (Igbaria & Siegel, 1992). Mulla's thirteen year longitudinal study of 2,141 Indian engineers found unmarried young engineers turnover more often than married and older engineers, particularly when the engineer's job is located in a region different than their upbringing (Mulla, Kelkar, Agarwal, Singh & Sen, 2013). Post's (2009) work/family conflict study found no direct correlation between the conflicts work places on family obligations and turnover intentions. However, high levels of work/family conflict, when combined with poor supervisor and colleague support, did decrease job satisfaction, which in turn, increased turnover intentions. In other words, helpful supervisors and colleagues blunt the stress caused by family obligations (Post, DiTomaso, Farris & Cordero, 2009). Sherman's (1986) investigation of job autonomy, job satisfaction and supervisor characteristics revealed job autonomy as having the strongest negative correlation to turnover intentions with job satisfaction and supervisor characteristics also negatively correlated but at lower levels (Sherman, 1986). Hofaidhllaoui & Chhinzer's (2014) survey of French engineers concluded that perceived organizational support (POS) moderates job dissatisfaction and supervisor dissatisfaction such that, when POS increases, turnover intentions decrease (Hofaidhllaoui & Chhinzer, 2014). Iammartino's (2016) analysis of a U.S. government survey of federal engineers focused on turnover rates as related to engineer supervisor (manager) to individual contributor ratios. The analysis identified a preference for more rather than fewer supervisors but, as the researchers did not have direct access to the survey participants, they were unable to divine why the higher ratio was preferred (Iammartino, Bischoff & Willy, 2016).

Other studies focus on specific engineering career fields, engineer cohorts and their turnover intentions. Software engineers were found to have higher turnover intentions when time demands of the job exceeded available time (Wickramasinghe, 2010) and when job autonomy, promotional opportunities and organizational support were perceived as low (Westlund & Hannon, 2008). Taiwanese construction engineers exhibited more sensitivity to pay levels and career promotion opportunities in their turnover intentions than to job and supervisor satisfaction (Sun, 2011). Lingard's (2003) study of Australian civil engineers identified positive correlations between burnout (emotional stress and organizational cynicism) and increasing turnover intentions (Lingard, 2003). Fouad's (2017) extensive qualitative study of 5,562 female engineers in the United States found 27% of these engineers left the engineering field entirely. The departed engineers cited, in order, work-family balance, loss of interest in the engineering career field, lack of promotional opportunities and dislike of the tasks undertaken by engineers, as reasons for leaving the career field (Fouad, Chang, Wan & Singh, 2017). Fouad's earlier (2016) quantitative study of the same female engineer population sample identified training and development opportunities as being central to confidence as an engineer, leading to higher job satisfaction and job attitudes, resulting in lower turnover intentions (Fouad, Singh, Cappaert, Chang & Wan, 2016). Studies of older engineers find those engineers that could retire but find the job of an engineer interesting continue working (Lord, 2002) but, in agreement with other engineer research, many older engineers, while still working, no longer work as engineers (Kennedy, 2009).

The engineer turnover literature, while fragmented in terms of population sample, tends towards a common theme. While no single researcher or research article can be pointed to as being seminal in this research stream, job factors such as task variability, job autonomy, high levels of job challenge (not boring) and, to a lesser degree, perceived organizational support, form the basis for lower turnover intentions.

The preponderance of engineer turnover research is quantitative, providing insights into, to what degree, push characteristics (e.g. organizational characteristics, job characteristics, supervisor characteristics) and pull characteristics (family conflict, career advancement…) correlate to turnover and turnover intentions. Most of this work can best be described as descriptive as no longitudinal studies investigating how deliberate (prescriptive) job or organizational changes impact turnover intentions have been located.

Effects of over-education and over-qualification

The possibility that the increased use of software to accomplish many AE job tasks has created conditions of an over-educated workforce was explored. In turn, over-education and over-qualification was considered as possible contributors to AE career dissatisfaction and turnover intentions. The impact of increasingly sophisticated software on the role of the application engineer has not been previously studied. However, what was a career heavily dependent upon knowledge of engineering principles to undertake the required handwritten calculations to complete job tasks, now centers around data entry into software that accomplishes the same engineering calculations.

While still in its' infancy, recent scholarly work on information technology (IT) and artificial intelligence comments that gradually everything becomes information technology and, by 2030, one third of jobs requiring a bachelor's degree will become automated (Hoeschl, Bueno & Hoeschl, 2017). IT's impact on job satisfaction has been found to depend on how an individual technology impacts job characteristics including the degree to which IT reduces required skill level (deskilling), leading to an oversimplification of job tasks and boredom, resulting in unused mental capacity of the educated workforce and concluding in "unmet expectations that education leads to more rewarding jobs" (Baxter, 1990, p. 252). In turn, boredom has been found to correlate with lower levels of job satisfaction (Kass, Vodanovich & Callender, 2001; Zakay, 2014; Velasco, 2017) that spill over into the next workday through negative work attitudes (van Hooff & van Hooft, 2017).

This trend towards sophisticated software accomplishing common and routine engineering calculations introduces the possibility that a condition of over-education exists within the application engineering field. Workers are considered overeducated if the skills they bring to their jobs exceed the skills required of the job (Groot & van den Brink, 2000; Alba-Ramirez, 1993). Over-educated workers demonstrate lower levels of job satisfaction, job performance, higher turnover intentions, and higher turnover rates (Alba-Ramirez, 1993; Fleming & Kler, 2008; Fleming & Kler, 2017; Tsang & Levin, 1985; Tsang, 1987; Allen & van der Velden, 2001) with younger workers occupying jobs requiring less education than that possessed leading to higher turnover rates than those of older workers (Groot & van den Brink, 1996). Groot and van den Brink posit one possible cause for the hiring of overeducated staff is a lack of on-the-job training (Groot & van den Brink, 2000), which characterizes the hiring preferences and training regimes common in the pump manufacturing and distribution business segments.

Education, qualification and information technology exhibit the same pattern of more is not always better. Each literature stream demonstrates that too much of either can have negative consequences on individual performance and turnover. Over-education and over-qualification lead directly to lower job satisfaction and higher turnover rates whereas information technology has been shown to lead to conditions of over-education and over-qualification.

Engineer Career Facets

Career Field Structure

A question the research project might generate is why would research studying engineers include non-engineers? Aren't job-titled engineers degreed engineers? Unlike other career fields requiring specific college degrees and the passing of a qualifying exam before individuals can present themselves as and pursue economic benefits associated with the job title (lawyer, medical doctor), no such limitation exists for the engineering career field. For example, the states of Texas, Missouri and Florida, among other states, require a practicing lawyer to have graduated from an American Bar Association approved law school and have passed a state bar examination before practicing law ("Becoming a Texas Lawyer", n.d.; "Florida Bar of Examiners", n.d.; "Admission Eligibility Requirements", n.d.). Oppositely, job-titled engineers, without engineering degrees, do utilize (practice) engineering principles to complete job tasks and receive compensation as a titled engineer.

An exception to the liberally applied job title “engineer” is the case of the Professional Engineer, who, according to individual state guidelines, must meet similar qualifications as the aforementioned attorney. For example, California engineers are required to have graduated from an accredited undergraduate engineering program and have spent two years as an apprentice engineer before taking the test leading to the legal right to refer to themselves as a “Professional Engineer” or “Consulting Engineer” (“Professional Engineers Act”, 2020). Other states follow a similar rule set (“When Can I Take the PE Exam?”, n.d.). Otherwise, the appropriate use of the word “engineer” in the job title is determined by the employer.

As an organized body, through the National Academy of Engineering (NAE), the engineering discipline recognizes the variability in the application of engineering duties and sets forth an occupational description of the same. This body describes the engineering occupation as:

> The occupational definition of an engineer captures some engineering degree holders as well as workers without an engineering degree who perform certain job duties that define an engineering occupation, while excluding holders of engineering degrees working in “engineering-proximate” occupations, those that draw heavily on the specialized technical

> and professional knowledge and skills of engineering graduates, as well as non-engineering occupations, those that draw on professional and more generic technical skills of engineering graduates (National Academy of Engineering, 2018, p. 16).

To delineate between types of engineers, the NAE formalized three overlapping categories defining this career field. 1) Those with engineering degrees regardless of occupation, 2) those with job duties that define an engineering occupation, as determined by the Standard Occupational Classification Systems (SOCS), regardless of education and 3) degreed engineers working in occupations requiring the knowledge acquired through an engineering degree (NAE, 2018).

The role of application engineer within the pump manufacturing and distribution segments draws heavily upon the tasks and duties the SOCS lists for mechanical engineers (SOCS code 17-2141) which include design, planning, installation, and maintenance of water/fluid systems (Occupational employment, 2017). For purposes of this research project, the above definitions of engineer labeled number two and three was applicable.

Engineer motivation and motivation to be an engineer.

As the research explored application engineer expectations, understanding what created those expectations was paramount. Due to the acceptance requirements of university engineering programs, the degreed engineer must have made the decision to become an engineer in their middle and high school academic careers (NAE, 2018) often beginning with algebra by the 7th or 8th grade (Pearson & Miller, 2012). These college entrance requirements universally require four years of science and advanced math (NAE, 2018; Pearson & Miller, 2012) requiring young high school students in their freshman year (age of 14) to select the career they will enter when twenty-two or twenty-three (Doi, Folger, Astin & Bayer, 1970). Vocational interest research finds that any interest expressed before the age of sixteen is likely too unstable to be an accurate prediction of future vocational interests yet engineers are placed on a career trajectory before the age of sixteen. Additionally, research finds vocational interest peaks and is most stable through young adulthood / college years (age 18 – 21) and declines thereafter (Low, Yoon, Roberts & Rounds, 2005). This vocational instability may explain, in part, why degreed engineers, as they age, shift away from engineering and engineering related occupations to other non-engineering vocations at rates higher than other career fields requiring a bachelor's degree (NAE, 2018; Kennedy, 2009; Kennedy, 2006).

Research inquiring as to why high school students select an engineering career pathway is scant. Matusovich's (2010) qualitative study found engineering undergraduate students picked the major through a combination of the individual's perception of themselves as an engineer (I am good at math and engineers are good at math.) and interest or enjoyment of the perceived tasks an engineer accomplishes such as understanding how mechanical things work (Matusovich, Streveler & Miller, 2010). Lee (2017) identified a disconnect between freshmen engineering student perceptions of what an engineer does (uses math and science to solve problems with little social element involved) and what they learned about the career through a summer bridge program (the centrality of collaboration and work-place social ties to solve problems) (Lee, Watford, Hampton, Lutz & Taylor, 2017). The remaining research focuses on understanding undergraduate engineering student success in college rather than broadening our understanding of why students chose an engineering undergraduate degree. This research identified positive correlations between success in college engineering programs and student demographics (race and gender), high school academic performance, level of confidence in mathematical abilities, parent's occupation as an engineer, high school location (rural / urban) and standardized test scores (Felder, Felder & Dietz, 1998; Jones, Paretti, Hein & Knott, 2010; Kabra & Bichkar, 2011; French, Immekus & Oakes, 2005).

The more philosophical strands of motivation research provide a broader frame within which to consider the engineer's deliberative path towards turnover intentions than the narrowly focused task or attitudinal theories of motivation. Within this broader frame exist two distinctive constructs, the motivation or reason to do something (normative reason), which is driven by a perceived need or want, and the motivation to do it (motivating reason) (Alvarez, 2018; Reasons for Action, 2016). One can have a reason to do something yet lack the motivation to do it (Singh, 2019).

Within the context of application engineer turnover, both the reason to become an engineer and the motivation to continue in the AE role may have separate yet combinative effects. The beliefs that underpinned a young students' desire to become an engineer may no longer hold in later years and the job tasks inherent in the application engineer role may not be sufficiently motivating to continue doing the job.

Engineers express a desire to innovate (McKelvey & Sekaran, 1977) while creatively solving challenging and interesting problems (Igbaria & Seigel, 1992) in an autonomous work environment that provides for the acquisition of new and useful knowledge through exposure to a variety of tasks and projects that are not monotonous or repetitive in nature (Franca, da Silva & Sharp, 2020; Gerwel, Chelin & Rouvrais, 2017). The repetitive nature of an AE's job tasks and reliance upon software to automatically complete engineering calculations align poorly with research's findings regarding engineer motivation and job desires.

The motivation-to-be and engineer-motivation literature presents a consistent image of engineer motivation. Engineering-bound high school students and college engineering students express a desire to solve problems and understand how things function. Employed engineers express similar desires with additional factors such as an autonomous work environment and a desire for job task variability being core job expectations. However, the vocational interest (VI) literature tears at the fabric forming the now aging engineer's reasons to have become an engineer. This literature finds vocational interests formed during young ages tends to wane after the age of twenty one. Combining the VI literature with the over-education / over-qualified literature, as driven by the broad adaptation of engineering software, may form a basis to partially explain engineer turnover in general and application engineer turnover specifically.

AE's and Competitive Advantage

Application engineers (AE) occupy a unique position in the customer / supplier relationship in ways other supplier engineers do not. The role and job tasks correspond with those of an inside sales role in industrial sales organizations (Narus & Anderson, 1986), requiring AE's to be in frequent contact with customers such that, as customer-facing organizational resources, they are the primary managers of inter-organizational relationships deemed critical in customer relationships (Lewin, 2009; Dekker, Donada, Mothe & Nogatchewsky, 2019). As boundary-spanning resources, AE's, through frequent interactions with customers, share information, manage conflicts, solve problems, and develop knowledge (Tangpong, Hung & Ro, 2010).

These frequent interactions result in the AE being key, more so than outside sales personnel, in increasing levels of customer satisfaction and organizational performance (Boyle, 1996; Lewin, 2009) where customer perceptions of service and support lead to higher overall purchase value assessments than product-related attributes (Lewin, 2009). In other words, price does not matter, much. Technical expertise, a core element of the AE position, is included in customer evaluations of value and is associated with higher levels of perceived value than pricing levels (Boyle, 1996). In cases of turnover or down-sizing of customer-facing staff, customer satisfaction levels decrease due to unrealized expectations resulting in reduced future purchase intentions (Lewin, 2009).

As a source of competitive advantage, knowledge is an organizational asset that should be valued and managed (Bogdanowicz & Bailey, 2002). As the repository for knowledge, knowledge workers, which includes engineers (Lee & Maurer, 1997), have been identified as a key, if not "the most important class of organizational participant" (Lee & Maurer, 1997, p. 247), in the post-industrial information age where global competition creates increasing demands for such workers (Nelson & McCann, 2010).

Identifying application engineers as a source of competitive advantage answers Barney's call to look inside the firm for sources of competitive advantage (Barney, 1995). In customer's eyes, the AE role and customer support functions provide greater perceived value than other supplier functions, including the outside sales force. At the core of this value proposition is the knowledge possessed by the application engineer, which, when lost through turnover, decreases the customer's perceived value of the supplier.

Gaps in the Literature

The engineering field is comprised of twelve main categorical disciplines (mechanical, electrical, civil, aeronautical….) with numerous sub-disciplines (National Association of Engineers, n.d.). This list of disciplines does not include specific engineering careers that cross disciplines such as sales engineer, project engineer, field engineer, reliability engineer or application engineer. Relevant to this study, engineer turnover research tends to focus on engineers broadly as defined by the main categories or, more recently, on gender studies seeking to understand a lack of female engineers in the work force. No research has been undertaken to understand the career field of application engineer within any context including the specific topic of application engineer turnover. More generally, the theoretical framework of met-expectations has not been used to explore engineer turnover intentions for any discipline or career field. Understanding why engineers decide to become engineers and whether their initial perceptions of the engineering field, often formed in high school, are misaligned with reality will provide human resource practitioners with information useful in reducing turnover. This study contributed to this gap.

This chapter presented literature covering the theoretical framework of met-expectations as well as important theoretical concepts useful in explaining the causes and implications of application engineer turnover and turnover intentions and the importance of the application engineer in a firm's pursuit of competitive advantage. This study closed the gap in the literature that pertains to factors contributing to application engineer turnover. Chapter three addresses the methodology and research design used to answer the research questions.

Chapter 3

Research Methods and Design

Overview

This study explored the turnover intentions of sales application engineers employed in the industrial pump manufacturing and distributor business segments. The researcher sought to understand the expectations engineers have of the job of sales application engineer, how and when those expectations form, how those expectations influence turnover intentions and whether age and job tenure moderate those expectations. The research questions were:

RQ1: In what way does the type of undergraduate degree held by application engineers impact job turnover intentions and/or job satisfaction?

RQ2: What aspects of an application engineer's workplace role and responsibilities fail to meet employed engineer expectations?

RQ2b: How can failed expectations impact job performance, motivation, and employee commitment?

RQ3: As application engineers age and their job tenure increases, how do job expectations change?

The essence of any phenomenon, in this case application engineer turnover intentions, is only discoverable by inquiry, through an exploration of the phenomenon utilizing questions and interviews (Moustakas, 1994). The ability to probe individual AE perceptions, experiences and expectations was paramount to fully understand not only each individual's experiences and expectations but also whether attitudinal patterns existed across the group. For this reason, a phenomenological approach was used in this study. Phenomenological research attempts to understand and describe how participants experience a phenomenon (Christensen, Johnson & Turner, 2011).

Organization of the Remainder of the Chapter

The following chapter will provide descriptions of the ethical considerations that may have arisen during the study, discuss researcher positionality and philosophical worldview, present the research methodology and design including the research process, the population sample information and participant selection.

Ethical Considerations

Research ethics is categorized in three areas: 1) the relationship between society and science, 2) professional issues, and 3) the treatment of research participants, a set of principles useful to researchers when deciding how to conduct ethical research (Christensen, Johnson & Turner, 2011). Any research involving participants carries some potential for harm (Traianou, 2014) requiring researchers to recognize the fundamental moral requirement to treat people in accord with standards that affirm their humanity by avoiding the causing of harm, distress, anxiety, harm or pain (Oliver, 2010).

In relation to this study, the potential for participant harm was not unavoidable in the absolute but was unlikely. Any harm that may have occurred would have taken place through two possible categories of harm, 1) material damage in the form of job loss or 2) reputation and status damage through the disclosure of information that was previously unknown to the employer (Traianou, 2014). As participant recruitment was made through personal contact with no recruitment aid provided by employers, the employers' knowledge, and therefore; their ability to apply sanctions for participation, was essentially eliminated .

However, it is conceivable, given that my professional network includes managers and multiple AE's from the same employers, word-of-mouth disclosure of participation might have occurred. However, should an employer have learned of an application engineer's participation, the study's focus on career and not organizational factors provided little to no cause for an employer to feel the study revealed negative organizational factors that should have remained confidential.

Participant confidentiality was paramount to the study. Identifying characteristics such as name, location, gender and employer were removed from the draft and final research reports (Morse, 1998). Additional care was taken to remove any information such as previous jobs or colleges attended from drafts and final reports that may have allowed readers to guess who a particular participant might be.

Interview materials, whether video, audio or written, are protected through password protected and encrypted services where available (De Chesney, 2015). Recorded interviews were conducted on a password protected I-Pad and uploaded to Otter.ia's secured transcription and storage service. To reduce the chance of participant exposure, the video conferencing component of Zoom was not used. In this study, Zoom's audio recording function was used and protected by Zoom's encryption and password features. Once the Zoom audio recording was transferred to Otter.ia's transcription service, the Zoom recording was deleted. Similarly, once transcription was completed in Otter.ia and transcribed interviews were transferred to Atlas.ti's encrypted Cloud-based coding service, the Otter.ia transcription files were deleted. The Atlas.ti files were stored in Atlas.ti's password protected and encrypted Cloud service. Few written notes were taken. Those that did exist were stored in a locked desk in a private home office and then shredded once coding was complete. Upon completion of the study, all materials, including the files stored on the Atlas.ti Cloud, were deleted or destroyed to prevent inadvertent release.

Researcher Positionality

Contemporary knowledge theory disputes the concept of researcher neutrality (Nagel, 1986) where a researcher can remove opinions held about the topic to be studied (Giorgi, 1986). These opinions, created by a researcher's experience, determine what will be investigated, the findings considered important enough to be included and the manner in which the findings are framed (Malterud, 2001). Positionality captures the concept of researcher situatedness as a means to allow a consumer of the research to consider how researcher experience and characteristics might influence the project's findings and conclusions (Freeth & Vilsmaier, 2020; Rose, 1997).

For much of my career, the application engineer has been central to revenue generation efforts and contributes to my professional success. In addition to having worked as an application engineer, I have managed application engineers as direct reports, indirect reports when performing management duties and held positions considered as internal customers to the application engineer function . Within the context of turnover, in my twenty-five years working in manufacturing and distribution, there have been few positions that cause as much disruption in the pursuit of revenue as when application engineers quit . Other positions, such as those found in the finance, accounting, supply chain and human resources functions, while causing temporary inconvenience when members departed, did not carry the same impact as the departed application engineer.

In the case of accounting and human resource positions, those roles could be outsourced to local accounting firms or payroll service firms until replacements could be found. At no time was identifying qualified candidates particularly difficult and once on the job, replacements required very little time to perform at the same level as the departed organizational member. The job tasks in these roles are largely codified, such as accounting standards, through industry best practices or the roles are more explicit-knowledge driven than tacit.

Application engineer value is not fully realized until a repository of tacit knowledge, both technical and bureaucrat, is created. AE's that depart with this knowledge leave knowledge gaps leading to disruptions and impairments in customer relationships. New hires with no experience require up to three years to fully replace the knowledge lost by the previous application engineer's departure.

Principally, as someone responsible for revenue generation, the loss of an application engineer makes my job more difficult as customers have choices and can go to other sources of supply when replies are delayed or of poor quality. Additionally, my workload, and that of those working in close association with the application engineer, increases. Those in my position are the second point of contact for customers but a field manager's role focuses on an array of tasks far removed from those of the application engineer. In short, being successful at my role is harder when application engineers quit.

Philosophical Worldview

Every scientific theory is based on an abstract philosophical foundation indicating a researcher's ontological, epistemological and methodological model (Babbage & Ronan, 2000). In turn, these models, otherwise known as worldviews, are based on researcher discipline orientation, experience, personality, advisors and mentors (Babbage & Ronan, 2000). The researcher worldview determines the observations to be made, the questions asked and the conclusions reached (Denzin & Lincoln, 2011; Creswell & Creswell, 2018; Johnson, Germer, Efran & Overton, 1988). Worldviews are a way of making sense of the complexities of the real world (Kaushik & Walsh, 2019). The researcher's worldview should be made explicit as a means to explain why a research method was chosen (Creswell & Creswell, 2018) and how the study should be interpreted (Kivunja & Kuyini, 2017).

This researcher's utilitarian temperament and thirty four years of professional experience focused on solving problems of ambiguous origin aligns with the pragmatic worldview where the primary purpose of inquiry is to understand some part of reality (Kaushik & Walsh, 2019) in order to create knowledge in the interest of action, change and improvement and not merely observation (Goldkuhl, 2012).

Pragmatism rejects the traditional dualism of objectivity and subjectivity (Biesta, 2010) where a researcher must choose one scientific method that contemplates reality as either independent of the mind or within the mind (Creswell & Creswell, 2018; Maxcy, 2004). Pragmatism recognizes there may be conditions where objective reality exists but this reality is grounded in the environment and can only be found through the human experience (Kaushik & Walsh, 2019). It permits the researcher to "look at the what and how to research based on the intended consequences" (Creswell & Creswell, 2018, p. 11), determine how well a methodological choice leads to a desired outcome (Tashakkori & Teddlie, 2008) and focus on the research consequences and research questions rather than on research methodology (Kaushik & Walsh, 2019).

Declaring one's worldview is important as the choice "permeates the research questions" (Kivunja & Kuyini, 2017, p. 36). Undergirding this research project and its' research questions was to better understand the many facets of AE turnover, including possible mitigation strategies, not just discover the drivers of AE turnover intentions and proceed no further.

Toward this end, the research questions involving age and tenure, while exceeding a narrowly scoped study of AE turnover intentions, hoped to isolate factors that decrease AE turnover rates, thereby providing information useful to the practitioner. Similarly, the selection of the framework of met-expectations intended to isolate one mechanism that may impact turnover intentions. The objective of the study was not to ask a binary question as to whether a position did or did not meet expectations, but to gain a clearer picture of the expectations, whether those expectations were an absolute condition of employment and could job task or organizational modifications be implemented to reduce or eliminate the turnover intention.

With an understanding of the perspectives of AE attitudes towards the job, a post-dissertation project will focus on developing human resource programs designed to reduce AE turnover. For this reason, a phenomenological method, within a pragmatic worldview, was selected rather than methods lacking a future orientation towards action.

Sample

The research participants were purposively sampled and limited to those possessing the job title of Application Engineer or Sales Application Engineer employed within the industrial pump manufacturing and distribution business segment. Participants were not selected or filtered by any other criteria such as age, education level, gender or ethnicity.

Participant Selection

Participants were identified and selected from my personal network in the pump manufacturing and distribution business. The initial list of potential participants numbered fifty-one. This list, which had no identifying characteristics other than name and contact information, was exported to MS Excel and, for convenience only, sorted by last name. Contacts were then called in alphabetic order. If the contact answered the phone, I explained the purpose of the research and gained permission to email further information. If the call went to voicemail, I hung up and called the next person on the list. After five contacts had agreed to an interview, I suspended further calls until the interviews were complete.

An important aspect of the participant selection method centered on a desire to obtain a fully representative demographic sample (age and gender) of application engineers. After approximately fifteen interviews, the demographics slanted heavily towards the young degreed AE with only a few older AE’s having been interviewed, although I knew there were more. As I did not want to miss this demographic's insights, I returned to the Excel contact database and purposefully selected those AE's I believed to be older. I also asked AE's, during subsequent interviews, if they were aware of any older AE's. None were able to offer any not already in my database. When no older AE's were identified and interviewed, I returned to the alphabetical method of contacting potential participants.

This exercise confirmed one of my suspicions and provided support for my concern regarding application engineers turnover. There are very few older AE's working in the field. As will be covered in later sections, young application engineers turnover quickly. Few survive in the career beyond the age of forty.

Of the fifty-one contacts in my database, forty were requested to participate with one abstaining due to concerns with the personal nature of the questions contained in the interview protocol.

Participant demographics follow in figures two and three below.

Average Age	35
Percent below age of 31	46%
Percent below age of 37	69%
Percent under 37 years with engineering degree	89%
Average career tenure as AE (not organizational tenure)	8.5 years
Percent with over ten years' experience as an AE	31%
Percent male	74%
Percent with engineering degree	77%
Percent married	72%
Percent with school aged children	49%

Figure 2: Participant Demographics

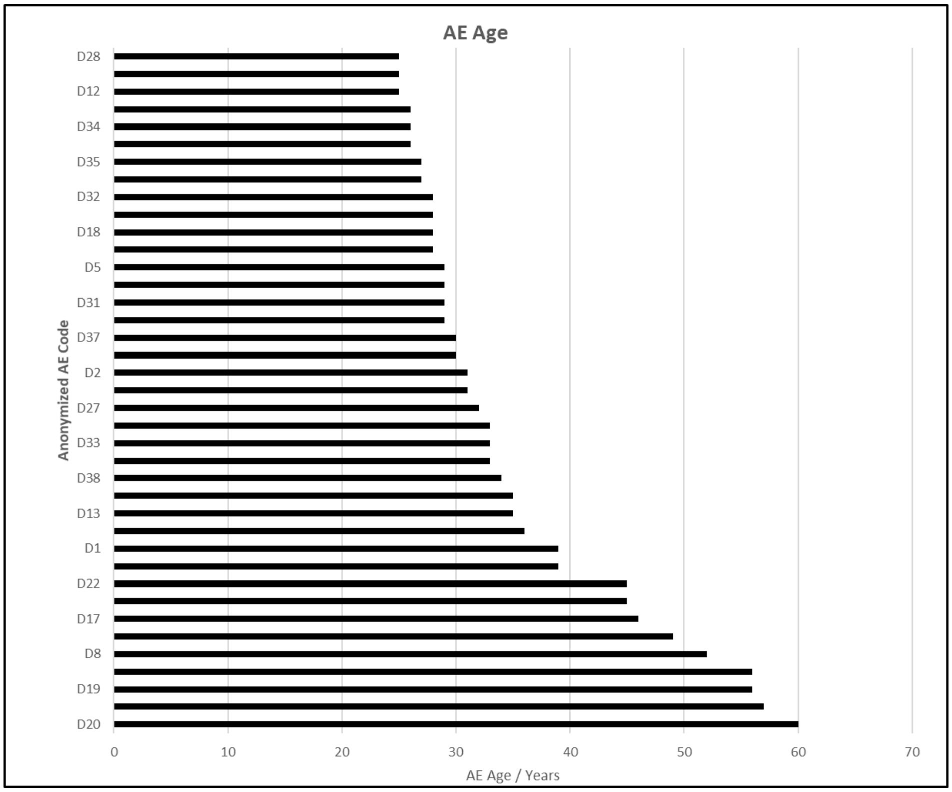


Figure 3. Age distribution

While reading this research project, a reader should recall a critical demographic to this study, those under the age of the thirty-seven and with an engineering degree. Discussed in detail in later sections, this cohort demonstrated significant turnover intentions. More concisely, 96% of this group is unlikely to remain in the career until retirement.

Site

All interviews were conducted remotely via Zoom using an iPad.

Method and Design

While measuring attitudes via a quantitative study was considered, perceptions and beliefs held by participants “cannot be meaningfully reduced to numbers or understood without reference to the context in which people live” (Choy, 2014, p. 102). Qualitative methods are particularly well placed when discovery and description of a phenomenon is the studies’ goal more so than justification and measurement (Park & Park, 2016; Denzin & Lincoln, 2011). While some elements of the research questions could be measured and correlations identified, such as age and job satisfaction, a survey design could not anticipate every possible career factor that might decrease job satisfaction and increase turnover intentions. Nor would a survey lend itself particularly well to understanding why a degreed engineer decided to become an engineer or what their future career plans may be. This weakness in survey design supports Park and Park’s (2016) observation that quantitative methods are best for justification but are not very good at research discovery (Park & Park, 2016).

Therefore, a qualitative phenomenological approach was chosen for the proposed study. Qualitative analysis is an inductive approach where patterns, themes, and categories emerge from the data rather than being imposed, such as occurs with quantitative analysis via surveys (Srivastava & Hopwood, 2009). Central to the phenomenological perspective is the desire to understand people from their own frames of references, how their experiences inform their reality and what those experiences mean to each individual. Employee perceptions form the primary basis for their knowledge and these perceptions should not be doubted (Moustakas, 1994; Christensen, Johnson & Turner, 2011; Taylor, Bogdan & DeVault, 2016).

The iterative process inherent in qualitative research, where a researcher is "on the hunt for concepts and themes...to understand what is going on." (Srivastava & Hopwood, 2009, p. 77) will ensure the participants are active participants in explaining and discovering their individual paths to the career of an AE, their feelings towards the job and whether those feelings change over time or remain constant with other factors mitigating turnover intentions. To ensure participants' responses and impressions were not constrained, open-ended questions were asked in a semi-structured interview process. The semi-structured process allows for detailed participant responses within a flexible format that permits the researcher to follow new thematic leads as they arise while affording the researcher control over the direction of the interview (Schonlau & Couper, 2016; Partington, 2001).

Nearly all published research exploring engineer turnover and turnover intentions is quantitative, following a variance theory method whereby the researcher views the world in terms of variables and their statistical relationships as being sufficient to explain outcomes (Maxwell, 2013). Alternatively, qualitative research follows a process theory approach whereby outcomes are explained by how some situations and events influence others, where research participant perspectives, and not just dominant theory, are considered as having a role in the outcome (Maxwell, 2004a; Maxwell, 2013). As the research will seek to understand what conditions, events or situations lead to the phenomenon of the intent to turnover, the phenomenological research method, one ideally situated to clarify the meaning and lived experiences of an individual as relates to a specific phenomenon (Christensen, Johnson & Turner, 2010), was selected.

Van Manen (Van Manen, 2017), a leading proponent of phenomenological research methods, places participant lived experience at the center of phenomenological research (Zahavi, 2020), where it is used to study the primordial and lived meaning of an experience using the methodological devices of epoché and reduction (van Manen, 2017). Epoché is the removal of researcher biases and assumptions that may prevent the true nature of the phenomenon from making itself known while reduction is the process of defining the primordial nature of the phenomenon (Christensen & Brumfield, 2010; van Manen, 2017). A failure to remove any bias, assumption or preconceived notion about a phenomenon may lead the researcher to incorrectly interpret an explanation of, "What is that experience like?" (Zahavi, 2019, p2) when interviewing participants.

Research Process

The phenomenological research process recommended by Moustakas (Moustakas, 1994) was utilized to conduct this research. This process encompassed seven steps:

1. Discover a topic and formulate research questions.
2. Conduct a literature review.
3. Construct participant selection criteria
4. Inform participants as to the nature of the study and obtain participant consent, insure confidentiality, select a place and time and receive permission to record the interview and publish the findings.
5. Develop interview questions.
6. Collect the data through person-to-person interview.
7. Organize and analyze the data.

Topic Discovery and Question Formulation

The topic idea was sourced from everyday life and practical issues (Christensen, Johnson & Turner, 2011) and developed from a general concern and "personal history" (Moustakas, 1994, p. 104) the researcher has as a practitioner working closely with application engineers. This topic is important to the researcher because the loss of these key organizational players is known to cause disruptions in customer relationships and decreases organizational efficiency when the increased workload reduces the remaining employees' performance. The tendency for sales organizations to assign one specific AE to a group of customers frequently creates conditions where only the departed engineer had exposure to common problems and customers preferences. In order to maintain a productive customer relationship, the selling organizations must then relearn things already learned.

The researcher sought to discover the turnover dynamics within the AE career field and develop retention policies, organizational designs and recruitment strategies focused on reducing application engineer turnover.

Conduct a Literature Review

This literature review drew from the organizational behavior, industrial organization psychology, vocational behavior, strategy, human resources, engineering management, engineering education and knowledge management disciplines. The main themes have been found in the turnover and job satisfaction literature with the theory of met-expectations serving as the main theoretical framework. The research gap of application engineer turnover has been primarily located in the engineering management literature where engineer turnover and job satisfaction is addressed but not the specific role of application engineer. Nor has the theoretical framework of met-expectations been found in any literature exploring engineering turnover intentions. It is therefore concluded that application engineer turnover represents a gap in the literature.

Develop Criteria For Selecting Participants

Given the studies' limited focus on application engineers in the pump manufacturing and distribution segments, participant selection was limited to those individuals currently employed as application engineers in these segments. As the studies' goal was to collect as much information as possible about application engineers' perceptions of the job and its' role in the organization, no further participant filtering, such as gender, age or ethnicity, was undertaken.

The researcher contacted potential participants through the researcher's own professional network. They were contacted via phone and email. The introductory email can be found in Appendix A.

Obtain Participant Consent, Ensure Confidentiality, Agree To A Place and Time and Obtain Permission To Record and Publish

The consent form (Appendix B), demographics form (Appendix C) and interview protocol (Appendix D) were emailed to those agreeing to participate. Any forms requiring completion by the participant were collected via return email.

Interview Questions

Interview questions are one form of data collection with survey instruments being the second (Christensen, Johnson & Turner, 2011). The "individual interview is a valuable method of gaining insight into people's perceptions, understandings and experiences of a given phenomenon and can contribute to in-depth data collection" (Ryan, Coughlan & Cronin, 2009, p. 309).

Phenomenological methods typically utilize a long interview process characterized as interactive and informal, taking place in a relaxed atmosphere (Moustakas, 1994). Determined before the interview, the open-ended questions, which may vary, alter or not be used at all, intend to evoke a comprehensive account of a phenomenon by probing participant experience in order to gain maximum data from the interview (Turner, 2010; Moustakas, 1994). Distinct from a questionnaire, a self-report instrument easily completed by a participant, interviews are "given a more specialized label of interview protocol" (Christensen, Johnson & Turner, 2011, p. 337) where the interview is an instrument of inquiry intended to generate a conversation about a particular topic more so than simply answer the interview questions one by one as they are written (Castillo-Montoya, 2016).

The interview protocol (Appendix D) was designed to understand why AE's became engineers, how those reasons align with the job being performed and whether they intend to remain in the career field until retirement. Additionally, it sought identify whether patterns exist in application engineer job satisfaction and dissatisfaction and whether those factors impact job performance. The study searched for job expectation differences as relates to education age and job tenure. Finally, it sought to understand AE' perceptions of the career's role in providing a competitive advantage and, to what degree, if at all, tacit knowledge plays in that advantage. By extension, it also inquired as to how long it takes to acquire that tacit knowledge under the assumption that a loss of tacit knowledge due to turnover equates to reduced or loss of competitive advantage.

While the original interview protocol remained largely true to its' original form, new themes emerged during participant interviews and were reflected in additional questions being posed not only to those participants that followed but also, during follow up interviews, with earlier participants. The new questions were added to the interview protocol.

Data Collection

The interview is one of the basic methods of data collection employed in the social sciences (Gudkova, 2018), conducted, in the case of a qualitative interview, for the purpose of understanding the themes and descriptions of an interviewee's world (Kvale, 2007). Data collection in a phenomenological study occurs through a researchers' exploration of the topic by asking a series of open-ended questions formulated to extract meaning for a participant's experience of a phenomenon. (Moustakas, 1994). In an open ended format, participants are asked identical questions worded so that participants contribute as much detailed information as desired with the researcher asking probing questions as a means of follow-up (Turner, 2010).

The interviews were conducted as semi-structured interviews, a method that allows a researcher to control the general direction of the interview without placing rigid boundaries as to how a participant can consider and reply to interview questions. The semi-structured interview method allows for the discovery of unplanned directions and topics, unlike structured interviews that limit a participant's ability to fully explore the meaning of their experience (Brinkmann, 2014).

Covid specific health concerns eliminated the ability to conduct the preferred method of face-to-face interviewing. Instead, interviews were conducted remotely via Zoom. One unanticipated advantage to the remote method under Covid restrictions was that application engineers were working out of their houses, thereby reducing the number of potential interview barriers such as work rules, the perception of being involved in a non-work activity for over an hour as well as more flexible schedules. This allowed for a faster than anticipated interview completion schedule where some days had two interviews.

A total of 49 interviews were conducted across 39 participants. The additional 10 interviews were conducted with participants that had been interviewed before new themes emerged during later interviews. These second interviews were short, none lasting more than ten minutes. The main interviews lasted between sixty and ninety minutes.

Sample Size and Saturation.

Saturation has attained broad acceptance as a methodological principle in determining qualitative research rigor (Saunders, et al., 2018). For this study, the number of interviews to be conducted was not predetermined. Rather, Urquhart's (2013) and Given's (2016) operationalizing definitions of saturation were followed where, during coding, when no new codes (themes) occur in the data, only the repeated use of the same codes (Urquhart, 2013) and the addition of new data (interviews) does not lead to new emergent themes (Given, 2016), saturation is reached and further interviews are not required.

However, recognizing that one critique of the saturation method to determine study rigor is that it is evident mainly by declaration on part of the researcher (Morse, 1995), a quantitative measure designed to demonstrate saturation was undertaken. Guest, Namey & Chen's (2020), hereafter as GN&C, meta-analysis of qualitative studies identified patterns whereby the value provided by conducting additional interviews quickly diminished beyond, depending on population homogeneity, between six and sixteen interviews for population samples with similar characteristics and twenty to forty interviews for population samples exhibiting lower levels of homogeneity.

While research has attempted to quantify the rigor of qualitative data saturation, GN&C find the statistical methods used are poorly suited to the purposeful sampling method undertaken in qualitative research. Whereas statistical probability relies on random sampling of a population, purposeful sampling, by its' very nature, is not random (Guest, Namey & Chen, 2020). Additionally, the methods identified in the meta-analysis were retrospective in nature, meaning saturation was not determined to have been reached until the studies' full dataset had been coded and analyzed. These methods provide post-study analysis to demonstrate rigor but are not useful to establish, during the study, when saturation has been reached (Guest, Namey & Chen, 2020).

The GN&C mathematical model relies on previous studies' findings that the majority of themes are discovered early in the interview process. The model compares the number of themes discovered during initial interviews with the number of new themes emerging during subsequent interviews. GN&C recommend that once the number of new themes discovered is 0% - 5% of the number of initial themes (not total themes), a level of saturation has been achieved (Guest, Namey & Chen, 2020). In this study, the ratio of new themes to initial themes reached 6% by interview number thirty five. All subsequent interviews (total interviews = 50) resulted in a ratio of 0%, indicating saturation had been achieved.

Organize and Analyze The Data

Qualitative data analysis searches for themes and concepts that provide the best explanation of what is going on in an inquiry. It is a loop-like pattern of repeatedly revisiting the data to answer newly emergent questions, explore connections not previously noticed and add analytical complexity in pursuit of a deeper understanding of the topic (Srivastava & Hopwood, 2009). It is a sequential-step process intended to make sense of the data collected during the interview process. This study followed Creswell & Creswell's data analysis process (Creswell & Creswell, 2018) detailed below.

Organize and Prepare Data For Analysis.

Organization begins with transcribing the collected data and sorting it by information source (Creswell & Creswell, 2018) followed by data horizontalization, a process whereby participant replies and narratives are placed at a figurative distance from the researcher such that answers are all viewed as equally important, without bias or assumptions (Moustakas, 1994; Malhotra & Rehorick, 2006). The unbiased meanings are placed into clusters used to developed descriptions and themes of participant experience(s) (Creswell & Creswell, 2018; Moustakas, 1994).

Transcription.

Transcription is the process of converting the spoken word to written form for analysis (Stuckey, 2014). Otter.ia's cloud-based transcription service was used for transcription. Interviews were conducted and recorded via Zoom with the audio portion then exported to Otter.ia. Initial transcription entailed listening to each interview while reading the transcribed text to ensure the transcription was correct. Other than minor corrections where Otter.ia combined words into one word or misinterpreted uncommon words, the Otter.ia transcription was accurate. Once corrected, each transcribed interview was exported to Atlas.ti for horizontalization and managing memos.

***Horizontalization.*.**

Themes and ideas are often hidden in the transcribed text, which represents a conversation, often informal and unfocused. Horizontalization is the isolation of interesting quotes and statements from the transcription. Once captured, quotes and statements are further reduced to themes (Moustakas, 1994; Klepper & Bruce, 2011).

The Atlas.ti memo function served this purpose by providing a digital notepad intended to organize and “capture your analytic thoughts and ideas” (Friese, 2019, p. 15) where memos act as the recording media critical in the effort to connect emergent concepts and theoretical ideas (Glaser, 2013) before coding begins. For example, the theme of engineer identity and its’ influence on turnover intentions appeared in interviews with younger engineers that intended to leave the career sooner rather than later. This theme became clearer as more interviews were conducted and questions intended to surface and clarify the theme of engineer identity were added to the interview protocol. An example of one of these memo’s is included below in figure four on the next page.

However, this comment recorded in the memo was just one within a series of participant comments regarding the pathway to becoming an engineer. Without memos before coding, effectively isolating and organizing this one construct would have been unlikely. In their raw form, themes may be too lengthy to serve as a code but, with refinement, they frequently lead to codes (Saldaña, 2016).

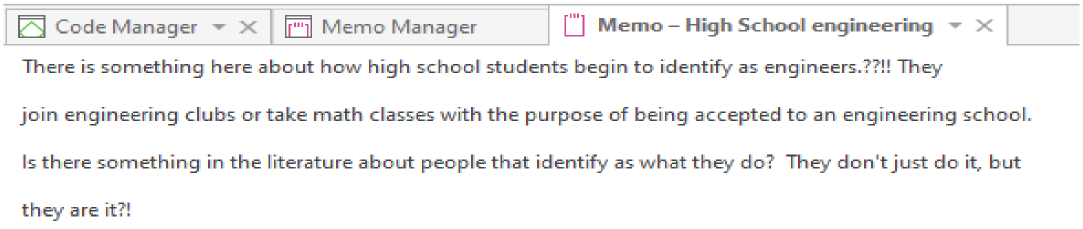


Figure 4. Memo example

Read and/or Look At All Data.

Review the organized data from an elevated viewpoint to gain a general sense of the data's pattern(s) and its' overall meaning while judging its' level of credibility. Do frequent patterns appear? Granular data interpretation is not of a concern at this step (Creswell & Creswell, 2018).

Code The Data.

Coding is the critical link between data collection and the explanation of the data's meaning that translates the data to researcher-interpreted meaning for the purpose of pattern detection and categorization (Saldaña, 2016). Coding organizes data by bracketing chunks of information into categories or themes for subsequent labeling based on participant language and wording (Creswell & Creswell, 2018). This study followed a recursive coding process, whereby initial codes are refined, redefined and code sub-categories created when additional transcripts are coded and new information provides clarity to existing themes and codes (Friese, 2019).

This study followed Saldaña's (Saldaña, 2016) recommended coding technique, which follows:

Data Layout.

Data layout organizes field notes and interview transcripts into short researcher-labeled paragraphs, sometimes referred to as stanzas, segmented by topic and sub-topic with the intension of revealing topical shifts and concealed meanings. It is the first step in forcing the interview data to reveal its' patterns. The manual categorization of the data layout is always a necessary component of manual coding while some software solutions may undertake much, but not all, of the data layout (Saldaña, 2016).

Given the acceptance of computer aided software in qualitative data analysis (CAQDS) (Gibbs, 2014) and its' primary use as an organizing tool (MacMillan & Koenig, 2004), this study used the Atlas.ti quotation and memoing features for the majority of data layout. As memos are written in freestyle form with no ideal or prescribed best method (Glaser, 2013), the combination of highlighting (selecting) interesting portions of the transcription with the Atlas.ti quotation function and then writing (memoing) impressions of the selected texts' concealed meanings (Saldaña, 2016) allowed the research to record numerous concepts representing possible patters. Microsoft Excel served as a secondary data mapping solution as answers to specific questions were annotated in a demographic's worksheet. This step allowed for a more granular evaluation of concepts such as primary reason(s) to leave the career field as expressed by each participant.

Pre-coding.

Pre-coding is an effort to highlight and emphasize thought-provoking text via circling, underlining or coloring in the laid-out data. These phrases or quotes potentially become key pieces in supporting a proposition, assertion or organizational framework. It is a minor yet important step in ensuring interesting aspects of a participant's narrative are not lost in the larger data set (Saldaña, 2016).

An example of the pre-coding exercise undertaken in Atlas.ti follows below (Figure 5). Pre-coding was accomplished by selecting interesting portions of the interview and creating a "quotation." A quotation is a specific function within Atlas.ti used to highlight interesting portions of a transcript. Themes and initial codes emerged from these quotations.

Often, pre-codes were too broad to serve as individual codes but many pre-codes were converted to code groups, such as "Why AE's leave", seen in the below pre-code. As general rule, these initial codes were often refined to better act as a focused code, changed to a code group or deleted.

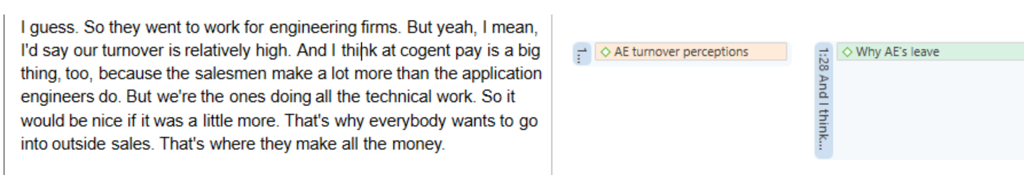


Figure 5. Pre-Coding in Atlas

Preliminary Jottings.

Preliminary jotting is a method for coding during data collection to reduce the risk first impressions and interesting ideas are not forgotten should a researcher wait until all fieldwork has been completed to begin final coding. Preliminary jottings provide a transitional link between raw data and final codes. This is also referred to as preliminary coding in as much as a researcher does not completely distill participant reactions upon further reflection during final coding (Saldaña, 2016).

As a separate process from that of memos, the jotting process occupied a minimal portion of this research project. Each participant interview included a printed sheet with the interview protocol and space to record demographic information. Any information believed to have been to conceptual too identify during the memos or transcription stage was written down on this sheet.

Final Coding.

There is more to data analysis than simply coding the data. Coding is heuristic, intending to stimulate thinking about the data rather than declare what the data means (Saldaña, 2016). As the most effective coding method "emerges during data analysis" (Creswell & Creswell, 2018, p. 196) due to the uniqueness of each research study (Saldaña, 2016), the most appropriate coding method did not manifest itself until coding began. For this project, a recursive process was followed whereby new codes were continually added throughout the analysis, some codes were refined and others deleted due to duplication or poor conceptualization. This followed Creswell and Creswell's (Creswell & Creswell, 2018) description whereby coding records all discovered codes, eliminates redundant codes and groups codes into themes that represent a common idea (Creswell & Creswell, 2018).

Atlas.ti was the software program used to aid in the data coding. The final coding exercise resulted in 118 unique codes, some used frequently others only once or twice. A portion of Atlas.ti's graphic code representation follows on the next page in figure six.

Figure 6. Final Coding in Atlas

When appropriate, individual codes were combined into code groups representing a common theme. Whereas individual codes are descriptive and may not capture concepts, the grouping of codes intends to create conceptual and contextual themes and ideas (Friese, 2019). This research project created 25 groups. Most, but not all, of the individuals codes were captured by a thematic group. The code groups are illustrated in figure seven on following page.

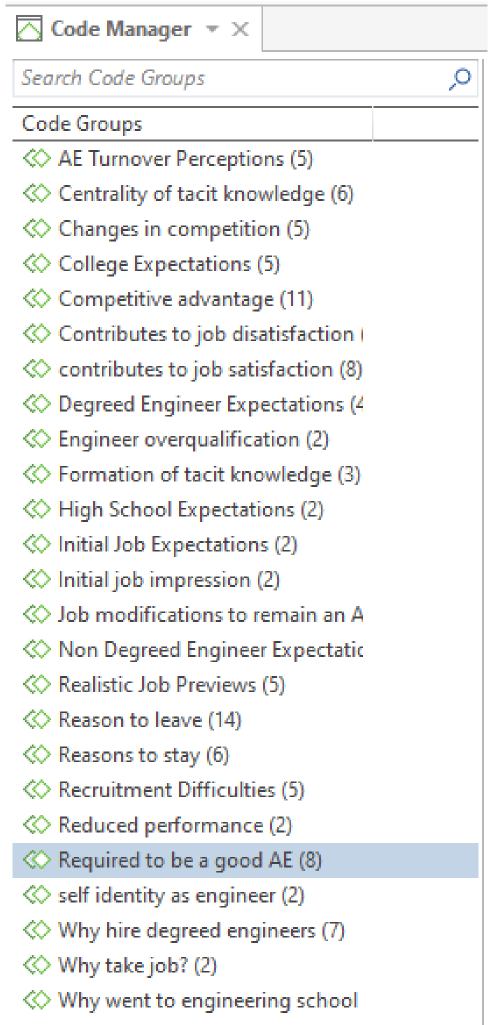


Figure 7. Atlas Code Groups

An example of one code group's contents (individual descriptive codes creating the group "contributes to job satisfaction") is provided in figure eight, on the following page.

Figure 8. Code Group Contents

Much of the coding effort revolved around determining whether a code created during the pre-coding step was a stand-alone code or represented a theme. For example, an initial code of "engineer job expectation" was captured over eighty times across all interviews. Such a general description did not capture the meanings contained within each interview. The improper use of this code as a stand-alone code did not become apparent until many interviews had undergone initial coding, requiring a revisit of previously coded interviews for refinement. Ultimately, the pre-code "engineer job expectation" developed into five thematic code groups comprised of ten unique codes, some shared across groups representing differences in education level and life stages. Without this additional effort, differences in inter-cohort and intra-cohort expectations would have remained uncaptured.

Interrelate Themes & Descriptions.

One challenge posed by qualitative data analysis is the loss of embedded meaning when large amounts of text-based data are reduced in an attempt to make the data more manageable (Daley, 2004). Concept maps allow qualitative researchers to create visual representations of dynamic schemes inherent in human relationships and interactions (Wheeldon & Faubert, 2009) when written descriptions are difficult to operationalize, making the identification of major themes and thematic connections difficult. (Daley, 2004). The use of a concept map solves this problem by presenting the themes from a general picture to a more specific picture (Creswell & Creswell, 2018).

There was some duplication of effort between the use of Saldaña's (Saldaña, 2016) data layout/pre-coding/jotting/coding method and the use of a concept map, but the concept map permitted me to visualize all of concepts that surfaced while following Saldaña's coding guidance. The concept map was created using Atlas.ti's relationship and networking manager functions to create an initial visual representation of coding and theme relationships. As these Atlas.ti functions did not create an easily exportable format for insertion into a MS Word document nor did they allow for customization to expand on themes, the initial concept map created in Atlas.ti was manually recreated in MS Excel and exported to this paper. The concept map is included in the appendix as Appendix E.

Interpreting The Meaning Of Themes.

Interpretation is the challenge at the heart of qualitative research **(**Willig, 2012)**.** The interpretation process replies to the question, "What are the lessons learned?" (Lincoln & Guba, 1985) and involves several procedures: summarizing the findings, comparing the findings to the literature, discussing the findings and stating limitation and future research (Creswell & Creswell, 2018). Interpretation of this project's themes is found in chapter four's findings section.

Validity and Reliability.

Validity.

Qualitative validity, also known as credibility (Long & Johnson, 2000), refers to the confidence the study's findings are accurate in the eyes of the researcher and participants (Creswell & Miller, 2000).

There are a number of strategies available to ensure the research findings are valid. This research project used three, peer debriefing, member checking (Creswell & Creswell, 2018) and a pilot study (Christensen, et al., 2011; Pritchard & Whiting, 2012).

Peer debriefing is a review of the data and research process by someone who is familiar with the phenomenon being studied. Their role is to question assumptions made and ask hard questions about researcher interpretations (Creswell & Miller, 2000). Two peer debriefers were used during the conduct of the research project. Each had worked, but no longer worked, as application engineers in the pump manufacturing and distribution segments. Both were sent a copy of the interview protocol to ensure the questions were clear and telephone discussions were held to discuss why the questions were being asked. The original interview protocol required no modification. The next step was to send samples of post-interview participant interviews (in MS Word form) along with the codes attempting to reduce the quotations to short descriptions of the underlying themes reflected in the quotations. As with the initial interview protocol, no major revisions to the codes was required. And finally, a draft of the final research report was submitted to ensure the results of the study were clearly communicated with no disagreements existing between the data contained within the report and the section detailing the research's findings. Minor changes were required to clarify certain points with no major contradictions or disagreements identified.

The second method, member checking, involves the submission of a draft to the participants to ensure the research report accurately represents participant views. In the event there is disagreement between the written report and participant opinions as to its' accuracy, the inaccurate portion(s) is either refined or removed from the final version (Creswell & Creswell, 2018). Member checking efforts concentrated on participant review of individual transcriptions of the Zoom-conducted interview to ensure transcription accuracy. In a few cases, concepts conveyed through the transcription were unclear. It was at this time the concepts were clarified and the transcripts modified.

The third method, piloting, is a pre-study run of the entire experiment, interview protocol or research design on a small number of participants (Christensen et al., 2011; Pritchard & Whiting, 2012). Its' purpose is to test and refine one or more aspects of the final study when the interview protocol, as originally designed, does not elicit the appropriate responses or provide rich data (Malmqvist, Hellbert, Mollas, Rose & Shevlin, 2019) as well as provide the researcher with experience before conducting the formal research (Christensen, et al., 2011). For this study, interview protocol pilot testing was conducted with two application engineers, one with an engineering degree and one without, to ensure each category or sub-sample of engineer understood the questions posed as well as provide an idea as to how well the interview protocol flowed. The pilot study revealed no concerns with the interview protocol.

Reliability.

Reliability is often understood in quantitative terms, where the methods of data generation can be standardized and non-biased (Mason, 1996). The non-standardization of qualitative methods and the search for greater validity through retention of context makes the goal of reliability in qualitative research impossible (Long & Johnson, 2000). Instead, this study made use of Brink's (1991) alternative view of reliability as presented in the form of stability, where the same question is asked additional times throughout the interview to ensure participants answer consistently (Brink, 1991). Additionally, in order to prevent a drift in the meaning of codes during the process of coding, Gibbs' (2007) recommendation of frequently comparing data and codes against a written definition of each code was followed (Gibbs, 2007; Creswell & Creswell, 2018).

Of particular concern in the study was the elimination of researcher bias, defined as a distortion in the results of the study (Galdas, 2017) that might have existed due to my close association with the role of application engineer in my professional career. A researcher, acting as the research instrument, is positioned to introduce bias into the study (Mehra, 2002) through, among other mechanisms, the "investigator may limit their curiosities so they only discover what they think they don't know rather than opening their inquiries to encompass also what they don't know what they don't know." (Chanail, 2011, p. 257).

Additionally, bias may exist due to individual experiences, while different, presenting themselves in similar phrases and wording, where researcher interpretation creates a disconnect between researcher and participant (Bourke, 2014). The use of critically reflective questioning, through the use of journaling, intends to expose tacit assumptions about meanings that influence, perhaps incorrectly, a researcher's interpretation of interview responses (Cunliff, 2016).

Journaling was used to address both concerns expressed in the previous paragraphs. Journaling, referred to as a "paper mirror" (Hubbs & Brand, 2005, p. 61), surfaces the researcher's tacit knowledge, forces the researcher to identify and question assumptions, reveals how the researcher relates to the received information (Cunliff, 2016), identifies preconceptions brought into the research (Malterud, 2001), minimizes "the biasing influence of pre-existing ideas" (Connor, Robinson & Wieling, 2008, p. 143) and “permits the researcher to discover things in their head that they did not know were there.” (Watt, 2007, p. 83).

In the former example, that of not knowing what I might not know (Chanail, 2011), a turnover intention mechanism acting in concert with the met-expectations framework was being expressed, albeit obliquely, by a specific degreed engineer cohort. An initial assumption was that all degreed engineers place themselves on an engineering school pathway early in the high school career and that this cohort’s members would be more similar than different. During interviewing and analysis, it was discovered this cohort is, in reality, two unique cohorts and, while each expressed turnover intentions, the intra-cohort intent timelines were neither uniform nor equal in severity.

For some degreed engineers, possessing an engineering degree was insufficient, in of itself, to identify as engineers, at a personal level, and this cohort attached importance to the idea that “engineers aren’t engineers if they aren’t engineering.” Their interview responses expressed sentiments that they were not being an engineer and they wanted to find a job with more engineering-like tasks so they could “be an engineer.” The phrasing struck me as that which a parent, whose children no longer live at home, might use to express feelings that they are less because they are no longer parenting.

A note in my journal inquired, “Why are they saying they don’t feel like they are an engineer? They have an engineering degree” The answer to this, covered in more detail elsewhere, is found in the engineer education and organizational psychology literature under the general concept of professional identity. Professional identity, in engineers, is shown to be determined by the level of exposure to engineering, through clubs and courses, while in high school. Research indicates that engineers with exposure to engineering activities while young were more likely to include being an engineer in their overall sense of self (Pierrakos, Bean, Constanzt, Johri & Anderson, 2009). This sub-cohort frequently expressed intentions to leave the career field sooner and with more commitment than did degreed engineers that came to the engineering career field for reasons related to an affinity for math or personal acquaintance with an engineer.

A second case of possible reduced reliability, that of similar words and phrases expressing different ideas, surfaced during analysis and journaling. The frequent participant use of the words “bored” and monotonous” were subject to my own interpretation based on my experience. As a former application engineer, I agreed with the sentiment of boredom but I did not attempt, initially, to understand what participants meant when declaring the job could be boring. My experience was the same but my tacit knowledge of the word’s meaning forced participant meanings into my view, which is clearly a biased interpretation. My journal entries developed into questions asking “What does this mean? For me, it means….” This led to the realization that being bored was a result of some work aspect and not a cause and, as such, required further exploration. Initial interviews did not seek to uncover what created the boredom as if boredom were the cause and the result at the same time. "I am bored because I am bored" as opposed to "I am bored because…." This omission, later corrected, required a second round of interviews with application engineers already interviewed.

Chapter 4

Findings

Overview

The findings from this research contribute to a better understanding of the factors contributing to and mitigating application engineer turnover intentions as well as provide insight into the application engineers' role in a firm's pursuit of competitive advantage. Following Moustakas' seven step research process and Sandaña's recommended coding technique, a phenomenological research method was used to conduct and code forty-nine interviews across thirty-nine participants. The qualitative software analysis tool, Atlas.ti, was used to organize and store the information throughout the data collection process. This chapter discusses the numerous surfaced themes that contributed to the study's results as well other findings relevant to the research questions.

For review and convenience, the study's research questions were:

> **RQ1**: In what way does the type of undergraduate degree held by application engineers impact job turnover intentions and/or job satisfaction?
>
> **RQ2**: What aspects of an application engineer's workplace role and responsibilities fail to meet employed engineer expectations?
>
> > **RQ2b**: How can failed expectations impact job performance, motivation, and employee commitment?

RQ3: As application engineers age and their job tenure increases, how do job expectations change?

As four unique application engineer cohorts emerged during the study, this chapter is organized into four sections.

1. Section One: General findings

2. Section Two: Findings specific to each cohort and explorations of surfaced themes when each cohort presented a unique perspective.

3. Section Three: Findings common across all cohorts.

4. Section Four: A summary of the findings.

General Findings

Findings indicated that AE turnover intentions follow identifiable patterns across and within the sampled degree type, age and AE career tenure cohorts. The research identified four categorizable cohorts. These were: degreed engineer with specific engineer career intentions formed in high school, (I went to engineering school to be an engineer), hereafter referred to as either “cohort one”, “engineer career trajectory” or “large cohort” for brevity, degreed engineers without specific engineer career intentions in high school (I went to engineering school because I was good at math, engineering seemed like a good job, my parents were engineers….), hereafter referred to as cohort two or the good-at-math cohort, young AE’s without engineering degrees who held few jobs before becoming an AE, referred to as cohort three and, lastly, cohort four, older AE's without engineering degrees who did not become an AE until having many years of work experience. Each major cohort presented nuanced turnover intentions and turnover drivers with only one cohort entirely populated by members expressing limited and highly conditional turnover intentions.

It is critical that a consumer of this research bear in mind two important criterium application engineers used when describing their turnover intentions. The first was the degree of importance participants attached to the inclusion of design tasks in the application engineer career. Not all AE's expressed an expectation that their job should involve design or rely substantially on engineering principles in completion of job duties. For those that did, not all held the expectation as being particularly important. Exploring the importance of design expectations intended to capture Porter and Steers' (Porter & Steers, 1973) observation that expectations must "be substantially met if the employee is to feel it worthwhile to remain" (Porter & Steers, 1973, p. 171) and the greater the misalignment between expectations and reality, the higher the propensity to exhibit withdrawal behaviors (Porter & Steers, 1973). The use of the words "substantially" and "greater" imply expectations exist on a continuum rather than as a binary choice. In this study, the low-importance (of design tasks) group did not exhibit the same turnover intentions as the high-importance (of design task) group. If they expressed turnover intentions, low-importance group members tended to express turnover intentions towards positions in management or sales as opposed to design engineering and the strength and timing of the intent was ambiguous. For those engineers that attached high importance to the presence of design duties, the direction of turnover was towards engineering and the intent to turnover was nearly absolute.

The second criteria used to clarify and categorize their intentions was the timing of converting the turnover intent to a purposeful act. This criteria was captured by understanding whether the AE intended to turnover sooner or later. Those that expressed an intent of sooner were likely to be currently looking or had concrete plans to look for alternative work once certain conditions were met. These conditions were remaining on the job long enough to show stable work history, the decrease in Covid's impact on the job market and whether a job meeting their expectations at their current employer was a likely possibility in the near term.

Those within the sooner category tended to be young, no school aged children in the house, held strong design expectations and were not open to job crafting changes implemented to ensure their continuance in the career. To be discussed in greater detail in the competitive advantage and tacit knowledge sections, those that intended to turnover sooner were likely to leave the career just at the point they developed the full knowledge repository required to provide the employer with a competitive advantage.

As relates to the study's theoretical framework, the theory of met-expectations, when design tasks or substantial use of engineering principles were expected to be included in the job's tasks *and* the presence of these tasks was considered important, ninety-five percent intended to turnover to a job that met those design expectations. Of the total sample (n = 39), this placed 46% of all participants at a substantial risk of turnover with 38% at risk in the near term. These participants expressed sentiments that the job contained an insufficient amount of engineering, the job did not meet their expectations and they intended to locate work that met those expectations.

Across the entire sample (n=39), no participant identified the application engineer role as an engineering job. Rather, they tended to classify it as technical sales or possessing limited engineering aspects. Furthermore, no application engineer believed the job required an engineering degree and all believed an application engineering department staffed by non-engineers of sufficient job tenure, mechanical aptitude and an interest in learning, supported by one or two AE's with engineering degrees, could meet the department's customer support mission.

An unanticipated characteristic distinguishing likely-to-turnover AE's surfaced during the interviews, that of the inclusion of being an engineer in their personal identities. Those that felt they were not involved in engineering work expressed concern they were not being engineers and it was important to locate work aligned with their professional and personal identities. Every engineer that intended to turnover and considered design to be important also identified, personally, as an engineer. See figure nine below.

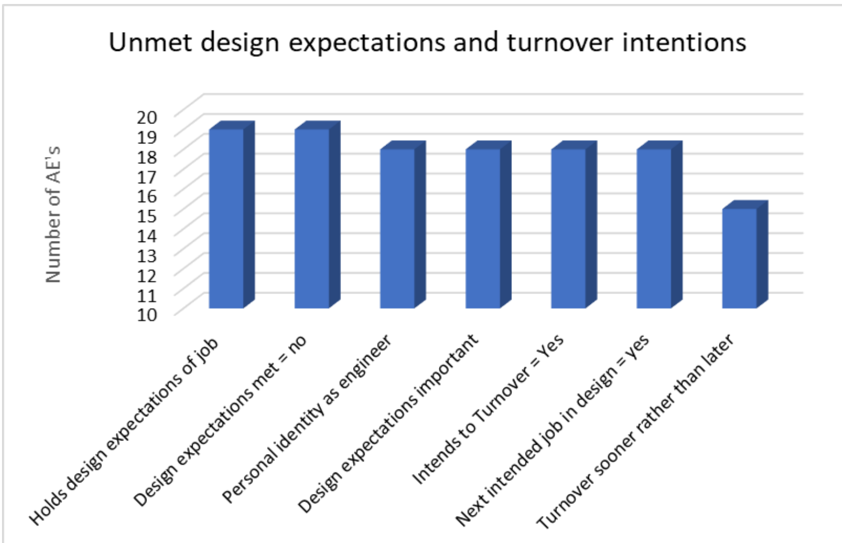


Figure 9. Unmet expectations and turnover intentions

Approaching the theory of met-expectations from the other direction, that of turnover and turnover intentions when expectations are met, those AE's that held an expectation that the job was oriented towards technical sales demonstrated low levels of turnover intentions. Of this group, 72% intended to remain in the career until retirement. Those intending to turnover directed their turnover orientation towards outside sales positions, preferred to remain with the current employer and had no specific timeframe to turnover. Often, the move to outside sales was aspirational rather than with specific intent or timing and was a result of perceptions of unfair compensation practices where application engineers felt the only way to be rewarded for their contribution was to move to outside sales. They often expressed frustration that the AE undertook the bulk of the work leading to a sale but the outside salesmen received the rewards in the form of higher pay through commissions and bonuses. For those directed towards outside sales, the level of AE pay was not a driver of turnover intentions, only the perceived inequity of compensation programs.

As supported in the literature, age and career tenure impacted turnover intentions. While increasing age did not completely eliminate turnover intentions, the rate of highest turnover intent (100%) for those below the age of 33 decreased to 20% for those 45 years and older. Similarly for career tenure. Ninety-three percent of those with less than ten years career tenure intended to turnover whereas only sixteen percent of those with over ten years career tenure, regardless of organizational tenure, intended to turnover. See figure ten.

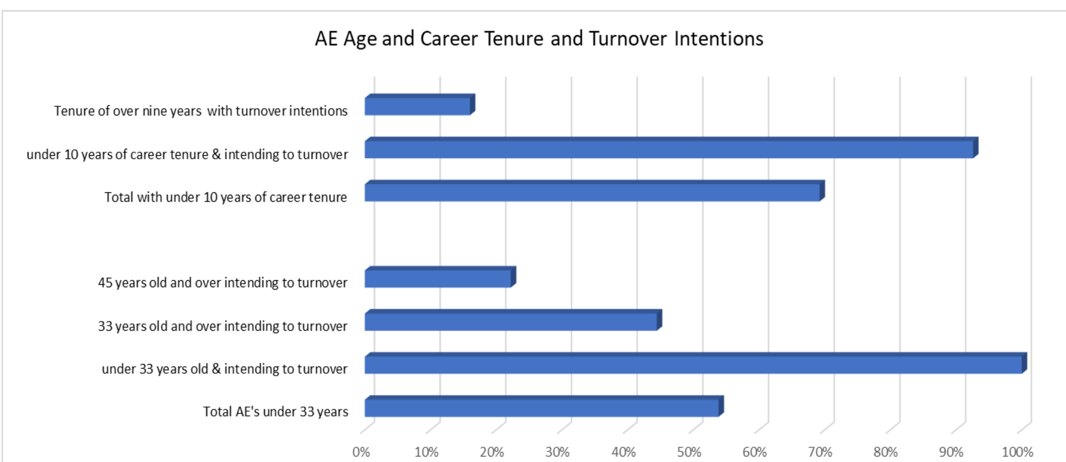


Figure 10. Age and Turnover Intentions

However, age-related components of this study must be consumed critically as the high turnover rates among AE's limited the number of participants capable of exploring their individual journeys over an extended period of time. This research project sought to discover whether and how individual application engineer job expectations changed over time, and, by extension, whether retention strategies should differ between younger and older application engineers. The desire was to allow participants to think about their individual journey but the sample's demographics prevented a meaningful collection of information.

While research finds that turnover and turnover intentions decrease with age and tenure (Griffeth et al., 2000; Ng & Feldman, 2009) and provided justification to explore these turnover themes, the high turnover rate among young application engineers limited the number of participants capable of describing any change in their job expectations and attitudes over time. That 100% of participating engineers under the age of 33 intended to turnover severely limited the ability to understand an individual's attitudinal changes over a long period of time. For those few AE's with sufficient career tenure to recall any changes in expectations, none could recall anything significant as the job was always what they expected it to be. In other words, the job met their expectations.

However, when viewed as a moment in time, this research project identified numerous age-related turnover themes supported by the literature. Taken as a common group, those in younger age ranges were found to be focused on career development and the presence of challenging work tasks. A lack of career progression, perceived unfair pay practices and unchallenging work tasks were contributors to job dissatisfaction (Moss & Frieze, 1993; Freund, 2006; Ng & Feldman, 2009). Older AE's identified the social aspects of the role as a primary reason to remain in the career. Carstensen (1991) describes this pivot in outlook from a utilitarian perspective (e.g., desire for more money to have more things) to a relationship perspective when there is a realization that time on earth is limited and stable social relationships provide greater enjoyment than material gains (Cartensen, 1991; Ng & Feldman, 2009).

The previous paragraphs presented the study's main themes and findings in the aggregate. The following section reviews findings specific to each cohort.

Cohort Specific Findings

Cohort One: Large Cohort – Engineering Career Track in High School

For those in the large AE cohort, those with engineering activities in high school and who entered engineering school because they wanted to be an engineer (n=21), ninety percent intended to turnover. This cohort was at the greatest risk of turnover and, more than other cohorts, demonstrated intentions explained entirely by the theory of met-expectations. For the other cohorts, the theory of met-expectations explained portions of members' turnover intentions but other mechanisms played a role.

A biographical description of this cohorts' members describes them as having decided upon an engineering career around the ages of fourteen or fifteen. Their high school and college academics were selected specifically for a career in engineering, they only applied to engineering schools and participated in engineering oriented activities in high school, activities such as robotics clubs, engineering clubs and STEM (science, technology, engineering & math) summer camps. This cohort's career expectations in high school and college centered on the use of math to solve problems, with design engineering roles as a specific career expectation.

Of this cohort's sample size of twenty-one, representing 54% of the total study sample, seventeen (81%) expressed an expectation that any engineering job they have should entail tasks requiring substantial knowledge and use of engineering concepts, frequently referred to as design engineering but sometimes manufacturing engineering captured this requirement. Of these seventeen, sixteen (94%) indicated it was important that a job meet those expectations. Of these, 100% intended to turnover. Summarizing, most degreed AE's in this cohort thought of engineering work as involving design and of those, most considered the presence of design work as a critical job characteristic to remain in the AE career. If they believed the job lacked enough engineering tasks, the intent to turnover was high. This data is visually represented below in figure eleven.

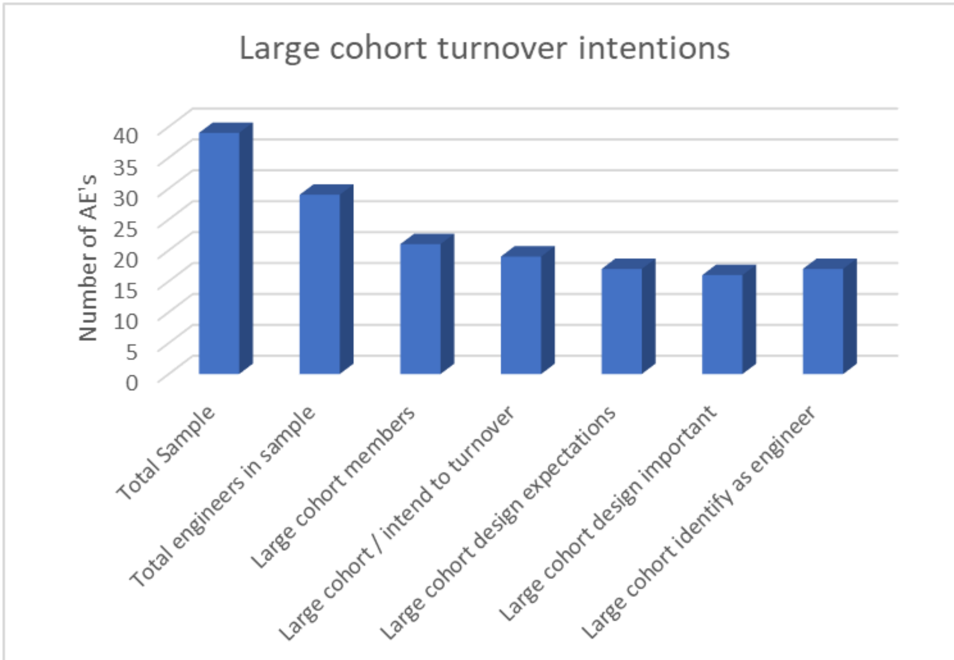


Figure 11. Cohort One Turnover Intentions

In support of this observation, the cohort members expressing an intent to turnover could not offer any solutions an employer might provide as an incentive to remain in the position. Benefits such as remote work, change in pay structure to better reflect their contribution or formal career management programs focused on transitioning from individual contributors to management roles did not dissuade them from an intent to turnover. Residing at the core of this retention challenge was the perception that application engineering is not an engineering job.

Cohort One Expectations (met / unmet)

An inattentive read of Porter and Steer's 1973 paper risks interpreting their findings as pertaining only to met/unmet positive work expectations but P&S were clear that they intended their theory to be applied to "positive and negative experiences" (Porter & Steers, 1973, p. 152) as relates to what an employee expected to encounter (Porter & Steers, 1973). In the cases of cohorts 2 and 4, cohorts occupied by older member, many had sufficient work experience to expect or know that the job lacked design tasks and might lack task variability. This was not the case for cohort one. This group of inexperienced engineers entered job interviews with preconceived notions of what engineer-titled jobs entailed, those being the use of math to solve problems, often within a design context. This firmly held belief combined with a lack of interviewing experience limited their ability to ask probing questions as to actual job duties and tasks.

AE coded as D35 was a childless single 25 year old female working for a manufacturer. She participated in a high school robotics club and a female-oriented engineering club in college and currently belongs to a national chapter of female engineers. This was her first post-college job with a two year job tenure. Both her high school and college expectations, what she described as being "a dream to design things that solved global problems" formed in high school where she saw her mom working as an environmental engineer. She intended to look for work better aligned with her expectations once the Covid pandemic is over.

> My mom worked for a consultant then and they were working on this idea that, if it worked, would capture the carbon dioxide released by power plants. She would talk about how they measured pollution levels and were trying to identify a method to reduce the impact of the worse pollutants. She hasn't done that for a long time now but I know I went to engineering school because, well, I was good at math and liked math, but I wanted to do that. Or something like it anyway. I just kind of thought that was what all engineers did.

When asked to elaborate on her path to her current position, to describe the interview, her job expectations before she took the position and shortly thereafter, she echoed the same narrative as many of the others in this cohort. She had no job prospects when graduating and relied on online job boards to identify engineering positions. She applied, in her words, "somewhat in the blind" to anything with the word engineer in the title and, given that she had to work to support herself, took the first job that was offered.

> You know, it was kind of an eye opener because, in college, everyone thinks engineering is such a hot career that you'll have work the day after you finish. I have no idea why I thought that but, unless you had a really

> high grade point average, career day was kind of a bust. There were something like 300 graduates in my class and only a few dozen openings at career day. My GPA was OK but not great. So I just started applying online, anywhere. I found this job, came in for an interview and well, here I am. I looked up application engineer online before the interview but I don't think it helped much because I, well, I just thought it was something different than it is, you know? I knew it was helping customers with pumps but I thought I would design a pump or, I don't know exactly, like each pump was designed and I would have to do something like design a pump for each customer. For the first six months, I thought I was in a kind of, I don't know, like an apprentiship, and they would eventually teach me the design part. That part obviously never came.

When asked to clarify her expectations and how they formed, she only had a vague idea as to how they formed but her expectations were well defined. She knew her mom's stories, who did work in what this AE considered an engineering role. She also referred to her engineering school classes and clubs as a source of her expectations.

> In high school and college, everything I did was, like, engineering. In high school, it was easy things like designing and building a bridge from

> popsicle sticks and my mom would help me. My college classes and clubs were the same, just harder and, obviously, not using popsicle sticks. I liked it. I liked picking which material would work best or would c-channel or an I-beam be better and then testing it in Autodesk. Sometimes, we could go to the engineering lab and use the hydraulic press to test a design. That was fun. I'm not doing any of that here. Engineering school was hard and it feels like I'm wasting my time here.

This engineer could not recall whether, during the interview, the employer was specific in describing the position as lacking a design component. She spent a few hours with one of the application engineers on her second and final interview but described the experience as being too removed from what she knew and didn't think she learned much about the actual job tasks.

> I just didn't learn much about the job during that 2nd interview. The 1st interview was more formal. I met a couple of different people in their offices, talked about my school and what classes I liked and the company and what they manufactured. The 2nd interview was longer but I think it was less interview and more about letting me see what the job was. There weren't any questions or anything like that. Like I said, I spent a few hours with an application engineer, watched him do quotes, went to lunch with

> my boss and then visited the testing lab. They called the next day and offered me the job.

The preceding interview section illustrated a common challenge many of cohort one's members faced during the interview, a lack of understanding of the job's tasks and purpose. A research stream often using the theory of met expectations to test its' validity is that of realistic job previews (RJP). RJP, a pre-hire technique providing applicants with a realistic view of the job (Baur, Buckley, Bagdasarov & Dharmasiri, 2014), finds that those recruits with previous experience with the job, job information from an existing employee or those that benefit from a concerted effort by the recruiting company to fully explain the job, demonstrate lower levels of turnover (Hom, Griffeth, Palich & Bracker, 1999; Phillips, 1998; Wanous, 1973; Wanous, 1992; Hayden, 2012).

Similarly, a 28 year old male AE coded D28, expressed confusion as to job tasks but, unlike; D35, this AE recalled discussions speaking to a lack of engineering tasks but communicated his preconceived notions and expectations of an engineering position colored his interpretations of what a "lack of engineering" meant.

Similar to the previous AE in all aspects except this engineer was married and developed the idea of entering engineering school after years of watching fighter jets takeoff and land from a base near his house.

> Me and my friends would ride our bikes to a park at the end of the runway and watch F-18's and F-14's takeoff and land. I must have watched every fighter jet movie there was a hundred times and I really wanted to be a pilot. When I was a kid, I thought Maverick was the coolest guy on the planet but my eyesight wasn't good enough to think about being a fighter pilot. But I was good at math and, if I couldn't fly, designing jets sounded fun.

This cohort often had a story as to why they pursued an engineering degree and career. Images in their heads as to what they would do created the impetus to pursue an engineering career at a young age. AE D35 expressed a youth-held desire to solve global problems of an environmental nature, an expectation based on her mom's work, while this engineer had a vision rooted in an experience involving military planes. When asked to clarify how the youth-held desire to work on planes informed his job expectations, this engineer related a desire to work in a cutting- edge industry discovering new ways to improve upon existing designs.

> In college, I had this image of sitting in a room with other engineers talking about some big design change that would make a difference. I can't say what it was, like maybe a wing. Other than being in a rocket club in college, I didn't have any experience with the engineering world. I

> expected to be in a room with other engineers working on a problem and then testing it.

Like the previous engineer, D35 came to his position through an online job posting when a job did not materialize during career day. He did recall the interview as being clear that design was not a substantial element of the job description.

> I know they said something about the job not being design engineering and I remember visiting the product engineers, who do design. To be honest, I don't think I understood that there wouldn't be any design. I can't blame my boss. He told me but I just, I don't know, an engineer not designing something didn't match that image I had in my head. I didn't have a good idea of what the job would be. I thought it would be engineering, or need engineering knowledge, I just wouldn't be designing pumps.

This engineer understood the position was within the sales department and his boss would be the sales manager and not the engineering manager. While he did not expect to be the person responsible for the overall product design, he did believe the job would require more use of his college classes than it does. He has remained in the position long enough to show resume stability before leaving for what he considers an engineering position.

> I did think I would have to use engineering software like AutoCAD or SolidWorks or maybe visit customers to work on plant design. I remember sitting at my computer on my first day looking for SolidWorks. That's all I knew about engineering, from college. We use software, but it is sales software and it does all the engineering work, like viscosity corrections and friction loss, so I'm not really doing the engineering work. You know, I went from this idea that I would be designing jets to doing technical sales. It's not what I pictured myself doing.

Unlike the others, AE D10, understood the position did not entail design and believes he had a good grasp on the duties but accepted the position with the expectation that he would be able to transfer into the design engineering department. During the interview, this childless four-year tenured married 28 year old was told specifically about a lack of design but accepted the position when, after six months of looking for work post-college, nothing had materialized.

> As far as your question about expectations, after college, I did expect to work in design or manufacturing. I wanted to work at Tesla or somewhere

> like that. I knew this job wasn't about design or an engineering job, nothing like product design. But I took it because, truthfully, I needed the work but I was told a product engineer was going to retire. I took the job thinking I could apply for that position later. I'm not sure I would have taken the job if they didn't hold that design position out as a carrot.

As with the other cohort members, this engineer formed an image of what he would do as an engineer while in high school.

> I went to a STEM high school so you can imagine engineering and math were everywhere. Everyone had to pick an area of interest and belong to a club based on your pick. I was into cars and picked a car, well, it was really a go-cart club. We designed carts with batteries, engines, solar panels or anything really. That was my college track, automotive engineering and I joined the same club in college. I expected to do that kind of work after college and applied to places like Tesla and Ford but never heard back.

AE D12, with two years job tenure, was one of the least experienced AE's in the sample. This unmarried male's path to an engineering career began earlier than the other AE's, in elementary school, through the Boy Scouts. As with the other cohort members without school-aged children, he planned on finding a job more aligned with his expectations soon.

> I can say I started to think about being an engineer after I finished getting all those merit badges everyone in Boy Scouts gets when they finish Cub Scouts. You have to pick which badge you'll get next and it is always something you are good at. So the football players went for all those athletic type badges but that wasn't me. I was more of a bookworm and computer kid so I picked the engineering, architecture and technology type badges. I wanted to reach Eagle Scout so I focused on those types of badges.

AE D12 could not recall a specific merit badge or accomplishment that solidified his desire to go to engineering school. He described it as a slow process.

> There wasn't one thing that told me I should go to engineering school or be an engineer although I did like building things and taking things apart to see how they worked. I wasn't a jock and didn't go to parties and things like that. I liked to go to the woods and build forts or build rockets and see how high they would go. I would say that was my thing. I was pretty serious about rockets. If I had to point to one thing that pushed me over the hump it

> was my high school robotics club. That was fun and cool. We built one of those fighting robots and tried to get it on BattleBots.

D12's expectations were solidly built upon the years of low-intensity exposure to engineering and technology while in the Boy Scouts.

> To get a merit badge, the Scout has to spend time with someone working in that field. For my architecture badge, I had to spend time with an architect. Same for the engineering, computer and nuclear energy badges. I visited so many engineers that I thought all engineers designed and invented things or solved problems.

D12's path to the AE position was unique in that he interviewed for a low level product engineer position at his current employer but did not get the job. He was invited back for an interview with the application engineer manager and offered the position. His job expectation was anchored to his years of exposure to the engineering field and, like other AE's, said the hiring manager may have mentioned something about the job lacking design tasks but his high school and college-formed expectations thwarted his comprehensive understanding of the job.

> When I interviewed for this job, I already had in mind what the other job was about, entry-level design working for a product engineer. There was a basic engineering knowledge test, very basic questions about hydraulics. I interviewed with one of the senior AE's and we did a couple of pump selections together. It was using software so there wasn't much to see. I can't tell you what my expectations were beyond what I thought engineers did, all those math and problem solving things I learned in college.

When D12 accepted the job offer, he could not point to expected job duties that formed his pre-employment expectations.

> I would like to tell you I knew exactly what the job was but I can't. I knew it involved working with customers and selecting pumps but I didn't know what that meant. Looking back on it, whatever I thought in college about engineering is basically what I thought this job would be. I didn't know any better.

Of the 21 engineers in this cohort, eighty percent intended to turnover but the timing of the intent (sooner or later) depended on whether they had school-age children at home *and* whether their employer allowed for flexible work hours or remote work. Of the sixteen AE's who considered design as being a critical job expectation, fourteen intended to turnover sooner rather than later. These fourteen engineers did not have school-age children. This is the case for the above engineers coded D35, D10, D12 and D36.

The presence of school-aged children in the house delayed but did not eliminate the intent to leave the career field. If the employer did not offer flexible work arrangements, the AE with school-aged children intended to turnover sooner rather than later. Without flexible work arrangements, there was nothing holding the degreed AE to the employer. Figure twelve below provides visual representation of this data.

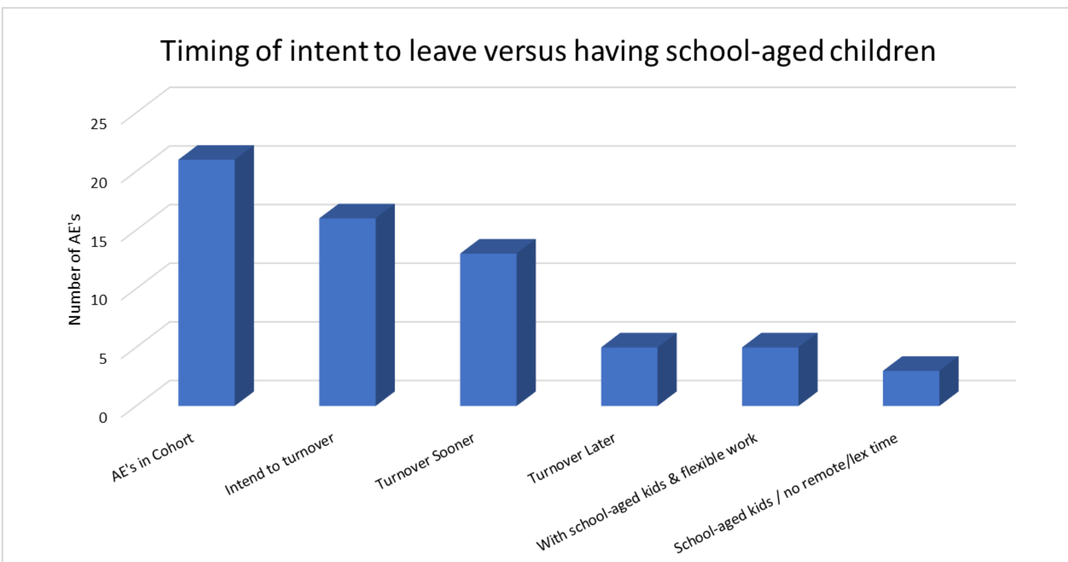


Figure 12. Children's Impact on Turnover Intentions

Porter & Steer's met-expectations, while capable of determining the strength of an expectation, was not formulated to explain why employees remain with organizations under conditions of low job satisfaction and unmet expectations. This question was relevant to this study as the ultimate intent is to devise recruitment and retention strategies reducing AE turnover for the purpose of exploiting AE knowledge in the pursuit of competitive advantage. What theory can be brought to bear to retain experienced AE's in the face of unmet expectations?

In this, the theory of job embeddedness (TJE) (Mitchell, Holtom, Lee, Sabliynski & Erez, 2001) provides an explanation as to why those AE's with school-aged children *and* flexible work arrangements chose to remain on the job. TJE recognizes many things influence employee retention. In addition to job satisfaction, TJE anticipates the connections people have with other people or activities relating to the job, the work environment and finally, sacrifice, what would have to be given up if they left, influence employee turnover decisions. Individually or collectively, these factors can reduce turnover intention despite low levels of job satisfaction (Mitchell et al., 2001).

Without a flexible work environment and the benefit it extended to those AE's with school-aged children, the entire cohort would be at significant risk of turnover sooner rather than later. However, it needs to be recalled that the presence of a flexible work environment could not incentivize those without children to remain in the career. Parenthood creates the environment in which job embeddedness theory potentially moderates turnover intentions but flexible work arrangements is what activates the theory's moderating effects.

AE coded as D26 fell within this child-at-home group. D26 is a married 29 year old female with five years' work tenure as an AE. Her current AE role was her first post-college job. As with the previous AE's, she began her path towards an engineering career early in high school when her guidance counselor recommended a summer STEM (science, technology, engineering and math) program. She said the program first attracted her because it allowed her to substitute a number of regular classes in high school with the program's credits and her older friends said it was easy. Her vocational interest in engineering didn't materialize until later but her interest and expectations remained firm through the last years of high school and throughout college.

> I wasn't too interested in engineering those first few years. It was just an easier way to receive a few high school credits than taking actual classes and I thought it would look good on a college application. When we got older, we visited engineers so we could see what they did. For me, it was a visit to a protein processing plant that made the protein powder my dad and I used. I was a high school athlete and my dad was kind of a fitness nut and we used this one brand of protein powder that was made at this plant. That

> was interesting, to see how it was made. There's a lot of engineering to it and I thought I might work there. You know, combine my athletic interests and my math skills to do something interesting? I went to chemical engineering school mainly because I thought I could work designing systems like the ones at that protein plant. I was just a kid, maybe not very realistic but that was what got me interested in engineering.

Like the previously discussed application engineers, D26 found the position lacked the engineering work deemed necessary to remain in the career. As with others, she also pointed not only to a lack of engineering tasks but also a lack of challenging work as primary contributors to dissatisfaction.

> I did expect my job to use more of the engineering I learned in college. Engineering school is hard and I spent a lot of weekends doing homework when my roommates were going out so it feels like I owe it to myself to do something that uses the things I learned. This job doesn't use any of it. Not much anyway. And it is pretty much the same work every day. The first few months were interesting because I was learning new things all the time. But after a few years, there aren't enough new things to challenge my brain.

When queried about her future intentions, she offered that she wants to find another job but will wait because she has a preschooler at home and her employer allows her flexible work hours.

> I interviewed for another position that was in manufacturing engineering. I liked the job but I was going to be tied to work depending on what was happening in the plant. My husband travels for work and, with a small one at home, not having a fixed work schedule wouldn't work. Here, I can leave and take my daughter to the doctor or come in late if she was up all night. Nobody cares as long as I'm getting my work done. If it weren't for the flexibility, I would probably have left already.

AE D5, a 29 year old married male with four years tenure, had turned in his two-week notice when working under inflexible work hours created a stressful personal environment when conflicts between work and caring for his elementary school-aged son emerged. The new employer also lacked a formal flex work policy but was within a few miles of his house and offered D5 a position in service engineering, something he said was closer to his job expectations. In an effort to retain D5, the current employer offered a number of incentives, including the ability to work remotely. When the hiring employer could not offer remote or flexible work arrangements, D5 determined remaining with the current employer was best for his life stage.

> I don't like this job very much. It can be boring and repetitive and I do want to work in something closer to engineering eventually but I need to be able to cart my kids around when the wife can't. She works shift work so there are times we don't see her for a few days unless we look in the bedroom. Our schedules are just out of sync. When they offered me remote work, all the stress of taking care of the kids just evaporated. I'll probably look for a different job when all the kids are in middle school but for now, I'm O.K. working as an AE.

The open-ended research method revealed an unanticipated turnover mechanism that provided some clarity as to this cohort's unmet expectation, that of identifying personally as an engineer. Being an engineer appeared to be part of their identity and if they were not doing what they perceived to be engineering work, conflict emerged between their work and personal identities. Of the 21 cohort members, 17 identified personally as an engineer. Of these 17, 100% intended to turnover. Within the total sample of 39 application engineers, 19 identified personally as engineers and 100% of these intended to turnover.

Captured within the broader theme of professional identity, which refers to "the extent to which employees perceive their profession as central to their self-concept" (Wen, Zhu & Liu, 216, p. 1234), where the individual's profession is more salient than the organization (Ashforth, Joshi, Anand, & O'Leary-Kelly, 2013), the phenomenon of engineer identity, as relates to turnover intentions, finds explanation in the blending of the undergraduate engineer education literature and the broader professional identity literature. As these cohort members were recent college graduates, the education literature provided insight into this young cohort's elevated turnover intentions.

This literature stream investigates why some undergraduates persevere and graduate such a demanding undergraduate degree program(s) while others fail. In this, research finds that development of an engineer professional identity is critical in completing an undergraduate engineering degree (Lakin, Wittig, Davis & Davis, 2020). While an interest in some specific engineering career aspect (design) or goal (solve environmental problems) better predicted a student's graduation than did academic ability, such as math, or the presence of an influencing figure such as a parent of teacher (Seymour & Hewitt, 1997; Mangu, Lee, Middleton & Nelson, 2015; Pierrakos, Beam, Constantz, Johri & Anderson, 2009), a student's self-image and sense of self as an engineer provided greater explanatory value of graduation (Matusovich et al, 2010). Further complicating the practitioner's effort to retain this young cohort is Trevelyan's (2010) findings that engineering school graduates possess rigid perceptions of what engineers do, beliefs formed while in college, where the instructional focus is on design and problem solving with little exposure to the social aspects of the engineering career field (Trevelyan, 2010). Students and recent graduates form concrete ideas of what is and is not "real engineering work" (Taylor, Lutz, Hampton, Lee & Waterford, 2017, p. 2; Trevelyan, 2010).

The vocational interest literature provides further explanation as to this cohort's near universal turnover intentions. This research stream finds vocational interests formed during youth are still strong through the mid-twenties and begin to diminish soon thereafter. (Low, Yoon, Roberts & Rounds, 2005). Not only did these engineers identify as engineers but the occupational vision they had of themselves when young remained salient in their minds.

The theme of professional identity and turnover intentions identified in the literature often explores professional identity as a moderator of turnover intentions despite inadequate levels of retention related organizational and individual factors. These studies find employees with higher levels of professional identity exhibit lower levels of turnover intentions when job tasks performed are related to the professional identity despite high levels of dissatisfaction. This cohort's engineer-identifying members work under conditions of low professional related tasks and exhibited turnover behavior as the literature predicts. (Wang, Xu, Zhang & Li, 2020; Zhang, Yang, Liu, & Meng, 2018; Hong, 2010; Das, 2012).

AE D16 was the first to surface the concept of engineer identity when describing a conversation he had with a family member.

> I had only been here for five or six months when a younger cousin, who was in engineering school at the time, asked about the job. I was short in my answer because I was, not exactly embarrassed, but didn't feel like I was an engineer. It just felt odd, like I couldn't say I was an engineer.

When asked to explain what being an engineer meant to him, he stated he wasn't doing the kind of work he thought engineering should entail. He was doing another job that had the title engineer.

> I feel like I should be doing engineering work, designing things. That is what engineers do, like solve problems. We are supposed to be problem-solvers, you know? Be the people that solve problems others can't because they don't have the degree or knowledge. It's like one thing is to say I am an engineer and another is to say I work as an engineer.

AE D15's view was similar but thought the use of the term engineer should be limited to those with an engineering degree.

> Don't get me wrong. We have an AE here that isn't an engineer and she does a great job. She knows a lot but I get kind of upset when she is described as an engineer. I know it comes across as mean but I went to engineering school and I'm an engineer. It's just that I'm an engineer not really doing engineering work. It's only a job and shouldn't make a difference but when people ask me what I do, I tell them I'm an engineer. But I don't really feel like one. It feels like I'm, not really lying to them but I feel like I should qualify what I say. Especially if I know they are an engineer. I expect them to ask, 'Oh, do you think you'll try to find real engineering work?"

AE D9's response was unusually emotional, not quite agitated but disappointment clearly permeated his answer.

> I'm glad you asked because it is really at the center of my thoughts. I understand the point of your research, about expectations but this idea of identifying as an engineer versus working as an engineer is what frustrates me and one of the main reasons I'll leave here. I don't think I'm being an engineer, like the way a medical doctor isn't being a doctor if he, I don't know, owns a Subway instead. You know? Can the doctor say he is a

> doctor if he owns and works at the sandwich shop? I don't feel like I can say I am an engineer.

AE D25 had only been out of engineering school a few years and clearly recalled feeling like an engineer as soon as he graduated.

> As soon as I had that diploma, I felt like I was an engineer. It was crazy because it wasn't when I finished my classes or my finals and knew I passed. It was that piece of paper. Before, when people asked me what I was going to do, I would say something like I was studying to be an engineer. But as soon as I had the diploma, I was an engineer. My friends, like the ones with business degrees, didn't say "I'm a business person." But I felt like I was an engineer.

D25 required some introspection to communicate what was meant by "I am an engineer" especially within the context of the current AE job.

> It just doesn't seem like I'm an engineer. It's hard to describe. I know the title is engineer, which is cool. But I'm not really doing engineering work so I don't feel like an engineer. I have a buddy who works at a defense contractor in design and, to me anyway, he is being an engineer. I would

> love to do something like that. I will someday when the world is normal again.

D25's use of the words 'be" and "am" when describing his status as an engineer was also used by AE D28 when describing his thoughts on identifying personally as an engineer.

> I don't have this idea that I am being an engineer here. Yeah, I'm doing engineering work, kind of, but I'm not an engineer. Not really. It's strange because, when I go to ASME meetings, I'll say I'm a mechanical engineer because you have to have a ME degree (*mechanical engineer*) to join but I don't feel like I'm an engineer. I can't tell anyone what I am working on or designing or give presentations because I'm not doing any design work. I feel like an outsider when I'm there.

These sentiments track what all participants said about the career. It does not require an engineering degree. The universal belief was that an AE department, as long as there was one degreed engineer on staff to answer questions, could function properly with motivated non-engineers.

Cohort Two: Degreed Engineer – Good at Math

The second cohort was populated by degreed engineers who entered engineering school for reasons other than a specific desire to be an engineer. Seven entered engineering school as freshman and two transferred from another college major. These cohort members described their entrance into engineering school as being driven by factors such as an enjoyment of and ability to do math (engineers use math and I like math), thought engineering was a respectable career with good job prospects or had a relationship with an engineer (mom/dad/aunt was an engineer). These cohort members did not participant in engineering extra-curricular activities in high school and, on average, were older than those in cohort one (38 years versus 31 years old). All but one of the older engineers had significant work experience in other engineering fields and came to the AE career later in life.

Of the two degreed engineer cohorts, this was the smallest, with nine cohort members representing 23% of the total study sample. Fifty-five percent (qty 5) expressed an intent to turnover whereas the larger degreed AE cohort demonstrated a ninety percent turnover intent rate, figure thirteen below. The difference between these intentions was the direction and timing of the intent, figure fourteen, with all cohort one (large cohort) members intending to find work in the engineering field sooner rather than later whereas cohort two intended to search later for positions in either sales or management with two directed towards design engineering positions.

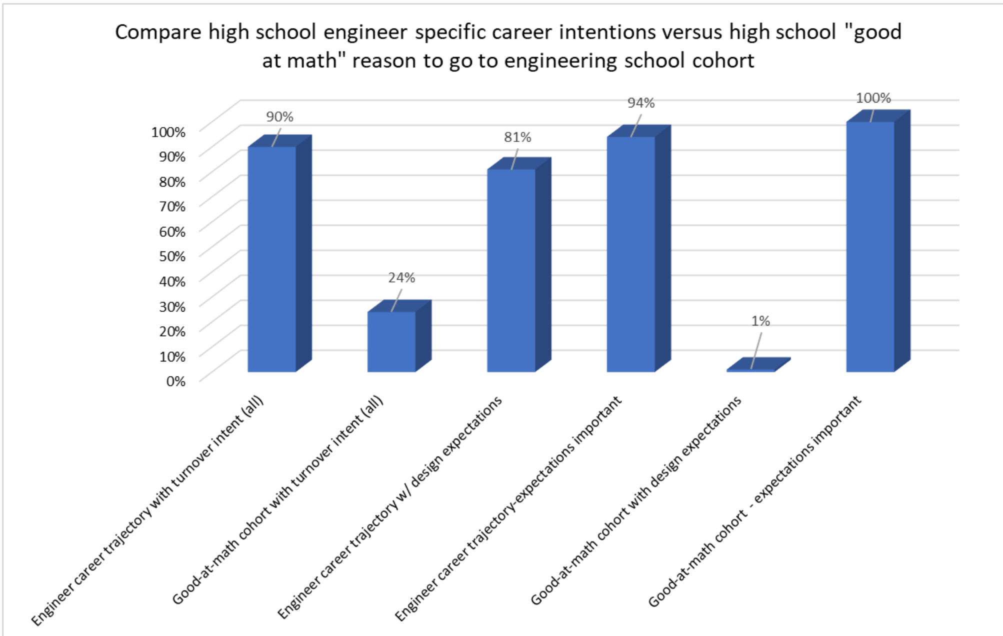


Figure 13. Engineer school decision

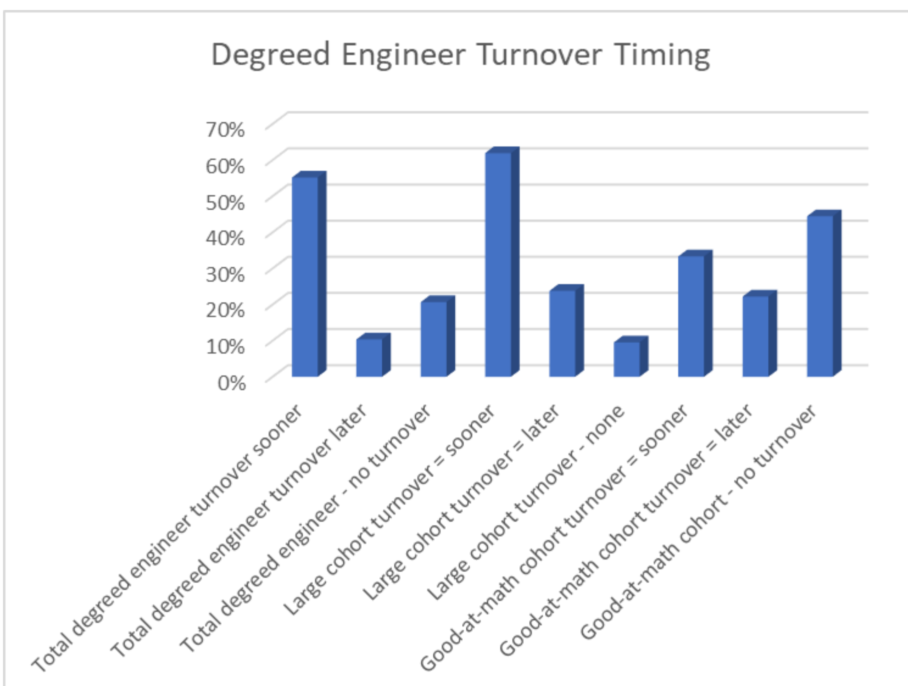


Figure 14. Turnover Intent Timing

Cohort Two – Path to Engineering School and the AE Role.

AE D14, a 35 year old married male with five years' tenure as an AE and ten years tenure working as an engineer, entered engineering school after a year in an undergraduate degree program lacking stable employment prospects.

> I did like my undergraduate program and didn't want to change degrees but nobody, literally, nobody was getting a job after graduation. Luckily, my school had an engineering program and I have always been good at math and had good SAT scores so transferring was easy. I just wanted to be in a career that was stable or had enough demand that I could find work if I needed to.

AE D13, a 35 year old married female with 13 years tenure as an AE, had a similar experience but she transferred from a math-centric science undergraduate program to engineering school when she realized working in that field was not what she thought it would be.

> I just couldn't see myself doing that job for a career. I liked the classes but the folks working in the field are never home, they can be out in the field for months in all kinds of weather. You have to really love the job to be away from home that long, you know? And I wasn't sure I liked the classes

> that much! My dad was still working as an engineer then so engineering was always kind of a Plan B. Growing up and in college, I spent time in his office, especially over the summer, so I had some idea what engineers did.

AE D32, a single 28 year old male with four years tenure who identifies as an engineer, holds design expectations and plans on turning over once an engineering position becomes available. He went to engineering school because his guidance counselor suggested it based on his math scores.

> I was a good student but not very focused on one career or another. Math came easy to me and engineering school was what people in my school did if they were good at math. I didn't give it too much thought, I just said, OK, I'll go to engineering school.

AE D25, a married 27 year old male who identifies as an engineer and intended to search for a job more in line with his engineering expectations, decided upon the career due to an enjoyment of math and physics. Like D32, and unlike those in the first cohort, he had no images in his head of what he would do as an engineer.

> I didn’t have this grand idea about what I would do with an engineering degree, not like some people. I liked math and physics and engineering was what you did when you were good at math.

AE’s D39 (age 49) and D17 (age 46), both married males with no intent to turnover, came to the career later in life when the AE career presented opportunities for a more stable work/life balance. Both knew their current employer on a professional basis and felt they knew what the application engineer career entailed.

AE D39 was a customer of his current employer and was ready for a career change.

> I had spent decades dealing with plant emergencies. I never knew if my weekend would be free or if my phone would ring in the middle of the night. The job was fun when I was single and had no kids but it was time to let someone else have fun. I knew the application engineer that handled my account had left and I knew his boss, who is now my boss. I make less here but when I leave the building, my time is mine and the stress is almost non-existent.

D17, having spent numerous years in the same position, stated he was ready for a change. He had occupied the position he held prior for so many years that it was no longer interesting.

> I was bored. My kids were out of the house, I didn't need to make the same amount of money and I had a long drive to work. I can get to work in ten minutes now. This company was one of my suppliers and I knew the application engineers and the service technicians so I had a good idea of what the job was. It's not the perfect job, it can be repetitive but I'm home by 5:30 and can work out of the house every other Friday so this is good for me at this age. I don't see a reason to leave.

AE D2, a 32 year old married male with turnover intentions, had a unique path to engineering school in that he spent a year working in construction before going to engineering school.

> I wasn't sure what I wanted to do after high school, I mean, I did well enough but graduation came and went and I had no plan. A family friend owned a contracting company so I worked in construction for a year. Man, let me tell you, it did not take long for me to realize that wasn't for me. I

> liked math and engineering was always somewhere in my mind but a year on a construction site convinced me I better get serious.

Cohort Two Expectations (met/unmet)

This group's expectations were not as uniform nor as concretely stated as cohort one's expectations. With the exception of two (D32 and D35), none included design duties as part of their job expectations or personally identified as an engineer. This did not remove the intent to turnover entirely but the turnover intentions, where they existed, were driven by other job and organizational factors.

Instead, these cohort members pointed to job boredom, lack of challenging work tasks, repetitive job tasks and perceived unfair compensation practices relative to those working in outside sales. In this regard, the application engineers believed they did most of the work leading to a sale but were paid far less than the outside sales force. This concern with pay equity existed within all cohorts except cohort one but only members of cohorts two and three considered it sufficiently important to lead to turnover.

AE's D39, D3, D30, D17 and D14 all came to the career expecting the job to provide a personal benefit that their previous engineering position did not. None of these expectations included design or the substantial use of engineering concepts in undertaking the position's duties.

D39, an experienced 49 year old engineer expected the position to provide a level of predictability in his work life while exposing him to new things.

> I understand your study relates to engineering expectations but I can't say I had any concrete expectations of doing engineering work when I took this job. I've been an engineer for 25 years and I don't find it as important as I did when I was young. I expected this position to provide the things we talked about earlier. I wanted to be left alone at night or while on vacation and maybe learn new things. I knew pumps from an end user's perspective but not from a design perspective so this has been fun. I get to learn about design but I'm not responsible for it. As far as I'm concerned, this job has met my every expectation.

AE D3, a 57 year old male engineer, had worked his entire career as an AE with the same employer. His narrative is unique in that he felt a sense of loyalty to the company's owners due to flexible work arrangement when health issues befell his family and he was permitted to care for family while fitting in work when he could.

> I have been here so long I can't remember what I expected when I finished college almost forty years ago. But to help your study, I can say I like this

> job because my customers are my friends and the social aspect is important to me. You could say it is a job expectation in the sense, if for some reason that I can't fathom, I left, I would need to work in a place where I felt I was helping friends solve a problem at their plant. That would be an important expectation. I get to do that here every day.

AE D30, a 33 year old married female with school-aged children, entered engineering school in belief it would lead to a stable job.

> I was never one of those engineers that wanted to invent the next great thing and I was lucky in college. I could do math and engineering school wasn't all that hard. If it were hard, I don't know if I would have been interested enough to keep going. When I interviewed here, I just wanted a sense that the company was stable and I could be here a long time. As long as I think the company isn't going anywhere, I probably won't either.

When asked what part of the job she liked and which parts she disliked and whether any of them were related to her expectations, she could only offer that she liked helping people but she wasn't sure it raised to an expectation.

> The job can be the same thing day in and day out and that can get boring but not enough to make me go somewhere else. I do have a couple of customers that I work with a lot, like a lot, they always seem to have one problem or another. So, yeah, I'll say I like that part of the job but I can't say it is an expectation. Like I said, I just wanted to work somewhere that wasn't going anywhere any time soon.

D17, a 46 year old married male, previously worked for an engineering consultant and found the work schedule and culture demanded too much of his time. He wanted an engineering position that allowed him to leave the office at five and leave the work at the office.

> Working at a consultant is a big ego boost, especially right out of college. For the first four or five years, I was all about the job. I worked nights and weekends and thought I was doing great. I was like, yeah, I'm an engineer! The job was interesting and the pay was good but I was so caught up in it that I didn't realize how miserable I was. I put on weight and my golf game went down the tubes. Anyway, this company sold the pumps used on my projects and I knew the application engineers so I had a good idea what the job involved when I took it. I go home at five and I don't take a laptop with me on vacation. That was really my only expectation, I wanted to have a

better work life balance and stay plugged into engineering, even if it isn't really engineering like I knew it.

D14, a 35 year old married male with school-aged children, came to the AE career when life changes in the form of an upcoming marriage with children planned soon thereafter. His previous engineering job required frequent travel involving extended stays. He stated he enjoyed that job more than the AE position but it was not conducive to married life.

> I needed a job where I could be home at night, or at least most nights. I travel a few nights a year here but nothing like my other job. That was my only real expectation when I took this job.

Further inquiry established what he liked and disliked about the job and whether any of them met or did not meet his expectations.

> I'm not one of those engineers that has to design things and I don't want to. I'm perfectly fine quoting pumps all day long. It can be monotonous at times but it doesn't bother me. I like being able to do some boring things sometimes. I have flexible work hours to take care of my kids and nobody is looking over my shoulder to see if I'm working or not.

D14 did intend to turnover but the intent was weak and without a specific time frame. His concern was that if he did not seek promotion, he was not working to his full potential. He viewed the AE position as an entry level position.

> I do think, sometimes, that I owe it to myself and my family to move up the ladder into management. Staying as an AE for the next twenty years feels like a cop-out, like I'm letting myself get too comfortable. But it's not because this job doesn't meet one expectation or another. That would probably miss the point.

AE D13, a 35 year old married female with school-aged children, followed a deliberative pathway similar to D14's, where a transition to management was a future plan but flexible work arrangements held her to the AE position.

> We have an engineering manager that has been on the retirement wagon for a few years so I've been, I guess, lazy waiting for him to retire. We talked about this job earlier, it can be boring and I don't think I've done a different thing in five years. I've been at this for so long that things have become awfully routine But I have great work hours that let me be a mom and take care of all that mom stuff. But my kids are older and run around under

> their own steam now so I'm thinking I can find something more challenging. I don't want to be in sales so management seems like a logical choice.

Like other engineers in this cohort, her expectations were not driven by a desire to do design. Her dad was an engineer and she liked math, which led her to engineering school but design was never a concrete desire.

> Designing pumps or whatever else has never been part of my makeup. My dad worked for a tractor manufacturer and that's what he did. He has patents and all these design drawings all over the house. I just never aspired to do what he did. I was good at math and he had contacts at the university, so it was easy to get in. I had no idea what I wanted to do so I took the path of least resistance.

This role was D13's first job after college and a thirteen year job tenure has not been supported by a specific job expectation being met or unmet.

> You know, after we talked about the interview and your study, I thought about what I expected from this job, as an engineer, and I just can't think of anything specific to the job itself. I expect the company to pay me and be

> flexible if something comes up but I just don't have any specific engineering expectations I can point you to. I like the job enough. I like my customers and some of us have kids on the same soccer teams and things like that. Maybe the job variability thing we talked about but I can't tell you I have this expectation of doing different things every day. I know I get bored when I do the same types of quotes all the time but I can't say it is an expectation.

AE D2, a 31 year old married male, is the only turnover-oriented AE who intended to turnover towards sales but sales was not a career aspiration. This engineer said he could not think of any particular expectations he had of the job when he accepted the offer shortly after graduation.

> I struggle to think of one or two specific expectations I had of this job. I knew it was an inside sales job and there wasn't a lot of engineering and I was OK with that. I had buddies in college that only wanted to work for a consultant or manufacturer and they thought it was a waste of my engineering degree to work here but I was never that kind of engineer in college. Engineering school was just a means to an end.

When clarifying what that end was in his mind, he offered it was to work in a field that had a number of different career paths and was a job that paid well.

> I wanted flexibility I think, like I didn't want to be stuck in one career like a teacher or nurse might be. I thought I could do many different jobs with an engineering degree and I could find work that paid a lot.

His turnover intentions weren't expectation driven but rather, by frustration with perceptions that the salesmen receive the benefit of his work through commissions and bonuses while his pay did not reflect his contribution.

> I know the sales guys work but the AE's do most of the work, and sometimes all the work, to get the sale and I know the salesmen make a lot more money than the AE's. Since I'm doing most of the work, I might as well find a way to get paid for it.

For the cohort two AE's reviewed thus far, those that expressed turnover intentions were being pushed away from the career more so than pulled to another role given their expectations, as was the case with cohort one. To understand whether those AE's intending to turnover could be incentivized to remain in the career, they were asked if there were any job or organizational modifications that would eliminate their intent to turnover. All AE's said there were changes that could be made, namely, change compensation programs to better reflect their contributions, allow for flexible work arrangements, implement job crafting changes that allowed them to spend time in other areas of the company to increase task variability and permit customer visits to allow for a better understanding of the environments in which the pumps are used and for a change of scenery.

The sales-oriented AE D2 indicated a change in the compensation program would be enough to retain him as an AE.

> I like this job. I like helping people and the technical side of the job. Like I said, it's just the compensation program that irks me. If they provided a bonus or commissions that was based on the work I do, I would be OK as an AE forever probably. Like I said, it's not the pay level itself. And maybe let me visit customers a couple times a month. Being cooped up in the office can be a grind.

As D2's turnover intention was driven by a perceived unfairness in pay relative to someone else's and the reversal of this intent involved a compensation program addressing D2's concern, Adam's equity theory explains this AE's turnover intention better than met-expectations. Adam's equity theory posits that employees compare the ratio of their inputs and outcomes to those of other employees. When this analysis leads to an unfavorable conclusion, the employee attempts to restore equity be reducing effort or leaving the organization (Pohler & Schmidt, 2016).

D13, the management-bound AE saw the path to retention through a change in job duties. She pointed to doing fewer routine quotes that a newer AE could easily manage and spend time in another department to create some change in her days.

> I am trying to change some of my job duties now because I don't think the engineering manager is going to retire soon. I want the newer AE's to handle all the routine quotes, like the 10 horsepower water pumps and all those administrative tasks like order follow up. I'm also trying to convince my boss to let me spend more time in our engineered skid department, even just a few hours a week or maybe manage one product category over there. If I could get away from the routine parts of the job and do something new, my attitude would probably change overnight.

D13's turnover intention mechanisms aren't solidly linked to a particular expectation(s) other than, perhaps, an unstated connection to engineer expectations in general, which is an expectation the work be challenging and varied (Igbaria &

Seigel, 1992; Franca, da Silva & Sharp, 2020). Her particular boredom was preconditioned by Harju and Hakanen's routine, where familiar and often repeated tasks can be completed with little cognitive effort (Harju & Hakanen, 2016). In this she was explicit, particularly when she contemplated what job changes might reverse her intent to move into management, which, in itself, was an attempt to find a position with more task variability. D13 did not claim management as a specific career objective and was undertaking her own effort at job crafting, a self-directed effort by employees to modify aspects of their jobs to improve the fit between their needs and the job's characteristics (Tims, Bakker & Derks, 2013), to eliminate her turnover intentions.

The remaining two AE's intending to turnover did expect engineers to do design work, currently held that expectation as being important and personally identified as engineers. These under-thirty engineers were more like those AE's in cohort one in their expectations despite a lack of engineering activities in high school. Both of these engineers expected their next jobs to involve design engineering duties.

AE D32, a single 28 year old currently applying to other engineering positions, felt the effort required to complete an engineering degree deserved a career that reflected the effort.

> Engineering school isn't easy, it's a lot of work. My business major roommate went out and partied while I stayed behind and did differential equations and statics' homework. I don't hate this job but it is not what I spent four and a half years of engineering school for. When I graduated, I expected to be designing manufacturing systems or working at an oil refinery or something like that.

AD25, a married 27 year old without school-aged children, expected to renew his search for other employment once Covid was over.

> I was already looking for work when Covid hit. The local consultants are my customers and I was using the people I know to find a way into one of them.   Before Covid, I was at their office once a month for project management meetings and, I can tell you, it just felt like that was where I belonged. They are working on these advanced powerplant designs and that is what I wanted to do in college. Not powerplant design necessarily but working on new technologies. It's hard to call a pump a new technology. I like the people I work with but this is not what I thought I would be doing after college.

Neither AD25 nor D32 were able to conceive of a change in job tasks that would incentivize them to remain as an AE.

Those cohort members without turnover intentions expressed an enjoyment of the career with the social aspects of problem solving a common contributor to job satisfaction. It was not uncommon for these engineers to consider their customers among their friends. These sentiments were particularly relevant for the three older AE's, D17, D39 & D3, all over 45 and with no fewer than 15 years' experience. All pointed to the social aspects as one reason for remaining in the field.

AE D39 came from an organization where social contacts were not an organizational or occupational characteristic and was surprised that such a thing as work-friends existed.

> I came from an environment that moved so fast that there wasn't time for these social ties to form. It was all transactional between me and my vendors. Here, after fifteen years of working with the same ten or twelve customers year in and year out, you get to know them and their work problems. You know their wives' names and if their kid is out of high school. Just personal details. So being able to help them out of a jam is fun. Don't get me wrong, I still want to leave by 5:00 but if they call me on a weekend, I know they are in trouble and I'm happy to help.

Age appears to play a role in the good-at-math degreed engineer cohort. In the good-at-math cohort, the three older engineers, over the age of 45, did not intend to turnover. The younger age range, thirty-five and younger, with the exception of one, intended to turnover. The AE that did not intend to turnover had school-aged children and flexible work hours that allowed for parental duties as they may arise. Figure fifteen presents the overall degreed engineer turnover intent rates by age group, regardless of degreed engineer cohort.

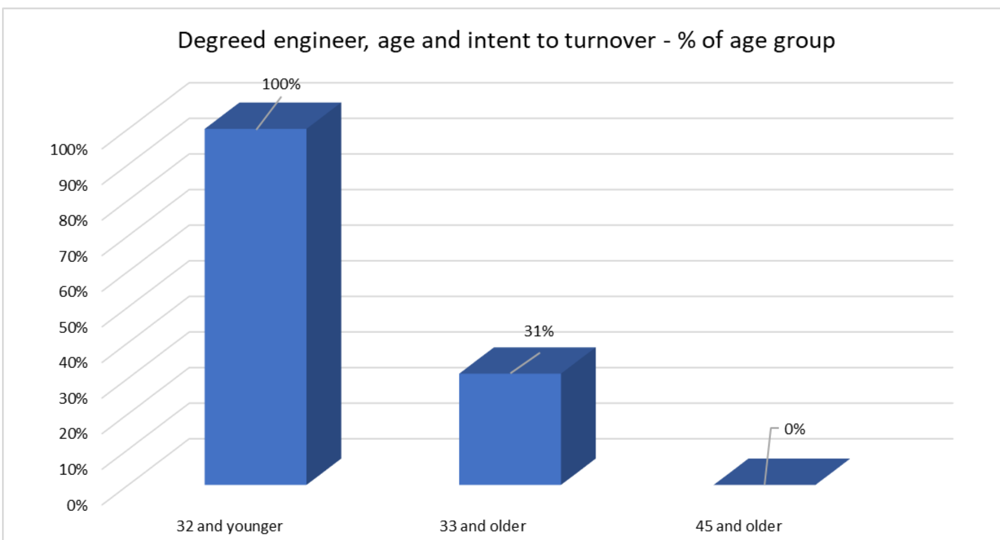


Figure 15. Degreed Engineer Age and Turnover Intentions

Figure sixteen presents the noticeable impact having school age children *and* flexible work arrangements has on delaying the intent to turnover among degreed engineers. While they all intended to turnover, when flexible work arrangements existed, the intent to turnover was delayed until the children were older.

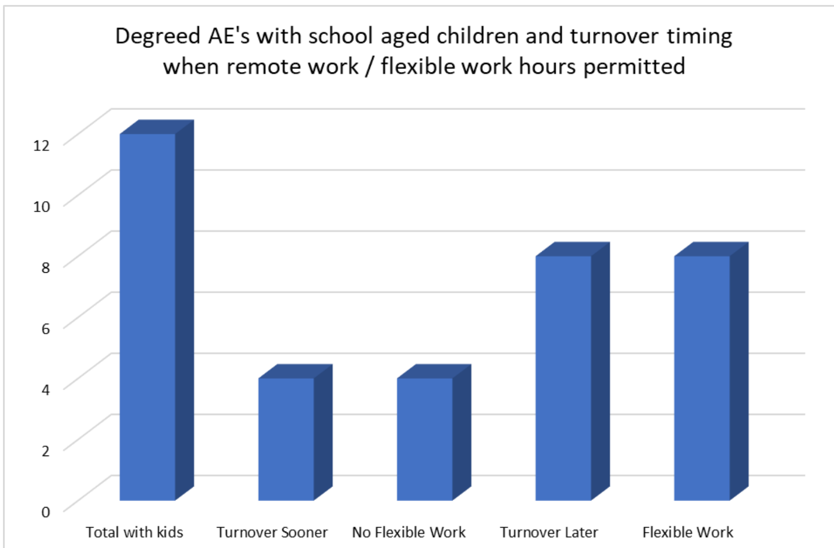


Figure 16. Children and turnover intentions

As with cohort one, the larger cohort, the theory of met-expectations did play a role in cohort two but it’s theoretical application was not as uniform. In some cases, turnover intentions where driven by unmet expectations and in other cases, the position met their expectations but, without job crafting, those met expectations were insufficient to prevent turnover intentions.

Those AE's that stated any job they have should involve design and those expectations were held as important, the intent to turnover was unambiguous, sooner rather than later and the direction of the turnover was towards design engineering.

Met-expectation's influence on turnover remained for those AE's that intended to turnover but the retaining influence of any met expectation(s) was countered by reasons unrelated to a specific expectation. Their propensity to turnover was driven by job boredom or concerns with perceived pay fairness. Those that intended to move into management presented an interesting dynamic in that the desire to manage others was not a vocational goal seen as a required stepping stone to further ascension up the organization chart. Rather, it was an attempt to solve the problem of job boredom. This also raised the question as to whether there are unspoken or hidden expectations? Is a job that is not boring an expectation? These AE's did not elucidate this as an explicit expectation.

Cohort Three: Non-Degreed AE's – Younger

The third cohort, the smallest of the four (n=3), was those AE's that did not have an engineering degree, were younger (under 33) and came to the AE career soon after high school or college and had only one or two jobs before becoming an AE. These AE's were only found employed in distribution, had previously worked in an inside sales or service role in a similar industry, had been exposed to the application engineer role before taking the job and knew their current employer before working for them.

Path To The AE Career.

AE D4, a 33 year old married male with school aged children, a four year non-engineer college degree, nine years tenure and no turnover intentions, started in spare parts sales at his current employer and moved into application engineering a year later. He described the spare parts position as a job the company places those that might have the skills to become an AE later.

> I wasn't interested in that spare parts position at all. I was already doing inside sales at another place that sold to this company but they said if I did well and showed I could manage customers, I would likely move into an engineering position, which I thought was crazy. I was a business major. But they said it was more of a title than a job description. The place I was working was a dead end job so I took the parts sales job here. A year later, they moved me into application engineering.

AE D37, a 30 year old married high school graduate with school aged children, six years tenure and turnover intentions, worked at one of his current employer's suppliers and knew the sales manager through that job.

> I know my boss from my first real job out of high school. I had a route sales job and this was one of my weekly stops. One day, he told me to come around for lunch and he would pay, which was odd. That never happens in a route sales job but it was free lunch and I wasn't exactly killing it, money-wise. He told me what he was looking for and described the job and what it paid. I was more interested in the money than the job so I took it before he could change his mind.

When asked if the job was presented as an engineering job, he said only in title.

> It didn't make sense to me. I didn't even have a college degree, much less an engineering degree but he said it was more technical sales than engineering. He said he had engineers to take care of the oil refineries and consultants, he needed someone to handle the day to day work.

AE D31 is similar to D37, a 29 year old married male with a high school degree, school-aged children, four years job tenure and turnover intentions. He began his AE career after spending three years in the shop repairing pumps. His path was unique in that he joined the Reserves after high school and learned to work on heavy equipment in the military.

> I went into the Reserves for the G.I. Bill but I didn't want to go active duty so I was limited in the careers I could pick. The local unit is a transportation brigade and that determined my job. Luckily, they didn't make me a driver. Anyway, when I finished training, I came home and needed a job. The pump repair job was the first one I applied to and started work right away. But you asked about how I got the AE position. I definitely did not want to be a mechanic, it was a means to an end. I'm taking night classes in business and, when the other AE moved to outside sales, I applied and told them I wasn't long for the shop and would go somewhere else if I needed to.

As he worked in the service shop, he knew what the AE job entailed and understood it was more technical sales than engineering.

> The shop guys, me included, gave the AE's grief because we knew most of them weren't engineers, or doing engineering work anyway, and most of the shop guys know more about pumps than the AE's. I knew what the job was and wasn't so nothing has surprised me. I didn't care about the engineering part. I just wanted a way out of the shop.

Cohort Three Expectations (met/unmet).

Of the three, one intended to remain as an AE and the other two intended to move into outside sales either with the current employer or another. Those that intended to turnover identified the problem solving and social aspects of the job as reasons to remain but expressed frustration with perceived pay inequities and boredom. Transition to management was not a goal for this cohort.

AD D4 said he could not think of any expectations he had other than the typical expectations one has of a new job.

> I didn't come to this job thinking it was one specific thing or another. I know we've had degreed engineers that quit fast because they wanted to do something in real engineering. I'm not an engineer so I don't have that hang up. I guess I expect them to do what they say. Pay me on time and give me the tools I need to do my job.

AD D4 had no turnover intentions. He pointed to good pay and an ability to pursue hobbies due to remote work arrangements.

> I have it good I think. My pay is good and the wife and I do fine. But I really like working out of the house when I want to. That's probably the

> biggest reason. My wife gives me grief and says I work to play golf, which is probably true. If my day is slow or I get up early, I can be on the course by 4:00 PM. I have my phone so I can handle anything that comes up and nobody monitors my coming and going here.

D37 said the job met his expectations, which weren't very specific.

> I'll say it meets my expectations but I can't say they are tough. I expected it to be inside sales, which it is. I expected it to be technical, which it is. There isn't much else I can think of.

D37's turnover intentions were caused by a sense he was doing all the work and the salesmen were getting the credit.

> The AE's do most of the grunt work but are paid a salary. I know the sales guys are off on Friday by lunch while I'm still in the office. They make commission from every sale, even for the customers they never visit. I know the commission rate so I have a good guess of what they make. It's a great deal if you can get it. If I can't get an outside sales job here, there are a couple of other distributors around I could work for.

Similar, D31's expectations were muted.

> Other than expecting to not work in the shop anymore, I can't think of any job expectations that everyone doesn't have. I like the job, there is enough technical to it to keep me interested and, if I get bored, I can go to the shop and turn a wrench for an hour. Pay me, give me time off if I need it and don't bother me on weekends unless the world is ending.

As with D37, D31's turnover intentions towards sales were driven by discontent with his compensation as compared to the salesmen.

> I see how much money the salesmen make and how much work the AE's do for them and it seems like a good racket to me. I know they work and deal with a lot of problems but I'm doing most of the work, in the office all day. They get paid for sales to some customers they've never been to. I like the job but that gets under my skin, you know?

As with the good-at-math cohort, they were able to suggest job changes that might retain them in the career, namely; offer equitable compensation programs reflecting their contribution, allow for remote work arrangements and permit customer visits to create a more variable work environment.

D31 thought a commission from each sale and the chance to work out of the house would probably eliminate his turnover intentions.

> I know the sales guy work hard and deal with a lot of crud from customers. I don't think they are paid too much but if I were paid, even just a few percentage points, for the sales I generate, I would be OK. Just don't treat me like an afterthought. If they did that and, after Covid, they let me stay working out of the house, that would definitely do it. We've been working out of the house for a year and I don't see why we should go back to the office full time.

An important characteristic of those intending to turnover into a sales career was an expression that there was a limit to their patience. They were willing to wait a few years for the current employer to present an opportunity but were ready to leave the organization as soon as a sales opportunity presented itself elsewhere.

D37 said he could not see a reason to remain for much longer if another company were willing to pay him more for doing, what he considered, about the same job.

> If another distributor is willing to pay me more in outside sales and, other than not quoting pumps anymore, the job is about the same, why stay? I solve problems and the salesmen solve problems. The only difference is they do it outside and I do it inside for less money. I don't see much difference.

For this young cohort, the job met their initial expectations but, as with cohort two, factors unrelated to a specific expectation reduced the theory of met expectation's ability to bind them to the firm. As with cohort two, Adam's theory of equity explained the turnover intention whereas met-expectations may have played a silent role where fair treatment was an expected but unspoken expectation. As with cohort two, this cohort did not explicitly state such an expectation.

Cohort Four: Non-Degreed AE's – Older

This cohort proved to be the most stable of the four with ages ranging from 39 to 60 with five of the AE's over the age of forty-four (n=6). No members expressed an intent to leave the organization but three expressed an intent to turnover into either sales or management. However, these intents were more opportunistic than goals pursued with purpose, which was a differentiating factor from the other cohorts. They were open to possibilities but did not intend to leave the AE career or the organization if the opportunities did not arise. They expected to remain an AE until retirement.

Cohort Four Expectations (met/unmet).

This cohort came to the AE role later in life and had enough experience to understand the job was not heavily dependent upon engineering knowledge and technical inside sales was a better job description than engineer.

D8, a high school educated 58 year old male without turnover intentions, worked inside sales at another industrial distributor and applied for the AE job when it was posted online.

> My other company had an application engineering department so I knew the job wasn't engineering, not like people usually think about engineering. I knew the job paid more money than inside sales and the other place I worked required an engineering degree. I didn't have any expectations except to be paid for my work I guess? I understand your question and study but I don't know if I'm much help. I knew it was inside sales and it was technical. Other than the higher pay, I didn't come here with any expectations. I guess it does meet my expectations but I'm not sure that was what you are looking for.

D19, a married 56 year old high school graduate without turnover intentions, transferred from field service to application engineering fifteen years ago. He has been with his current employer for 28 years and other than the military, it has been his only employer.

> I just wanted to get in from the field. Field service technicians are on call 24-7, 365 days a year. When a boiler feed pump at a nuclear plant goes down, there is no waiting until Monday. I expected it to be pretty much what it is, a technical inside sales job. I know you are focusing on engineering and that's my title but this isn't an engineering job.

D36, the youngest in the group at 39 years old, has a high school diploma and worked as a project manager for a rendering plant before becoming an application engineer two years ago.

> If you've ever been to a rendering plant, you know it's a lousy environment to work in. The smell never goes away. I used to buy pumps from this company and knew the sales guys and application engineers. I was ready to get out of rendering and into a clean environment. That's really all I expected. I haven't been here long but there isn't anything I can point to that would make me want to leave. I might like to move to a manager's job here someday but I'm in no hurry. I get to work out of the house every other Friday and my office doesn't smell like dead cows. That's really about it.

AE D20, a high school educated sixty year old single male with fifteen years tenure as an AE was interested in an upcoming sales position due to the increased pay.

> I would like to be able to put more money into 401(k). We have a salesman retiring later this year and I already let them know I'm interested. If I don't get it, I'll finish my time here as an application engineer.

AE's D7 and D36 were aware of management positions becoming available in the future and intended to apply for them. Both focused on a change to management in order to add some variability to their days. D7, a 45 year old married male with a bachelor's in business and 16 years tenure as an AE, two with his current employer, believed management would be a good change of scenery for him.

> I've been an AE for a long time and it feels like it is time to try something new. I'm not unhappy as an AE and I like the company but my days feel like that movie, Ground Hog Day. We don't see many different applications to quote here so things are stale. I see some areas I could change here to make the company better and change my days in the process.

> I'm not sure about the management position though. I've managed people before and I like coming to work and only worrying about myself.

D19, a 56 year old high school educated male, did not intend to turnover. He liked helping other people with their problems and didn't think he could make the same pay in another job.

> This is only my second job after high school. I worked as a buyer at a powerplant first. This place was a vendor and that's how I came across this job. I know what it is like working at a powerplant, it's always chaos. I've gotten good at the pumps they use and have been able to get them out of a pinch more than once. I like that, finding the right pump and helping someone out. And I don't think I could make this money anywhere else with just a high school degree even if I wanted to look.

Like cohorts two and three, these high school educated AE's came to the career after holding other jobs but these AE's had spent numerous years, between 10 and 30, at other employers. Their expectations were met in that they understood the AE job to be a technical sales role and not an engineering position. Furthermore, each AE communicated the move into the AE role addressed the factor(s) that caused them to leave their previous employer.

Findings Across All Cohorts

Numerous research themes were common across all cohorts and AE insights into the study's research questions were not the exclusive domain of one cohort. Topics such as hiring practices, AE tacit knowledge and AE turnover perceptions cut across all cohorts. These findings are presented in this section.

AE Turnover Perceptions

For those participants with sufficient tenure to feel qualified to comment on actual AE turnover (n = 14), estimates of the actual rate of AE turnover at their respective employers ranged from fifty percent on the low end with one AE placing it as high as seventy-five percent. Only two AE's, both working for the same employer, placed AE turnover rates at under five percent.

Participant perceptions of actual AE turnover placed turnover mechanisms within two categories. The majority attributed turnover to a lack of engineering-related tasks and, therefore, perceptions of actual turnover fell within the scope of the theory of met-expectations. Two AE's cited a fast paced work environment as creating turnover.

AE D3 had 25 years total AE tenure across three organizations, ten with his current employer, a manufacturer. D3 placed the high turnover rates cause as a lack of engineering tasks and employer's insistence on hiring young degreed engineers as replacement engineers.

> I know it is a lack of engineering in the job. I've been in enough exit interviews to know the young AE's are leaving for those stereotypical engineering jobs like product or manufacturing engineering. Other than me and one other AE, our AE's don't hang around for more than five or six years. I can only guess at our turnover rate but somewhere at fifty percent over five years We probably cycle through three quarters of our AE's every seven or eight years, just shooting from the hip. I keep telling my boss we need to keep AE's around longer and should find people we think might have some staying power but we keep going back to the engineering schools to replace the AE that left.

AE D11, a thirty year AE veteran with the same distributor, echoed D3's observations that retaining degreed AE's is difficult.

> When I first started here, a long time ago, I was the exception. I was the only one without an engineering degree and I've lost track of how many AE's we lost in those days. They would stay for a few years and then go to one of our customers or a consultant. We haven't hired a young degreed engineer in ten years because we know they won't stay. I know we had one AE move into outside sales about three years ago so I guess we didn't really lose him.

AE D13, a distributor AE with thirteen years tenure, all with the same employer, estimated turnover at fifty percent and also attributes the turnover to a lack of engineering tasks.

> I hate to say it because I have an engineering degree but these young AE's won't stay. We have five AE slots here and three are like a revolving door. I am careful to tell them the job is not a design job during the interview and I think they understand. But five years later, we lose them to a product engineering job or sometimes, a customer, which burns me up a bit. It's funny because your research is timely. We are thinking about transferring our service technicians and spare parts sales people into an empty AE spot because we are tired of losing all that experience we spend five years paying to build only to have to rebuild it all over.

AE's D39 and D24 attribute AE turnover to a fast paced work environment that does not lend itself to a predictable work day.

AE D39 works in distribution and finds he frequently must decide which emergency is more important than another, even when he acknowledges all customer emergencies deserve equal attention.

> This job can be like a firefighter's job sometimes. I have no idea what my day will look like when I start but I know there will be five or six emergencies to deal with every week. I can take it to the bank. We'll have three or four customers down and they all want me to deal with their problem first, which is impossible. It can be really hectic and stressful. The engineers that come here thinking they can sit down, plan their day and work methodically get hit with reality quick. I think that is what drives most of the AE's away.

D24 works in manufacturing and is responsible for bidding large complex projects in the oil refinery customer segment. He works in one department contained within a larger application engineer division and relates the constantly changing customer requirements creates stress when deadlines must be maintained.

> I haven't been around long enough to know what our overall turnover rate is. We are a big company and I work in one section. In oil and gas, I think we lose about a quarter of our AE's to another division or they leave all together because of the work, it's always hectic and these are multi-million dollar jobs. One mistake can cost a lot of money. I like it, it makes the day go fast but I can see why some engineers don't want to work here. One AE just asked to be transferred to the commercial division because he said he

couldn’t deal with the stress of so much change. Great engineer, he just wasn’t built for this craziness.

When job demands outpace an employee’s resources, either internal or external, the Job Demands-Resource (JD-R) model may explain some AE’s voluntary turnover better than the theory of met-expectations. The JD-R model attempts to explain both positive and negative work outcomes where challenging job demands tap available employee resources and positively impact employee outcomes. The opposite type of job demands, hindering job demands, exceed employee resources, resulting in negative employee outcomes (Demerouti & Bakker, 2011; Tims, Bakker & Derks, 2013).

AE Hiring Practices

The question raised during the interviews was, if such high turnover is known to exist, why aren’t hiring organizations modifying their candidate profile? The consensus among the participants is that the job tasks of an AE do not require an engineering degree yet degreed engineers, by this study’s demographic, are the most frequently hired candidate.

Participant response to the inquiry frequently fell within Groot and van den Brink’s supposition that one possible cause for the hiring of overeducated staff is a lack of formal and on-the-job training (Groot & van den Brink, 2000).

Participant's related a lack of internal resources, both in time and staff, to train non-engineers in the underlying engineering concepts found in the AE role.

D13, a 13 year tenured AE with a role in hiring decisions acknowledged the obvious connection between turnover and the hiring of young degreed engineers but explained the speed of business precluded the option of a candidate selection process that did not include people with a demonstrated ability and interest in learning basic engineering concepts.

> This turnover we are talking about isn't foreign to us. We know we will have high turnover in the AE ranks. Even if I had the time to train AE's without an engineering degree, which I don't, our customers don't have time to wait for an AE to spend six months in a formal training program before they hit the ground running. Trust me, I get it. I just don't have the resources to solve that problem.

D11, an AE with 30 years' tenure, also acknowledged the problem of AE turnover. His long tenure allowed him to comment on changes in the industry that have forced organizations into these unsatisfactory turnover conditions.

> When I came into the industry, this change in recruiting and training had just started to take hold. My first boss said he had to spend six months at

> the factory working in assembly, service and marketing before he set foot in his assigned sales office. Once in the office, there was more formal training. There is no way we could do that now. Even if the factories had formal training programs, which they don't, things move way to fast here, especially with the internet and all the competitive changes it's created. We need an AE to produce right away. I know degreed engineers won't stay but I don't know how to find someone with enough mechanical aptitude and interest to do the job without a year of training. AE's have to take it upon themselves to learn the material, they need to be naturally curious. How do I find that person outside of engineering, quickly?

D3, with 25 years total experience as an AE, referred to a lack of a training department as driving the policy of hiring only degreed engineers.

> I guess we have two choices. We could hire someone that we think might be able to learn the basic hydraulic concepts but who would train them? The AE's work remotely so there is no person-to-person training like there used to be. But even if there were, the AE's are already busy with their normal work. I basically learned on the job, little by little but I understood pump and system hydraulic dynamics. I know non-engineers can learn Bernoulli's principle but how do we know what that off-the-streets

candidate looks like? Don't get me wrong. We have AE's that aren't engineers but we knew them because they transferred from spare parts or service and they had been here a long time.

D7, an AE with 16 years tenure, thought the degreed engineer requirement was case specific. He thought some products did not require any knowledge of engineering principles while others were probably better served by having degreed engineers on staff.

> We have a mix of degreed and non-degreed AE's here and we divide market and product responsibilities by how much engineering knowledge is required. But we are a distributor so we can be flexible. Some of my manufacturers don't have that luxury. Our degreed AE's focus on the oil refineries and the products that are harder to apply like boiler feed pumps. But we have about a half dozen products in our line card that don't require even a basic understanding of engineering. The degreed engineers don't work on those products and I don't think we would hire one for the easier products.

Tacit Knowledge & Competitive Advantage

This research project's primary and explicit purpose was to understand application engineer turnover intentions. However, an underlying purpose was to inform future human resource practices tailored to reduce turnover, an endeavor which will require senior management participation. Given senior management's concern with strategic matters more so than tactical ones, such as employee turnover, the interview protocol was designed to uncover in what ways AE's might be a source of competitive advantage and what forms that advantage.

The industrial sales literature finds customers identify those working in inside sales roles, which characterizes the application engineer role, as being a key element in customer evaluation of a supplier's value and relationship satisfaction to a greater extent than the outside sales force (Boyle, 1996; Lewin, 2009). As one possible source of AE competitive advantage, the strategy literature acknowledges tacit knowledge as being a source of competitive advantage (Teece, Pisano & Shuen, 1997) where knowledge is the fundamental source of revenue (Spender & Grant, 1996; Grant, 1991).

AE perceptions of their role in providing a competitive advantage was found to be contained in the use of tacit knowledge in the maintenance of existing customer relationships rather than forming new sources of revenue, which AE's believed to be the purview of the outside sales force.

As with other participants, AE D13 commented that the customer's first call for any inquiry, urgent or otherwise, was the application engineer assigned to the account.

> The AE's are the first people our customers call, and they don't call just one distributor. They'll call all of them until they find an answer they like. I understand why, the salesmen are always traveling and don't have the information we have. Each of us is assigned certain customers and we get to know them as well as they know themselves after a while. I know their problems, what we did to solve a problem, like five years ago, and, I don't know, we just know so much. And none of it is written down anywhere, it's just in my head.

D11's observations reflected those of D13 but his 30 year tenure puts him in a position to know things his customers didn't know.

> I have been here so long, sometimes longer than my customers, that I know more about their plant than they do, at least the pump stuff. I know why a certain pump was installed fifteen years ago or I have job files that they've lost. It's in piles all over my office, I'm not even sure where some of this information is, but it's here somewhere. You know, over the years, there's

> so much information in my brain that I've picked up and sometimes, some miscellaneous piece of information saves the day. The sales guy are great but it's not their job. They are supposed to find new customers. I'm really the salesman for our existing customers.

D38 believed his advantage over his competitors was his knowledge as to his customer's unwritten rules and preferences.

> I work with the engineering consultants on large bids and all competitors have the same equipment so there's no real technical advantage. But that is the salesman's job, to get us in the door. But once we are in, the AE's takeover, especially for long-time customers. Anyway, I've done this long enough to know how each consultant wants the technical information, like where to enter information in Excel or what information they focus on to make decisions. Like one engineer isn't too concerned with a complete set of technical data up front. For him, whoever submits first gets first bite at the apple. But you have to learn what he wants, he doesn't tell you. We've won a lot with him because I've learned how he works. We just hired an AE from a competitor because she knows how another group of consultants operate and we couldn't win a job to save our lives with those guys. Now we have the person that knows.

D22 explained upcoming organizational changes being implemented to better respond to a changing competitive landscape.

> We've always had more salesmen than AE's and our salesmen have been here forever. But customers don't want to see salesmen anymore, especially the younger engineers and managers, they prefer to communicate via email or text. I'm even linked up to one of my customer's through Teams. Anyway, we have one salesman retiring this year and we aren't going to replace him. We will hire another AE so we can reply faster to all the emails coming in. We used to only compete with the other distributors in town but now we compete with distributors from California and Texas, the really big distributors. We've gotten behind on emailed requests and we know we lost the job. And these were long time customers, there's no loyalty anymore.

D39 placed his advantage over his competitors in this knowledge as to how his customers were structured and who could make decisions.

> I'm probably the only one here that knows when a project engineer is involved in a decision at my customer or if it is a warehouse manager decision or someone else. Some of the AE's here have products that have a

> technical advantage but mine don't. I handle the basic pumps like diaphragm and gear pumps so I have to know who makes the decisions. Some of my customers are big and knowing who can make what decision is half the battle, like, are they in my Outlook? You know, which warehouse manager oversees spare parts and which one takes care of complete pumps? It's the personalities and a lot more. I had to learn the hard way and it took a couple of years to figure it out. I should probably write it down in case I get hit by a bus.

The tacit knowledge literature speaks to knowledge as being gained through experience (Fernie et al., 2003). This definition guided the interview protocol to inquire as to the time required for an AE to acquire the requisite knowledge, both technical and otherwise, before they were considered fully trained and in a position to have gained the same amount of knowledge as a departed engineer.

AE's tended to categorize the time by segmenting the knowledge required to undertake the strictly technical aspects of the project where the consequences of an error were low or high. Additionally, these AE's separated technical knowledge, tacit or otherwise, and organizational, what one AE referred to as knowing how to get the world to do what he needed.

For those projects where the consequences of an error were minimal, AE training time was placed at six months to a year. For those with significant consequences, either technical, financial or reputational, training time was thought to be between two and four years. When tacit knowledge, particularly organizational knowledge, was considered separately, some AE's believed five years was required before a replacement AE had fully acquired the knowledge of a departed AE.

AE D26 placed her tacit knowledge at about half of what she knew and felt, after five years on the job, she could handle most inquiries unsupervised.

> You know, at first, everything I did was in an engineering manual or I had it in my training notes but I was always asking questions. But now, I think about half of what I know isn't in a manual or on some Post-It note somewhere. It's this slow process that builds and one day, I discovered I knew things. Like now, I don't have to talk over my cubicle wall to the other AE's.

D11, the thirty-year tenured AE, estimates his tacit knowledge at seventy or eighty percent and comments there is concern in his company with so much knowledge residing in the hands of one person on track to retire.

> I'm probably not a good measure for you because I don't know many AE's that have been around as long as I have. Guessing, I would say it's about seventy percent, maybe eighty percent. The young AE's will ask me a question and I'll just know it from something we did before. I should write this stuff down but I don't think about it. Heck, I don't even know where I would write everything down or what I should write. There's so much information about customers, things that didn't work, things that did work, what suppliers are good at and what they aren't good at. I wouldn't know where to start.

AE D21, a younger AE with two years' experience, doesn't think he is to the point where he has formed a significant level of tacit knowledge.

> I've been here just over two years and I'm still learning the basics. It's hard for me to tell how much is explicit and tacit. Maybe 20% is tacit? I'm not sure. What there is might be in how the software works, maybe? That manual is horrible and you just have to teach yourself. But I'm still asking the engineering manager questions every day.

AE D3, a twenty-five year tenured AE, echoes the other experienced AE's at tacit knowledge levels over fifty percent. His concern, which no other AE expressed, is that the move to remote work is reducing the amount of institutional tacit knowledge because people aren't in a position to share information without specific intent.

> I will say my tacit knowledge is probably over fifty percent. Maybe more but fifty percent sounds safe. But that has always been the case, there's so much we do that isn't written down. The problem is that it isn't shared anymore because we are all working out of our houses now and probably will when Covid is over. We are selling the building we used to work in and going to one of those office concepts where you reserve a desk for the day, not sure how that will work. But all that banter that used to happen in the hall or at lunch doesn't happen anymore. I learned a lot of what I know from getting coffee.

AE D4 has training responsibilities as well as his AE responsibilities. He finds that the young degreed AE's, such as those in cohort one, turnover at a time when their knowledge formation is at a critical point.

> I would put my tacit knowledge at somewhere around fifty percent. Maybe a little less but that seems about right. We talked about this earlier, I help train new engineers and I know it takes two years before they can manage

> most of the technical aspects by themselves. It’s closer to four years before I think, if I go on vacation, they won’t be emailing me while I’m at the pool. But most of them leave before they are really fully trained. We lost a great AE in November. She was here for six years and was right at the point where she could have moved into a senior AE position. We just hired her replacement and now I have to start from scratch.

Job Performance and Unmet Expectations

Participant’s did not believe unmet expectations significantly impacted their individual efforts to adequately perform their duties. In some case, performance was reduced when conditions of job boredom were present for extended periods. As discussed previously, no AE communicated an explicit expectation that the job not be boring and met-expectations theory does not attempt to delineate between explicitly understood expectations and underlying expectations that might remain unspoken or unrealized.

AE D35 stated that the routine or unchallenging quotes are, at times, avoided in preference for those that are challenging or different.

> We work in an AE pool and the next RFQ in the queue is taken by the next available AE. Well, I don’t always do what I should and I’ll look for a project that looks interesting and pick that one. I feel bad sometimes but

> there are times I just can't do another 5 horsepower pump. If there were nobody here to do it, I would take it but I know someone will do it.

AE D14 resists answering emails and phone calls from customers he knows are asking for quotes or answers that aren't challenging.

> I always get to them, don't get me wrong. But I have a couple of customers that only need me to quote basic pumps, like a $500.00 1 horsepower sump pump and there are times, I hate to admit, they go to the bottom of the pile. A six year old can quote that and I'll put it off until I've taken care of everything else.

D6 admits to mistakes when he gets bored.

> I have made mistakes when I get bored and am doing the same types of quotes over and over. Our software does all the engineering calculations and selections so there are times I'm not paying attention to what I'm doing. I usually catch my mistake and, the few times I haven't, I could fix it later. But, yeah, I can get bored and just, kind of, mentally fade away.

The interview protocol anticipated the possibility that the use of software would lead to a condition of deskilling and create conditions of over-education, which has been shown to decrease job satisfaction and increase turnover (Baxter, 1990; Alba-Ramirez, 1993; Fleming & Kler, 2008). Participants could not point to the software as a source of dissatisfaction or job boredom in any meaningful way. They communicated that, without the software, they could not keep up with the pace of work although they did agree the software did reduce the need to understand and apply engineering principles to the job. The young AE's had never worked without a computer and therefore, could not compare now versus a time without software.

D11, the thirty-year AE veteran, understood why the question was part of the interview protocol but any boredom the software might cause was made up by its' efficiency.

> I understand your question because there was a time I did everything by hand, with a calculator. All we had was a PC with Windows 3.1 and Word Perfect. Doing the engineering calculations by hand has its' advantages because you can actually see the information instead of the data hiding in a software program. But I don't think I could keep up with today's work pace

> without the software. I don't think it makes me any more or less bored than hand writing quotes all day long.

D3 thought the use of engineering software was a double-edged sword in that it reduced the amount of understanding an AE has of the application and where a problem might surface.

> I'm torn on the software, especially for the new AE's. I make my new AE's do manual viscosity corrections, horsepower calculations and curve selections when they first start. They think I'm crazy but I want them to understand what the software is trying to do, because sometimes it isn't right and I need them to recognize an output that seems odd. But that only goes on for a week and then they use the software. The software can turn you into a robot though, just trusting everything the software kicks out.

Synthesis and Summary of Data

Met Expectations

Summarizing the study's findings, the theory of met-expectations was found to provide substantial explanation of AE turnover intentions in the directions of intentions to quit and intentions to remain. Those application engineers holding strong expectations that any position they occupy require the frequent use of substantial engineering knowledge intended to turn over due to unmet expectations.

This turnover dynamic was particularly relevant in cohort one, young degreed engineers that found the AE position was deficient in the tasks they characterized as engineering oriented, such as design engineering. These AE's can be described as being pulled away from the career towards something that meets their expectations.

Those application engineers that expected the job to be oriented towards technical sales or expected the job to address a source of dissatisfaction at a previous employer found the job did meet their expectations and expressed either no turnover intentions or ambiguous turnover intentions. When they did, the intent was not particularly strong and hypothetical individualized job crafting addressing specific turnover drivers reduced, if not eliminated, the turnover intentions that did exist. For those AE's that did express turnover intentions, they can be said to be pushed away from the career due to job factors unrelated to an explicitly stated expectation.

These turnover-oriented AE's described future turnover actions as being designed to address job and organizational factors such as job boredom and perceptions of unfair compensation programs. These AE's did not identify a critically deficient job aspect that could only be addressed by turning over.

Given the high turnover rates of young AE's, increasing age and job tenure's impact on AE job expectations was not very illuminating. Few AE's had remained in the field long enough to provide insight into how their individual expectations changed over time. It is clear that age plays a role in expectations but the older participants with expectations more focused on the job's social aspects than career advancement had entered this life stage before becoming an AE. The study's findings regarding the different expectations between the various age cohorts cannot be discounted but the hope was that a sufficient number of participants could describe a change in their expectations.

Other Findings

As with other studies, this project generated an unanticipated finding, that of the literature supported concept of engineer identity as relates to professional identity. Engineer identity appears to be a possible underlying mechanism of degreed engineer turnover and, in the case of cohort one, might create a non-negotiable job expectation. Met-expectations explains the turnover intentions but inquiring as to what formed AE expectations was not an initial study goal. The theory of met-expectations limits its' inquiry to the degree of congruence between employee expectations and reality once on the job. It does not attempt to explore a particular expectation's genesis. Engineer identify filled in this missing piece.

Similarly, employing the met expectations theory in explaining turnover intentions driven by boredom or perceived pay inequity raised the question as to whether Porter and Steers' theoretical development contemplated unspoken expectations or expectations not readily apparent to a participant. Is not being bored an expectation if it is not explicitly understood by an AE? Porter & Steers

(Porter & Steers, 1973) paper is silent on this topic. However, this is more than a critical evaluation of theoretical gaps. It is apparent that any practitioner's effort to reduce AE turnover will have to expand Porter and Steer's conceptualization of met expectations to include the possible unspoken expectations uncovered in this study.

Contribution to Applied Practice

The information gathered in this study contributes to a better understanding of application engineering turnover intents in the industrial pump manufacturing and distributor business segments. Findings indicate there is hazard in focusing recruitment efforts on young degreed engineers who may possess strong underlying characteristics that make turnover all but guaranteed.

It also highlights, given the universal findings that the job does not require an engineering degree, there is value in recruiting older application engineers, degreed or otherwise, who either come to the career with expectations of technical sales or who seek to escape the dissatisfying aspects of another position. These groups prove to be the most stable if their concerns with job boredom and unfair compensation practices are addressed. Further discussion of the research implications are continued in Chapter Five.

Chapter 5

Discussions, Implications, Recommendations

Overview

The phenomenological study's purpose was to gain insights into why application engineers leave the career. The study's findings are intended to inform human resource recruitment and retention practices developed to increase retention in this important customer-facing engineering position. The study's research questions focused on what expectations applications engineers had of the career, how those expectations impacted turnover decisions and whether those expectations were different when education level and type, age and job tenure were taken into consideration. Further, the study explored application engineer perceptions of the role the position plays in providing the organization with a competitive advantage.

Organization of the Remainder of the Chapter

The chapter's first section covers the study's contribution . The second section presents a discussion of the data as relates to the research questions. Recommendations, limitations and areas of future research follow. The chapter ends with the researcher's reflections.

Study Contributions

The study's collected data contributes to a better understanding of application engineering turnover by understanding what creates turnover intentions in the first place. Using the theory of met-expectations as a theoretical framework, the study's findings will allow researchers to further investigate engineer turnover. It also explored, through the lense of competitive advantage, why application engineer turnover might be a critical management issue beyond the often cited concerns associated with the direct costs of turnover. As manager's operate under conditions of resource constraint, these findings may be useful in senior management's decision-making processes as to which organizational resources should receive focus in their pursuit of competitive advantage and profits. Lastly, Porter and Steer's (1973) theory of met-expectations has not been used to investigate engineer turnover or turnover intentions within any engineering discipline and studies investigating application engineer turnover specifically have not been found in the literature.

Discussion and Implications

The theory of met-expectations attempts to explain employee turnover by discovering the source of employee dissatisfaction, a primary contributor to employee turnover (Porter & Steers, 1973).   Through one-on-one interviews, this study revealed identifiable patterns of application engineer expectations that influenced intentions to turnover and intentions to remain. Furthermore, the research created unanticipated knowledge that allowed the application engineers to be segmented into specific cohorts delineated by their expectations, strength of the expectations, career tenure before becoming an AE and the drivers of their turnover intentions. This segmentation may lead to human resource policies tailored to each cohort, both in terms of recruit profile and retention strategies.

These expectations can be organized into two categories, an expectation of the presence of job tasks requiring substantial engineering knowledge and expectations of the role as a technical inside sales role. For those application engineers that expected their job to require the substantial use of engineering principles and that expectation was held as important, the intent to turnover was strong and irreversible. If the design expectation was not strong, turnover intentions were ambiguous and not absolute. The level of the expectation's importance played a salient role in the application engineers' turnover intentions. This dynamic tracks with Porter and Steer's findings that the more incongruent reality is with preemployment expectations, the more likely the employee is to turnover (Porter & Steers, 1973). Only AE's with engineering degrees possessed design expectations although not all degreed engineers expected their job to be design-oriented.

For those AE's that entered the career expecting the position to be a technical inside sales role rather than, as the title suggests, an engineering role, the intent to turnover due to unmet expectations was nil. The job met their expectations. Where turnover intentions did exist, they were related to organizational factors (perceptions of pay inequity) or dissatisfaction with a lack of job task variability. These turnover intentions could be mitigated with small changes in job duties, changes in pay structure or implementation of remote work arrangements. Job duties and pay structure changes were seen as directly addressing dissatisfaction while remote work arrangements were viewed as a benefit acting as a counter-balance to dissatisfaction. Importantly, this counter-balance, by itself, was only sufficient to mitigate concerns with job task variability. In other words, the ability to work out of the house offset concerns with job boredom as driven by lack of task variability. Without addressing pay equity concerns, participants indicated remote work might reduce their turnover intentions but was unlikely to eliminate them. The research findings are represented broadly in figure sixteen below.

	Engineering Degree	Design Expectations	Technical Sales Expectation	Expectations Important	Expectations Met	Turnover Intentions	Turnover Intentions Mitigatable
Cohort One	Yes	Yes	No	Yes	No	High	No
Cohort Two	Yes	Mixed	No	No	Yes	Mixed	Yes
Cohort Three	No	No	Yes	Yes	Yes	Mixed	Yes
Cohort Four	No	No	Yes	Yes	Yes	No	N/A

Figure 16. Research Findings Presented Broadly

Organizations appear to struggle with the tension between the short-term needs of hiring a replacement application engineer and participant acknowledgment that AE turnover is high. The pace of business and competitive pressures require the hiring of a replacement application engineer as soon as possible while the lack of formal training programs and difficulty in identifying suitable non-engineers who, according to this study, will exhibit lower turnover intentions over the long term, conspire to create a business environment in which high AE turnover rates have become an accepted cost of doing business. Participants universally agree the position does not require an engineering degree but there is little confidence an applicant without an engineering degree will have the required innate subject-matter curiosity to undergo their own self-directed learning of the most basic engineering concepts undergirding the job duties.

The impact of unmet expectations on job performance and motivation appears to be a factor in motivation where application engineers choose to avoid unchallenging quotes but, performance, as measured by whether the quotes are eventually done in time to meet deadlines, was explicitly stated as not having occurred. A theoretical note may be appropriate in this regard, As discussed in previous sections, Porter and Steers (Porter & Steers, 1973) are silent as to whether expectations that are not explicitly stated or known to exist should be considered within their framework. In the question of performance and motivation, a lack of boredom and it's various antecedents were not explicitly stated as participant job expectations. Rather, boredom's antecedents in the form of task invariability and unchallenging tasks were pointed to as causes of job dissatisfaction and areas of improvement available to decrease turnover intentions. A reasonable interpretation of the theory of met-expectations may allow for this implied connection but the theory's understood boundaries must be declared.

Recommendations

This study's findings point to a number of recommendations developed to reduce application engineer turnover. The near uniform hiring practice of relying on young degreed engineers to replace departed application engineers creates a deficit of suitably experienced AE's to provide organizations with a competitive advantage. Based on Boyle's (1996) and Lewin's (2009) findings that customers in industrial markets identify inside sales staff as providing greater value and supplier relationship satisfaction than outside sales staff (Boyle, 1996; Lewin, 2009), particularly when tacit knowledge can be brought to bear as a source of competitive advantage (Teece, Pisano & Shuen, 1997), current AE turnover patterns ensure most AE's will turnover at a time when they have only just developed sufficient tacit knowledge to provide employers with a competitive advantage.

Organizations would be well served to modify hiring practices away from the expeditiously convenient method of identifying replacement engineers in the easy-to-find locations, college career centers and passive online job postings, the primary sources this study's high-turnover intentioned participants indicated was their route to their AE position. Instead, hiring managers should view the hiring event as an opportunity to create individual and institutional tacit knowledge in lieu of filling an empty AE seat with the first available candidate.

This research showed that potential recruits, including degreed engineers, with only a few years of work experience provide greater employment stability than degreed engineers searching for their first post-college job. If degreed engineers are considered critical to the department, only degreed engineers that identify the application engineer role as solving a problem with an existing employer should be considered, particularly if they are explicit in a lack of design expectations and the job's tasks have been fully explained during the interview. Ideally, these degreed engineers' AE job expectations will revolve around solving a specific source of dissatisfaction at the current employer and all parties involved believe the perspective employer is in a position to address the concerns in a specific way. Job crafting flexibility may be required for this degreed engineer. Some may be swayed by flexible work arrangements alone while others may require job enriching efforts designed to increase task challenge and task variability.

Given the universal agreement that the AE position does not require an engineering degree, this research project suggests the most stable and knowledge-retaining application engineer function (department) may be a mix of non-degreed application engineers and degreed engineers. This study's AE's without an engineering degree displayed low turnover intentions, were able to identify key job aspects binding them to the job (social aspects), and, when turnover intentions did exist, inexpensive (sales commissions) and small changes in work arrangements (remote work) were identified as likely mitigating turnover intentions.

Limitations

This study's primary limitation is an unknown as to whether the study's sample AE population is an accurate demographic representation of all application engineers. While a purposeful intent was undertaken to ensure all possible older AE's were included in the study, it cannot be known if some unknown characteristic of this researcher's professional database was unrealistically skewed towards younger engineers. Based on the researcher's decades of work experience with the AE field, it is believed the sample in the project is generally representative of the entire AE field but it cannot be known without validated quantitative sampling procedures.

This study focused on U.S. based AE's working for American firms. It cannot be known if participant sentiments and the research findings are applicable to AE's working in other countries.

It was not feasible to interview every application engineer working in the American pump manufacturing and distribution business segment nor did it extend to other engineer careers within the same segment. The study does not afford any generalizability to all engineers in the pump manufacturing and distribution business segments or related segments.

Future Research

Future research should focus on creating a quantitative model of the study's results. A number of validated surveys exist to build and test any future model. The Professional Identity Scale and the Clarity of Professional Identity Measurement may be useful in determining the degree to which engineers identify personally and professional as engineers. Participant perceptions of met-expectations could be anchored using Lee and Mowday's five point expectation Likert scale while the aspects of expectations could be developed from the research findings, pay equity, pay level, job tasks, task variability, level of job task challenge and flexible work arrangements. The Michigan Organizational Assessment Tool would be useful to measure turnover intentions and job satisfaction.

Researcher's Reflections

As an emergent practitioner-scholar intending to present findings and recommendations to senior management, the confirmation that the management-literature perceived gap between theory and practice is not simply an academic contemplation is simultaneously disheartening and encouraging. The theory of met-expectations is by no means new, theoretically complex, difficult to operationalize or too vague to incorporate into human resource management practices, yet the common sense notion of purposefully aligning expectations with job tasks seems to be missing from application engineer recruitment and retention efforts.

I held no expectation that any participant be familiar with Porter and Steers or the theory of met expectations but I was surprised when participants had to make efforts to define what their job expectations were, as if job expectations was a concept inaccessible to conscious consideration. However, on the bright side, once the exercise was undertaken, participants had little difficulty in voicing their expectations, both upon taking the job and their current expectations. For example, the concept of task variability had to be teased out but once it bubbled to the surface, it became a salient point of job boredom and dissatisfaction. The theoretical question as to whether unspoken expectations are job expectations aside, AE job satisfaction is clearly driven by a need for task variability.

Those application engineers with formal hiring roles acknowledged matching job duties with explicit recruit expectations was not a specific interview topic. These AE's operated as the little Dutch boy with his finger in the dike and had little time, inclination or organizational mandate to think in terms of competitive advantage. As with the concept of task variability, as an opening comment on application engineer turnover, no participant opined application engineer turnover harmed competitive advantage. However, when asked the specific question about the role of inside sales in retaining customers, little effort was required to speak to the important role AE's play in retaining existing customers both under historic pre-internet conditions when competition was limited to firms in similar geographies and under intensifying pressures wrought by technology and globalization.

The bright side is that possible solutions to application engineer turnover are not so complex as to be inaccessible by managers of even modest motivation or innate abilities. The basis for solutions already exist, although they remain buried in academia. Hence, the gap between academics and practitioners. My decision to enter a doctoral program was not driven by a desire for an organizational vertical ascent or to find new ways to solve problems in my existing role. My path to F.I.T. was intended as a perceived benefit a doctoral degree might provide as I transition from the corporate environment to a retirement focused on remaining engaged in the world by teaching at the university level. However, it has become clear that, like a medical general practitioner who applies theory to patient health, a D.B.A., if applied with vigor, is well placed to solve organizational challenges by applying theories that, for lack of a bridge, remained trapped in academia.

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Appendix A
Email to Participants

Hello,

I am a doctoral student at Florida Institute of Technology who is interested in exploring the factors contributing to application engineer job satisfaction and turnover intentions in the industrial pump manufacturing and distribution business segments. Because you work as a titled Application Engineer (AE) in one of these business segments, your knowledge and experience is vital to exploring what drives AE job satisfaction and turnover intentions (thoughts of looking for other employment). Specifically, it will investigate what impact undergraduate education degree type, common job tasks, age and job tenure have on an AE's perception of job satisfaction and turnover. The results will benefit both researchers and employers in these two business segments by exploring a not-yet-studied engineering career field. Researchers will be able to draw and extend the results of this study to other engineering career fields. Employers will have access to information useful in increasing AE job satisfaction and reducing AE turnover rates.

Your participation in the study will be greatly appreciated. Participation is voluntary and confidential with no participant identification markers (name, employer, location, education institute…) being included in the final research paper, to which you will have access. If you chose to participate in the study, you may pause or end the interview at any time. There are no foreseeable risks associated with participation in this study and confidentially is always maintained.

I would like to discuss the study in more detail with you when you find it convenient. The interview may be in person, on the phone or via web conferencing as you prefer. Please contact me at the email addressed used to send this form or the cell phone contact information included with the email to express either interest or disinterest.

Thank you for any help you can provide.

Bill Kelley

Appendix B
Consent Form

Please read this consent document carefully before deciding to participate in the study. The researcher will answer any questions before you sign the form.

Study Title: Sales Application Engineer Turnover Intentions: An Exploration of Education, Age and Job Tenure Through the Met-Expectations Perspective

Study Purpose: This qualitative study will examine possible factors contributing to application engineer turnover intentions anchored in job dissatisfaction and whether the realities of the common tasks required of an AE are in alignment with what research participants expect of the job. The research seeks to answer the following questions: In what way does education level and degree type impact AE job satisfaction and turnover intentions? What aspects of an AE's job fail to meet expectations of the job? How can failed expectations impact job performance, motivation and employee commitment? As AE job tenure increases or as they age, how do job expectation change? A key point is the research explores the individual and the job and does not consider the individual and the organization.

Procedure: You have been asked to participate in a single interview with will require approximately sixty minutes to complete. The interview will consist of six demographic questions and thirteen interview questions. The questions are open ended questions, allowing you to elaborate on your thoughts and opinions.

Audio Recording: For accuracy purposes, the interview will be audio recorded, if permitted although notes taken by the researcher are possible if preferred. These recordings and notes are secured in a password protected file on a password protected computer. The audio files will be manually transcribed into electronic text files which are stored on a password protected storage device and encrypted when not in use. Once transcribed, the audio files are permanently deleted.

Potential Risks of Participating: The risks associated with participation are no more than those that exist in everyday life. All participants will be informed the conversations will remain confidential and names and employer will not be revealed through the questions asked. Maintaining participant confidentiality reduces the likelihood of an adverse event occurring.

Potential Benefits of Participating: Participants receive to direct benefit from participation. The study's benefit is to understand the factors contributing to AE job dissatisfaction and aims to provide employers with an understanding of what may create unknown conditions of job dissatisfaction among AE's in general. Participants are encouraged to contact the researcher for the study's results.
Compensation: Participation is voluntary and no compensation is offered.

Confidentiality: The identify of all participants will be kept confidential to the extent provided by law. The names of the participants will not be used in this study. All data will be stored in a secure location during the research process. All information collected during the study will be stored on a removable storage device and encrypted when not in use. The storage devices will, in turn, be stored in a locked cabinet with access only available to the researcher. When the study is complete, all personally identifiable information will be destroy. No names will be used in any report.

Voluntary Participation: Participation is voluntary with no penalty for not participating. A participate may refuse to answer any question.

Right to Withdraw: A participant, without penalty, has the right to withdraw from the study at any time.

Agreement: I have read the procedure described above and voluntarily agree to participate in this study as outlined in the procedure above stated. I confirm I have received a copy of this description.

Participant Name: Date:

Researcher: Date:

Appendix C
Demographics

1. What is your age?
   a. 20 – 25
   b. 26 – 30
   c. 31 – 35
   d. 36 – 40
   e. 41 – 45
   f. 46 – 50
   g. 51 – 60
   h. 61 and over

2. What is your gender?
   a. Female
   b. Male

3. What is your highest education level?
   a. High school graduate
   b. High school graduate with some college
   c. Associates
   d. Bachelors
   e. Masters

4. If you have a college degree, is it an engineering degree, excluding engineering technology?
   a. Yes
   b. No
   c. No college degree

5. How long have you been employed by your current employer?
   a. 0 – 5 years
   b. 6 – 10 years
   c. 10 – 15 years
   d. Over 15 years

6. Including all employers, past and present, how long have you been an application engineer?
   a. 0 – 5 years
   b. 5 – 10 years
   c. 10 – 15 years
   d. Over 15 years

Appendix D
Interview Protocol

1. Can you share with me why you decided to become an engineer?

    a. How old were you when you first considered becoming an engineer?

2. What were the specific steps you took to become an engineer? If relevant, include the steps taken before college.

3. When you first considered becoming an engineer, what did you expect the job of engineer to be like? What were those expectations, if applicable, after finishing college?

    a. In what ways does the job of an AE meet those expectations?
    b. In what ways does the job of an AE not meet those expectations?
    c. How important is it that the job of AE meets the expectations you have of an engineering job?
    d. What are you perceptions or insights into application engineer turnover?
    e. What are your perceptions about what other AE's have about the job of an AE?
    f. What are your perceptions, if any, of how the AE role has changed over time?

4. In what ways does the job of application engineer rely on the classes you took in college or high school?
5. Can you see a connection between your college coursework and your current professional role as an AE?

    a. When considering the tasks common to your job, do they draw more upon training and learning received once on the job or upon the classes taken in a formal education setting such as college classes?

6. If you were responsible for training someone who never worked as an application engineer, how long do you think it would take them to learn to accomplish routine daily tasks?

a. What types of tasks could be learned quickly such that the trainee could accomplish them unsupervised with six months of training?

b. Describe the tasks you would not feel comfortable allowing them to accomplish unsupervised without more than a year on the job?

c. In a typical week, how much of your work falls into the category of tasks that could be accomplished unsupervised with only six months of training?

d. Describe how you learned to become an AE? How did you remember what steps to take and when?

7. If you had the power to make changes, what would you change about your job as an application engineer?

    a. What aspects of the AE job do you like most?

    b. What aspects do you like least?

8. What are your long term career aspirations?

9. Describe the role software designed for engineering and product selection plays in your job?

    a. Describe the ways in which the software makes you a better engineer.

    b. If the software were no longer made available, what would change about your job?

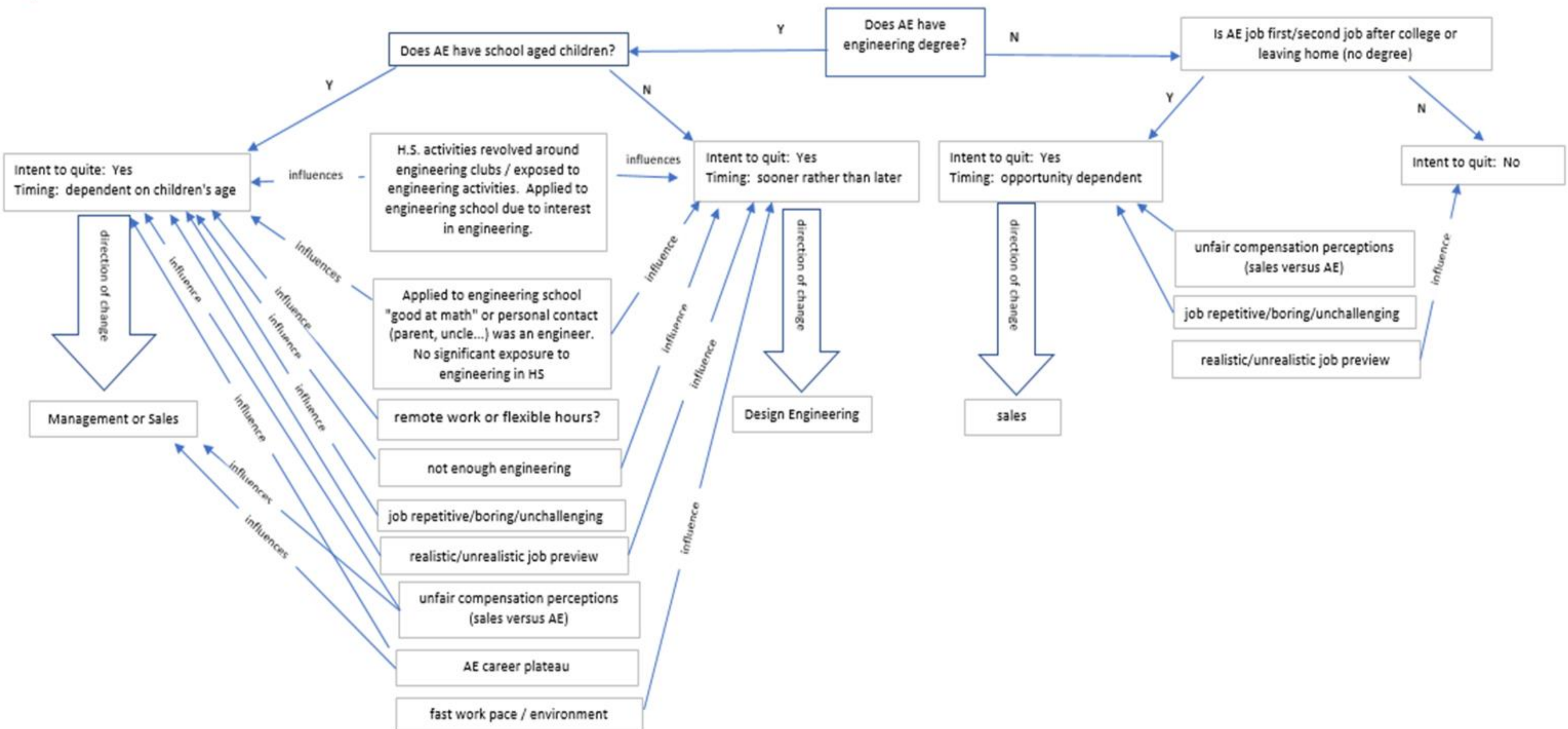
10. Describe a circumstance or time when you might have considered leaving the application engineering career field for another career field, including another career within another engineering discipline.

    a. What type of job opportunity might entice you to depart the application engineering career field?

11. Can you think of times when you felt you were not performing your job as well as was possible or required due to some level of dissatisfaction with the job itself rather than the organization?

12. Do you identify as an engineer? Is part of who you are, as a person, include being an engineer?

Appendix E
Concept Map



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