

TOWARD ALTERNATIVE PATHWAYS: NONTRADITIONAL STUDENT
SUCCESS IN A DISTANCE –DELIVERED, UNDERGRADUATE
ENGINEERING TRANSFER PROGRAM

by

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ABSTRACT

Towards Alternative Pathways: Nontraditional Student Success
in a Distance-delivered, Undergraduate
Engineering Transfer Program

by

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Today, postsecondary engineering education stands perched on the edge of transformation. A precursor to impending change is national recognition that nontraditional students—adults and working students with socioeconomic backgrounds not currently well-represented in engineering education—possess untapped potential to improve the diversity as well as increase the size of the U.S. engineering workforce. To support nontraditional student participation in engineering, a qualitative investigation was undertaken to examine the ways in which nontraditional engineering undergraduates defined and experienced success during their engineering education. It is thought that, through a deeper, richer understanding of the ways in which the nontraditional engineering undergraduates overcome barriers and experience success, newer, more

impactful alternative pathways that assist nontraditional students in becoming part of the engineering profession can be envisioned and developed.

During this study, 14 nontraditional student participants were purposefully sampled from the population of undergraduates who participated in a distance-delivered, alternative engineering transfer program offered at a western, land-grant, public university between 2009-2015. Qualitative data from in-depth interviews were used to co-develop life history–style narratives for each of the participants. Completed narratives chronologically ordered and richly described the participants’ experiences leading up to, happening during, and occurring after their engineering education. Narrative analysis revealed that the nontraditional student participants viewed their own educational success contextually, relationally, and in terms of their long-term goals for social mobility through engineering careers. Additionally, the distance-delivered alternative engineering transfer program was seen to promote their educational success in three ways: a) working to promote long-range career goals through job market signaling, b) enabling academic bootstrapping in an adult learning environment, and c) maintaining connection to community-based support through place. Recommendations for engineering programs that seek to broaden nontraditional student participation are offered.

(395 pages)

PUBLIC ABSTRACT

Towards Alternative Pathways: Nontraditional Student Success
in a Distance-delivered, Undergraduate
Engineering Transfer Program

Angela L. Minichiello

Nontraditional students, including those who delay college entry, attend college part-time, work full-time, or financially support themselves or dependents, are highly underrepresented in engineering education. Recently, the United States began emphasizing a need to access this untapped human potential. U.S. educational policymakers now seek increased nontraditional student participation in engineering education through the creation of robust new pathways—within and between 2- and 4-year institutions—to undergraduate engineering degrees.

To be impactful, alternative pathways must be grounded in knowledge related to nontraditional student success in engineering. To access this knowledge, this study qualitatively examined the experiences of 14 nontraditional students who pursued engineering degrees via a distance-delivered, alternative engineering transfer program. Data from in-depth interviews were used to create personal, experiential stories with each participant. Analysis revealed that nontraditional student views of their educational success departed substantially from common views of academic success. In addition, analysis showed that the alternative engineering program promoted nontraditional student success in three ways: a) by promoting long-term career goals, b) by enabling academic bootstrapping, and c) by maintaining connections to local communities of support.

DEDICATION

To Ezra and Kokanee, ever-faithful friends and the best of writing companions.

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"Silent gratitude isn't very much to anyone."—Gertrude Stein

I send heartfelt gratitude out to many, many people without whom my doctoral journey would not have been possible.

First, I thank all of the preengineering students who graciously volunteered to be a part of this study. I thank the participants for their time, patience, and willingness to share their personal stories with me and with others. I wish them all the absolute best this world has to offer.

I thank my committee members, Dr. Kurt Becker, Dr. David Feldon, and Dr. Idalis Villanueva, for their time and thoughtful consideration of this work. The insights offered by each have been important and valuable contributions.

I deeply thank my advisors, Dr. Oenardi Lawanto and Dr. Sherry Marx, for their considerable time and efforts on my behalf. I have learned a tremendous amount from each, as an engineering education student in their classrooms and later as a doctoral advisee. I sincerely hope for more opportunities to collaborate with each in the future.

And last but by no means least, I want to express my overwhelming appreciation and love for my family, Barton and Samuel Smith. I would not have completed this journey had it not been for their unwavering support, patience, and understanding. I hold them close in my heart and pray that I realize the confidence they have placed in me.

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CHAPTER I

INTRODUCTION

Background of the Study

Today, a national debate related to America’s ability to maintain its position of global competitive advantage persists. During the last decade, statistical indicators (National Science Foundation, 2014) continued to report that much of the industrialized world may be out-performing the United States in training a robust science, technology, engineering, and mathematics (STEM) workforce. As U.S. President Barack Obama emphasized during a 2009 address to the National Academy of Sciences, “We know that a nation that out-educates us today—will out-compete us tomorrow” (as cited by the President's Council of Advisors on Science and Technology (PCAST), 2012).

Deepening concern for America’s economic future and national security has resulted in substantial policy measures directed toward improving STEM education at all levels—from K-12 through postsecondary instruction. In 2005, for example, the National Academy of Sciences, the National Academy of Engineering, and the Institute of Medicine (Committee on Prospering in the Global Economy of the 21st Century, 2005) jointly recommended broad improvements for K-12 STEM education. In their report entitled *Rising Above the Gathering Storm: Energizing and Employing America for a Brighter Economic Future*, the National Academies proposed to increase the number of postsecondary STEM students by implementing scholarship programs to attract new K-12 STEM teachers, specialized training for current K-12 STEM teachers, and incentive programs for K-12 students choosing to pursue STEM degrees.

In 2006, the Association of American Universities (AAU) (2006) advised government, academia, and critical industry sectors to implement several mutually supportive initiatives in order to overcome national economic and security challenges. Specifically, the AAU recommended that academia “cultivate American talent” (p. 5) by implementing accelerated K-12 STEM teacher training programs, promoting best practices in STEM undergraduate education—especially practices that address attrition and underrepresentation of minorities, establishing professional masters programs to meet STEM workforce needs, and reducing the time to graduation for STEM Ph.D. candidates. Thus, it can be seen that a substantial number of policy initiatives of the past decade have focused on incentivizing and shoring up the current STEM education system as means to increase America’s STEM workforce.

Yet, despite this attention toward improving STEM education in order to attract and retain more of our national talent, these educational initiatives may have been weakened by a failure to directly address a critical, underlying issue—the nature of underrepresentation in STEM. As highlighted here, initiatives have focused on incentivizing STEM enrollment and improving STEM retention largely for the sake of the numbers embodied by underrepresented student groups. In many ways, these policies have translated merely as efforts to increase the STEM enrollment “pool” and fix leaks within the “STEM pipeline” with little regard for the characteristics and needs of targeted underrepresented groups.

In this moment, however, it can be seen that educational policy makers are starting to address underrepresentation in STEM more directly and in ways that reconsider the

needs of America's "underrepresented majority" (S. A. Jackson, 2004). Moreover, the talents of nontraditional students are now being recognized—at a national level—as resources capable of increasing the quality, as well as the size, of America's workforce.

An example of this shift is seen in a 2012 report by the President's Council of Advisors on Science and Technology known as PCAST (2012). Citing economic projections that forecast a demand for one million more STEM professionals by 2022, the council declared the need to "... transform undergraduate STEM education" (p. ii) during the high school to college transition and the first two years of undergraduate study by "[diversifying] pathways to STEM degrees" (p. ii). They stated:

To take advantage of the breath of available talent, non-traditional students should receive special attention. Adult and working students and those from backgrounds atypical of traditional STEM students may need alternative pathways to be successful in STEM disciplines. The concept of a "pipeline" to STEM competency and accomplishment needs to be superseded by the image of multiple pathways to these goals. All colleges and universities, including 2- and 4-year institutions, need better connections among themselves and with other institutions to provide more entry points and pathways to STEM degrees. (President's Council of Advisors on Science and Technology (PCAST), 2012, p. vii)

With this report, the council laid a foundation for improving STEM education by transforming the STEM educational paradigm. The council's transformative vision seeks to move STEM education away from its current "pipeline" (p. vii) model, toward a framework that works inherently to broaden STEM participation via networks of mutually supportive pathways to STEM degrees. Amid this newer perspective concerning underrepresentation in STEM, understanding the experiences of nontraditional students as they traverse alternative pathways toward STEM degrees emerges as an important area for education research.

Purpose and Objectives

In support of efforts to broaden access to undergraduate STEM education, the purpose of this study was to qualitatively explore the construct of success among a subset of nontraditional students engaged in an alternative engineering program. The qualitative researcher sought to understand ways in which these nontraditional students defined and experienced success while participating in a distance-delivered, alternative engineering transfer program that was offered at a western, public university from 2009 - 2015. As part of the university's land grant mission, the engineering transfer program employed distance-delivery to provide the first 2-years of its bachelor of science engineering curricula to geographically underrepresented, rural, and working adult who resided within the large, western state. The program was administered within a regional campus framework via evening classes conducted synchronously through interactive video conferencing (IVC). Graduates of the program earned an associate's degree in preengineering and were eligible to transfer to the university's main campus in order to complete their engineering bachelor's degree.

The guiding objectives of the proposed study were to explore the ways in which nontraditional students defined and experienced success and to understand the major barriers faced by nontraditional students in alternative STEM education programs. As a group, nontraditional students come from a variety of educational, economic, social, ethnic, and cultural backgrounds. Thus, in order to describe the subset of nontraditional student participants in this study, the continuum model proposed Horn (1996) was used as a framework for defining the term "nontraditional student." This continuum model was

employed to categorize student participants according to their level of divergence from the “traditional undergraduate” (Choy, 2002, p. 1) archetype (i.e., minimally, moderately, and highly nontraditional). The model was useful for selecting nontraditional student participants and as well as for differentiating the varied student experiences that were explored.

Research Questions

The proposed study used qualitative inquiry to describe and understand the experiences of this group of nontraditional students who participated in the alternative engineering transfer program. Two primary research questions were used to guide the study:

1. Within the context of alternative engineering transfer program, how do nontraditional engineering students define success?
2. Within the context of alternative engineering transfer program, how do nontraditional engineering students experience success?
 - a. Sub question: What are the major barriers to success experienced by nontraditional students?
 - b. Sub question: What are the actions and base of knowledge that enable nontraditional students to overcome these barriers?

Research Design

The proposed study was conducted using a qualitative research approach. Use of qualitative inquiry for educational research is well-established in the literature and can be recognized by several defining characteristics including naturalistic research settings, use of multiple types and sources of textual or image-based data, employment of a complex mix of inductive and deductive reasoning, emergent and evolving research designs, and holistic, reflexive accountings of complex, multi-faceted issues or problems (Creswell, 2014, pp. 185-186). As Creswell (2014) explains, qualitative inquiry is well suited for research that focuses on the meaning that individuals give to their own experiences and that recognizes the importance of preserving and describing the complexity of the research context (p. 4). “Given the wide variety of issues still left to be explored in engineering education,” the “low representation of qualitative studies” (Borrego, Douglas, & Amelink, 2009, p. 53) has led to several calls for increasing use of qualitative inquiry in engineering education (Borrego et al., 2009; Koro-Ljungberg & Douglas, 2008).

The proposed qualitative study was conducted within the interpretive theoretical perspective and using a narrative research methodology. Interpretivism, as discussed by Glesne (2011, p. 8), became its own form of social science in the 1700s. Distinct from positivists and post-positivists, interpretivists believe that there is “... no direct understanding of the [natural and social] world. The world is always interpreted through the mind” (Schwandt, 2007, p. 143). Interpretivist research seeks “contextualization, understanding, and interpretation” rather than “generalizability, causal explanations, and prediction” (Glesne, 2011, p. 9). Narrative methodology is expressly fitting for

interpretivist research related to nontraditional student experience in alternative engineering education programs because, as Foor, Walden, and Trytten (2007) describe, “narrative is a means through which those who have been historically marginalized can be heard” (p. 104). Together, the works of Felder (1989), Foor et al. (2007), and Pawley (2013) establish a precedent for use of narrative inquiry within engineering education research.

Methods used in this study consisted of semi-structured, retrospective interviews with student volunteers who participated in the 2-year engineering transfer program. “Purposive,” “purposeful,” or “selective” sampling (Creswell, 2014; Glesne, 2011; Patton, 2002) was used to select the individual participants for this study. As Glesne (2011) and Patton (2002) describe, qualitative researchers often use purposive sampling to select their research participants. Patton (2002) writes,

The logic and power of purposeful sampling...leads to selecting information-rich cases for study in depth. Information rich cases are those from which one can learn a great deal about issues of central importance to the purpose of the research. (p. 64)

Because the intent of this study is to answer the research questions and provide insights for designing effective alternative engineering pathways for nontraditional students, the researcher used a sampling strategy known as intensity sampling (Patton, 2002). Intensity sampling was used to select “excellent or rich examples of the phenomenon of interest, but not highly unusual cases” that are typically chosen using extreme or deviant case sampling (Patton, 2002, p. 234). With intensity sampling, the researcher will purposefully select participants that “manifest sufficient intensity to illuminate the nature...” of [nontraditional student] success rather than “extreme or deviant cases [that] may be so

unusual as to distort” the experiences of the nontraditional student participants (Patton, 2002, p. 234).

In-depth interviewing was used to elicit participants’ descriptive accounts of their experiences and reflections on personal success during and as a result of the program. Qualitative data consisted of audio-recorded conversations (which were transcribed into written form), supporting documentation (examples of student work, course documents, emails, etc.) that students voluntarily employed to help tell their stories, and post-interview reflective memos created by the researcher to capture immediate details concerning the interview. Data was used to co-create an individual narrative for each participant. Upon completion of the participant narratives, adult learning theory (Knowles, Holton, & Swanson, 2005) was used as a theoretical framework to scaffold narrative interpretations and answer the research questions.

Significance of the Study

This study addresses a current problem of national importance in STEM education by qualitatively exploring factors influencing nontraditional student success in a distance-delivered, alternative engineering transfer program. Results from this study add to the pool of knowledge in three broad areas: alternative engineering programs, distance-delivered undergraduate engineering education, and nontraditional student success in STEM. Specifically, the study explored important topics for future research as proposed in the literature, including improving understanding of multi-institutional /multi-degree pathways for engineering undergraduates (Ohland et al., 2008), identifying

barriers experienced by nontraditional transfer students in STEM (Malcolm, 2010) and understanding student satisfaction in distance-delivered engineering programs (Bourne, Harris, & Mayadas, 2005).

Assumptions

The study rested on two main assumptions. The first assumption was that students who have participated in the engineering transfer program would be willing to share their personal stories of success—and perhaps failure—with the researcher. The second assumption was that the student participants would be able to deeply reflect on and describe their experiences in the program in a richly detailed manner, even though their participation in the program may have ended several years prior.

Limitations of the Study

A primary limitation of this study may be considered to be its small sample size. Small sample sizes are characteristic of the qualitative approach to research because they allow for in-depth, detailed data collection and, in the case of this study, the co-creation of an individual narrative with each participant. It is important to note that the small samples that are typical of qualitative research do not purport to be representative of the population of interest. Rather, the qualitative researcher employs purposeful sampling in order to select the participants that “...will best help the researcher understand the problem and answer the research questions” (Creswell, 2014, p. 189). As Borrego et al. (2009) describe,

The goal [of qualitative research] is not to provide a broad, generalizable

description that is representative of most situations, but rather to describe a particular situation in enough depth that the full meaning of what occurs is made apparent. This approach is particularly useful when considering unusual or non-traditional cases. (p. 57)

Therefore, the richly detailed and descriptive nature of the data that is collected from the participants is seen to mitigate the sample size limitation in this qualitative study.

A second limitation to this study is a lack of cultural, ethnic, and gender diversity within the sample population from which the study participants were selected. The sample population in this study is strongly influenced by the location of the alternative engineering transfer program at a public university in the western United States; the majority of students who participated in the alternative engineering transfer program are white and male. Many are of the dominant religious faith of the area (The Church of Jesus Christ of Latter-day Saints).

The use of Horn's (1996) continuum model of nontraditional students helped to mitigate this second limitation. Horn's model was employed to characterize potential and actual student participants as minimally, moderately, or highly nontraditional based on socio-economic and educational factors—rather than on race, ethnicity, or gender. Use of Horn's model promoted the selection of participants from diverse socio-economic and educational backgrounds and experiences, even though many shared the same race, ethnicity, and gender. Use of this model provided a framework for describing and categorizing participants in a way that helped present findings that are more readily transferrable to other nontraditional student contexts.

A third limitation of the study is the reflective nature of the data. Because the participants retrospectively described their experiences in the engineering transfer

program, there remained uncertainty as to whether these descriptions closely matched the descriptions the participants would have provided if interviewed while still active in the program. It may be true that the participants, at the time of the interviews, possessed a more holistic opinion of the program that affected their memories of experiences during the program. Methodological emphasis on data triangulation and member checking of co-created narratives and the prolonged field time of the researcher (six years teaching in the program) helped to mitigate this limitation.

A fourth limitation to this study became clear after participant selection. All of study volunteers who met the sampling requirements had participated in the engineering transfer program at the Brigham City regional campus. Although separated from the Logan, Utah by the northern end of the Wasatch Mountain Range, Brigham City, Utah is considered to be within commuting distance of the main university campus. Therefore, the barriers to transfer to the professional program reported in this study are likely to be less numerous and/or less difficult to overcome than those experienced by students who transfer from regional sites that are located farther away. Furthermore, it cannot be assumed that this study captures all of the barriers experienced by nontraditional students at the more remote sites.

Definition of Key Terms

The following definitions are provided to improve the clarity of this research proposal.

1. *Theoretical perspective*: the philosophical stance informing the research methodology and thus providing context for the research process, its logic, and criteria (Crotty, 1998, p. 3).
2. *Theoretical framework*: the application of social, educational, or other human theory as a perspective or lens through which to view the data (Borrego et al., 2009, p. 57); “a diffractive reading of text (data) through another (theory)” in order to “produce different thought” (A. Y. Jackson & Mazzei, 2012, p. 13).
3. *Methodology*: the research strategy, process, or design that links the choice and use of methods to the desired research outcomes (Crotty, 1998, p. 3).
4. *Methods*: the techniques or procedures used to gather and analyze data that will be used to answer the research questions (Crotty, 1998, p. 3).
5. *Triangulation*: the use of multiple methods of data collections and/or sources of data to build a justification for themes or findings (Creswell, 2014, p. 201; Glesne, 2011, p. 285).
6. *Member-checking*: the process of seeking participant agreement with major research results as a means to demonstrate the accuracy of the qualitative interpretive findings (Creswell, 2014, p. 201).
7. *Alternative engineering program*: postsecondary engineering programs offered in ways to engage locally, regionally, or nationally underrepresented groups in undergraduate engineering curricula. Alternative engineering programs contrast with traditional engineering programs, namely 4-year baccalaureate degree programs, that do not expressly serve nontraditional student groups through

alternative or “sub-baccalaureate” degree (e.g., associate’s degree) options, flexible or evening scheduling, multiple regional locations, etc.

8. *Emic perspective*: “How local people think” or how a culture perceives and makes sense of and explains its world. The emic perspective also includes a local culture’s rules for behavior (Kottak, 2006, p. 46). “Emic” generally refers to insider.
9. *Etic perspective*: how a researcher thinks about and interprets the perspectives and behaviors of a culture (Kottak, 2006, p. 46). “Etic” generally refers to outsider.

Organization of this Dissertation

This dissertation is organized in a monograph (traditional) format with its contents arranged in six chapters. Chapter I provides the introduction to the study, including the background, objectives, and design of the research study. Chapter II presents a review of the research literature concerning current models of STEM education, alternative STEM programs and nontraditional students in STEM, distance-delivered STEM programs, and research approaches used to operationalize the construct of student success in STEM. Chapter III describes the research methodology, methods of data collection, and analysis techniques used in the study. Chapter IV presents the collected narratives of each of the fourteen nontraditional students that participated in the study. In Chapter V, the researcher presents the discussion of the narrative analysis. The dissertation concludes with Chapter VI. Chapter VI presents the conclusions and lessons

learned from the study and provides recommendations for promoting alternative pathways in engineering education for future nontraditional students.

CHAPTER II

REVIEW OF THE LITERATURE

Introduction

This study addressed a current problem of national importance in STEM education by qualitatively exploring the construct of nontraditional student success in a distance-delivered, undergraduate engineering transfer program. This program was considered as an “alternative transfer program” because students graduated from the program with an associate’s degree in preengineering and then became eligible to transfer to the main university campus to complete the remainder of their engineering baccalaureate degree. This study added to the pool of knowledge in three broad areas: nontraditional student success in STEM, the design of alternative STEM programs to meet the needs of nontraditional students, and distance–delivery of undergraduate engineering education. Specifically, this study explored important topics for future research as proposed in the literature, including barriers experienced by nontraditional transfer students in STEM (Malcolm, 2010, pp. 37-38), identifying multi-institutional /multi-degree pathways for engineering undergraduates (Ohland et al., 2008, p. 259 and p. 276), and understanding student satisfaction in distance-delivered engineering programs (Bourne et al., 2005, p. 138).

In order to situate this study within the larger body of research related to nontraditional students and alternative pathways in STEM education, a review of relevant literature was conducted. The review begins by examining the current status of

nontraditional students within STEM education, including ways in which the term “nontraditional” has been defined in the literature. Next, studies related to alternative STEM programs and institutions serving nontraditional students are considered. Methods that have been used for operationalizing the construct of student success within STEM, including the ways in which nontraditional students may characterize success and the unique barrier to success they face, are then discussed. The literature review concludes by examining how the literature base has influenced the focus and scope of this study.

In conducting the literature review, the researcher examined several educational research databases, including Education Source, ERIC, and EBSCO, using the following keywords: academic persistence, retention, inclusion, inclusion AND STEM, inclusion AND engineering education, barriers AND engineering education, distance engineering education, nontraditional students, and student success. In addition several specific journals, including *The Journal of Engineering Education*, *The European Journal of Engineering Education*, and *The Journal of STEM Education*, were individually reviewed for potential primary and secondary sources.

Nontraditional Students in STEM

“Nontraditional Student” Defined

The long-held notion of the traditional undergraduate may be giving way in 21st century America. Choy (2002), for example, found that a majority (73%) of college students displayed at least one characteristic commonly considered to be atypical of “traditional” college undergraduates:

The traditional student, characterized here as one who earns a high school diploma, enrolls full time immediately after finishing high school, depends on parents for financial support, and either does not work during the school year or works part time- is the exception rather than the rule. In 1999-2000, just 27 percent of all undergraduates [including students from less-than-2 year, 2-year and 4-year post secondary institutions] met all of these criteria. (Choy, 2002, p. 1)

Yet, the term “nontraditional student” has proven difficult to define due to the multifaceted ways in which contemporary students can differ:

Nontraditional students can be from any part of the country; from rural or urban settings; rich or poor; black, white, or Hispanic; 18 years old or older; not employed, working full- or part-time, or retired; male or female; with or without dependents; married, single, or divorced; and enrolled for vocational or avocational reasons in a single course or in a degree or certificate program. (Bean & Metzner, 1985, p. 488)

Bean and Metzner (1985) also pointed out that nontraditional students differ from traditional students in that they do not become “socialized” and are not “greatly influenced by the social environment of the institution” (p. 489). Nontraditional students tend to be more interested in academic offerings (courses, certificates, and degrees) than social environments. Bean and Metzner (1985), in fact, critically questioned whether a “widely acceptable formula could be derived that precisely distinguishes traditional from nontraditional students” because, as they discussed, “the difference between traditional and nontraditional students is a matter of extent; traditional and nontraditional students cannot be easily classified into simple dichotomous categories” (p. 488).

Further challenging a binary interpretation of traditional vs. nontraditional students, Horn (1996, p. i) proposed a continuum model to describe the extent to which undergraduates display nontraditional characteristics. According to this model, a

nontraditional student in postsecondary education is one who possesses any one of the following characteristics:

- Delays enrollment (does not enter postsecondary education in the same calendar year that high school graduation);
- Attends part-time for at least part of the academic year;
- Works full-time (35 hours or more per week) while enrolled;
- Is considered “financially independent” (i.e., is a dependent of a parent or guardian) for the determination of eligibility for financial aid;
- Has dependents other than a spouse (usually children, but may also be caregivers of sick or elderly family members);
- Is a single parent (either not married or married but separated and has dependents);
or
- Does not have a high school diploma (completed high school with a GED or other high school completion certificate or did not finish high school).

According to Horn (1996), students can be categorized as “minimally nontraditional” if they possess only one of these characteristics, “moderately nontraditional” if they possess two or three characteristics, and “highly nontraditional” if they possess four or more characteristics (p. i). Horn’s framework, therefore, can be used to track critical characteristics of an underrepresented nontraditional student population that are not necessarily reflected by ethnic, racial, or gender categorization.

Status of Nontraditional Students in STEM

Examining the enrollment trends of students between the years 1986 and 1993, Horn (1996) reported that a majority of undergraduates were categorized as at least minimally nontraditional. Horn (1996) also found that nontraditional students were much less likely than their traditional counterparts to earn a degree within five years and far more likely to leave their postsecondary program without returning. Moreover, Horn (1996) reported “discernible growth in the enrollment of moderately nontraditional students in 4-year institutions” and discovered nontraditional students to be “...more than twice as likely to leave school with the first year than were traditional students (38% versus 16%)” (pp. i-ii).

In a more recent study, Chen and Weko (2009) examined the differences between students who enroll in STEM programs and students who complete STEM baccalaureate degrees. They, too, found a stark demarcation between traditional and nontraditional student achievement. Chen and Weko (2009) reported that, for U.S. undergraduates between 1995-96 and 2001, atypical students enrolling in traditional (4-year) STEM baccalaureate degree programs (not including computer science programs) were female, of other than Asian/Pacific Islander ethnicity, age twenty-four or older, responsible for supporting themselves financially, from low socio-economic backgrounds, children of parents having a high school education or less, or academically underprepared in mathematics.

While Chen and Weko (2009) did not find significant gender difference in rates of baccalaureate degree attainment, they did report significant differences in the degree

outcomes of other diverse groups. Black and Hispanic students, for example, completed STEM degrees at significantly lower rates than Asian and White students did.

Additionally, age and financial dependency factors played a role: Significantly lower percentages of students who entered STEM programs at age 20 or older or as financially self-supporting completed degrees compared with students who entered at age 19 or younger or as dependents of a parent or guardian. Differences in the ways in which undergraduate students left STEM baccalaureate programs were also found: More younger and dependent students left by changing to a non-STEM major, while more older and self-supporting students left by leaving postsecondary education altogether.

These findings point to the potential usefulness of a flexible pathways model—instead of a rigid and linear pipeline model—for STEM education. While the work of Chen and Weko (2009) showed that women (as a group) experienced barriers to access/enrollment in STEM education, students who were older, from underrepresented minorities, or financially self-supporting experienced barriers to retention in addition to barriers to access/enrollment. The existence of multiple, overlapping barriers may increase the difficulty for these nontraditional groups (i.e., older, minority, and self-supporting students) to achieve “traditional” baccalaureate degrees in STEM fields. Alternative STEM programs, designed to provide additional entry and exits points to undergraduate STEM education (e.g., those offering sub-baccalaureate credentials, such as associate’s degrees or certificate credentials, that can lead to four year degrees), may better serve older, minority, and financially self-supporting students. As Pulley (2012) wrote, “sub-baccalaureate credentials also inject dynamism that can smooth the path to

higher education—a path that is traditionally linear and generally lacks easily navigable on-ramps and secondary roads” (p. 8).

With shorter estimated times-to-completion, programs culminating in sub-baccalaureate degrees or technical credentials can be paid for and completed more easily than traditional 4-year programs. Pulley (2012) explained that lower-income and financially self-supporting students often “...view sub-baccalaureate degrees as a financially prudent alternative to residential colleges—a way to get some education without going deep into debt” (pp. 7-8). Sub-baccalaureate credentialing programs may also enable progression to baccalaureate degree programs through a system of “stackable credentials” (Mullin, April 2012, p. 4).

The idea of stackable credentials originated in a 2012 report by the 21st Century Commission on the Future of Community Colleges (American Association of Community Colleges, 2012). As Garcia (January/February, 2014) explained,

The idea of stackable credentials is to form a pathway for students to acquire credentials along a trajectory that can lead to a baccalaureate and beyond but that has exit and entry points designed in a way to allow students to pick up wherever they left off en route to the next level of achievement. Of course, the notion of stackable credentials is not new. Associate's degrees leading to bachelor's degrees leading to master's degrees are stacked credentials. The wrinkle in today's approach is that the initial stacks are sliced thinner, typically starting with an industry certification or the completion of a course sequence that provides the student with a marketable skill. (para. 3)

Interestingly, it is argued that other underrepresented groups in STEM education may choose sub-baccalaureate credentialing programs for different reasons. A. Lee (2011), for example, reported that students with disabilities who enroll in STEM programs tended to choose 2-year programs over 4-year programs. This trend was found to be influenced by

the perceived ease of receiving disability accommodations at 2-year vs. 4-year institutions.

Alternative STEM Programs

For today's nontraditional students, navigable pathways to STEM careers may differ markedly from the current standard of a 4-year, residential, baccalaureate degree program. As Garcia (January/February, 2014) forewarned, "To effectively reengage and reenroll a student into the next level of certification requires that higher education institutions and faculty design a curriculum and process to meet the needs of students" (para. 5). Thus, it is now recognized that alternative degree programs and delivery methods may be effective for serving nontraditional students in STEM. In this section of the literature review, research on alternative STEM degree programs and distance-delivered STEM programs is discussed.

Public 2-year Colleges

As Olson and Labov (2012) described, public 2-year colleges, or community colleges, "...are an often overlooked but essential component in the U.S. STEM education system" (p. 2). They stated,

Community colleges provide not only general education but also many of the essential technical skills on which economic development and innovation are based. Almost one-half of the Americans who receive bachelor's degrees in science and engineering attended community college at some point during their education, and almost one-third of recipients of science or engineering master's degree did so (Tsapogas, 2004). (Olson & Labov, 2012, p. 2)

Annually, approximately 40% of American undergraduates enroll in community colleges (Aud et al., 2012; Olson & Labov, 2012). Increasing enrollments seen in U.S. community colleges in recent years may result from the community college “triple mission”: a) to provide vocational preparation and workforce development, b) to provide certificate programs for part-time students for additional or advanced training on work-related technologies, and c) to serve as a primary provider of post-secondary undergraduate instruction (Hachey, Conway, & Wladis, 2013). A large portion of the recent 2007-2008 “recession-era” enrollment boom came from underrepresented minority freshmen, including racial and ethnic minorities, immigrants, and women (Fry, 2010). Community colleges have experienced this boom firsthand as more minority students attended community colleges and trade schools in recent years than 4-year institutions (Fry, 2010).

While students have commonly attended community colleges to enroll in 2-year associate degree and certificate programs (Aud et al., 2012), recent data suggest that more students are entering community colleges with the goal of attaining baccalaureate and/or post baccalaureate degrees sometime in the future (Horn & Skomsvold, 2012). In this way, community colleges have emerged as “stepping [stones]” (Monaghan & Attewell, 2014, p. 1) to baccalaureate degree granting institutions. However, as Hagedorn, Moon, Cyper, Maxwell, and Lester (2006) pointed out, “Too often students believe that the community colleges are literally 2-year institutions” (p. 239). On the contrary, these authors found that students within the Los Angeles Community College District enrolled in an average of nine and one-half semesters before becoming “transfer ready”— eligible to transfer to a 4-year college in the state of California (p. 231). As these authors reported,

this average value was not indicative of the actual time elapsed, but rather included only the number of semesters in which the students actually enrolled in classes. These findings suggest that community colleges are not, in fact, 2-year institutions but rather “...require students to persevere much longer” than two years (Hagedorn et al., 2006, p. 237).

Community colleges commonly serve groups that are underrepresented in postsecondary education, such as racial minorities—including increasing numbers of American Indians (Pavel & Colby, 1992) and Latina/o students (Malcolm, 2010), women, military veterans, first-generation students, and working parents (Olson & Labov, 2012, p. 2). Moreover, “minorities who are underrepresented in STEM fields are disproportionately enrolled in community colleges” (Olson & Labov, 2012, p. 2).

Hagedorn et al. (2006) emphasized that the students who attend community colleges often lack the “level of cultural capital that will assist them in understanding the college environment” (p. 238) and suggested that “counseling is key to obtaining the knowledge that will lead them through...” (Hagedorn et al., 2006, p. 239).

Hagedorn et al. (2006) further pointed out that administrative “policy makers,” who often “rely on day care as the sole answer to involvement of nontraditional students,” may not understand the needs of older students “who may be more likely to be burdened with the needs of school-aged children, teen-aged children, and aging parents” (p. 238).

These authors reported on the need for programs able to address the “pull factors” that are relevant to the nontraditional students they serve (Hagedorn et al., 2006, p. 238).

Similarly, J. J. Lee, Sax, Kim, and Hagedorn (2004) showed that there may be substantial differences in students’ needs across the range of parental educational achievement

outcomes (e.g., junior high school, high school, bachelor's degree, and master's degree). They argued that a binary interpretation of parental college achievement (i.e., did parents achieve a four year degree? yes or no) is not sufficient and that “community college practitioners should consider the unique characteristics of students from different levels of parental education as they devise support programs for students” (J. J. Lee et al., 2004, Conclusions and Limitations section, para. 1).

In addition to serving groups that are traditionally underrepresented in STEM, community colleges are also an attractive option for low-income students. Along with concerns related to the total cost of education (which may include relocation and housing expenses), low-income students often choose community college due to time factors. Time is an important factor for low-income students particularly because their time to participate in education is limited (Mullin, April 2012). Many low-income students must work while enrolled; working, especially more than twenty hours per week, has been shown to correlate negatively with post-secondary degree attainment (Cook & King, 2007). Full-time college students in the lowest income bracket have also been shown to spend more time on homework than any other income group (Mortenson, 2011). This statistic signals a potential lack of preparedness for higher education and a risk for postsecondary degree non-completion among low-income students. Finally, community college students may “stop-out” (Mullin, April 2012, p. 6) by taking a break from schooling in times of personal or financial hardship (Fry, 2002; Mullin, April 2012). The ability to stop-out may be an important draw for low-income students.

The literature indicates that 2-year and community colleges are becoming aware of the time constraints faced by their students. Hagedorn, Maxwell, Rodriguez, Hocevar, and Fillpot (2000) emphasized that “the classroom is the main point of student contact within the [community] college” and that community college students rarely give high priority to participation in clubs, student government, or music, arts, and athletic events (p. 596). These authors called for more research concerning student development, including gendered peer-relations and student-faculty interaction, and students’ social and academic needs within community college settings. Mullin (April 2012), who identified time as a “core unit of human capital” (p. 4), discussed ways in which community colleges “consider the influence of time on student success” (p. 4) in order to better serve their students. Time-sensitive teaching practices include evening course scheduling, instructional methods based on active learning; diagnostic testing; modularized; online; or accelerated learning opportunities; and structured programs of study with stackable credentials (Mullin, April 2012, p. 4).

Community college attrition. Despite growing enrollments and ardent use of student-centered teaching practices, community colleges continue to face dogged attrition problems—especially within STEM-related programs. While Bettinger (2010) found that high school students who enrolled in 2-year and 4-year STEM degree programs had similar intentions to pursue STEM majors in college, he also reported that the college retention rates for these groups varied significantly. Bettinger (2010) found that 43% of high school students who declared an intention to pursue a STEM major in high school graduated in STEM fields. Examining the portion of students who enrolled in STEM

programs at 2-year colleges, Bettinger (2010) showed that the STEM retention rate of 2-year college student group was 14%.

Moreover, high attrition rates for STEM majors in community colleges are not allayed by student migration from non-STEM majors into STEM majors; Olson and Labov (2012) reported that migration into STEM majors at community colleges is approximately 3%. Reasons that have been proposed for high STEM attrition and low STEM migration in community college settings include inadequate student preparation in secondary school, rigid STEM curricular structures, an uninviting and competitive postsecondary STEM culture, and perceived degree/career returns that do not make up for the intense commitment required to survive in STEM education (Olson & Labov, 2012, pp. 20-21).

Academic transfer process. The process of transferring from a 2-year college to a 4-year college or university also poses significant challenges for community college students. For example, Hoachlander, Sikora, Horn, and Carroll (2003) reported that only 29% of students who enrolled in community college in 1995-1996 had transferred to a 4-year institution by 2001. Considering only the students who reported an intention to pursue a 4-year degree after community college, the reported transfer rate was 51%. In either case, the statistics represent a substantial loss of potential workforce talent.

Olson and Labov (2012) cited several factors shown to contribute to low STEM transfer rates including ill-defined articulation agreements between two- and 4-year institutions (especially among mathematics courses), poor advising, a lack of discipline-specific student orientation programs, and the culture of exclusivity that remains

pervasive within many STEM disciplines. Gard, Paton, and Gosselin (2012) found that improper advising, financial issues, and psychosocial factors, such as a lack of familial or parental support, were major barriers to successful transfer of predominantly Hispanic students at a southwestern U. S. community college. Reyes (2011) proposed the need for new recruitment and undergraduate research programs for students and inclusive teaching practice and family/cultural awareness programs for faculty at 4-year institutions in order to improve transfer success of female, minority students in STEM.

Distance Education

In addition to alternative degree programs, distance education may serve nontraditional students in unique and compelling ways. The term “distance education” is considered to encompass all forms of instruction occurring when a “...teacher and student(s) are separated by a physical distance and technology is used to bridge the instructional gap” (Martin, 2005, p. 398). It is largely held that distance education has the ability to alter the landscape of undergraduate education by “[reversing] the traditional way of providing education.... Instead of students coming to the university to get that needed education, the university instead comes to the student” (Kunnath & Eaglin, 1998, p. 2). Thus, one of the most compelling reasons for promoting distance education, especially in STEM disciplines, may be to extend life-changing educational access to underrepresented, underserved, and marginalized groups. As Hall (1995) wrote, “Distance education is a movement that sought not to challenge or change the structure of higher learning but a movement to extend the traditional university, a movement to overcome its inherent problems of scarcity and exclusivity” (Distance Education and the

Traditional University section, para. 1). In this section, the literature review considers distance education research within two contexts: a) distance education within undergraduate engineering education and b) distance education within 2 year- and community colleges.

Distance education in undergraduate engineering. In the United States, the advance of distance education in undergraduate engineering has lagged compared to its progress within other STEM disciplines. Currently, the majority of U.S. distance-delivered engineering programs exist at the master's degree or professional certificate levels. The lack of engineering distance programs below the master's degree level has been attributed to several factors including the need for hands-on laboratories and a traditional pedagogical culture within engineering disciplines that is especially strong and pervasive at undergraduate levels (Bourne et al., 2005).

A review of the literature indicated that there is general acceptance of distance-delivered engineering education outside of the United States. For example, Ariadurai and Manohanthan (2008) reported on the distance instruction within a preparatory preengineering program offered at the Open University of Sri Lanka. Graduates of this program received diplomas and are considered eligible and academically prepared to enroll in bachelors of engineering programs. Dowling (2006) described the pedagogical principles used to inform a tailored, self-directed distance-education engineering program. This program enabled experienced engineering technologists to become registered Chartered Professional Engineers in Australia by providing an alternate path for experienced, working technology professionals to become licensed engineers. Karlsson

(2004) presented a web-based, freshman level, required undergraduate engineering course in mechanics offered at the Royal Institute of Technology in Stockholm, Sweden. The course targeted potential engineering students who cannot attend the traditional undergraduate engineering program. Finally, Oliver and Haim (2009) presented an innovative, distance engineering laboratory methodology applied across four undergraduate digital design course offerings at the University de la Republica in Montevideo, Uruguay.

Within the United States, there is scant documented research that reports on distinct, distance-delivered undergraduate engineering programs. The U.S. engineering education literature published before the year 2000 focuses on distance learning at the engineering course level. This body of literature includes studies presenting a variety of distance-education related topics within the context of engineering including web-mediated course design and development (Wallace & Mutooni, 1997), team teaching nuclear power plant design via synchronous interactive video conferencing between two universities (Rutz & Hajek, 1998), the use of technology and software to replicate traditional classroom-based learning (Thiagarajan & Jacobs, 2001), and the process of transitioning from a classroom to a distance-learning environment (Williamson, Bernhard, & Chamberlin, 2000). It is also within this period that general acceptance of distance learning in engineering—at the course level—was established (Dutton, Dutton, & Perry, 2001; Thiagarajan & Jacobs, 2001; Wallace & Mutooni, 1997). More recent research is focused on larger, more integrative issues that could lead to programmatic innovation in engineering (Bourne et al., 2005), such as distance-delivered engineering

course quality (Cohen & Ellis, 2004), computer-mediated engineering student design teams (Whitman et al., 2005), and distance delivery of engineering laboratories (Alexander & Smelser, 2003; Feisel & Rosa, 2005).

Distance education in community colleges. Despite slow acceptance of distance education within U.S. engineering programs, the use of distance-delivery methods appears to be spreading rapidly among U.S. institutions of higher learning. From 2009-2010, Sloan-C (Allen & Seaman, 2010) reported that 75% of all higher education institutions—public, private nonprofit, and private for profit—experienced an increase in demand for online courses and programs as a result of the recent national economic downturn. In 2011, the Pearson Foundation (2011) reported that 61% of all community college students were taking at least one online course. This rising trend in distance education in community colleges is not so surprising: As Allen and Seaman (2007) discuss, “2-year associate’s institutions have the highest growth rates and account for over one-half of all online enrollment for the last five years [ending in 2006]” (p. 1). Thus, amid rapidly rising enrollments and increasing budgetary constraints, community colleges are opting to go online instead of “adding brick and mortar” (Hachey et al., 2013).

The move toward distance education at 2-year colleges, however, comes with appreciable concerns. Although a 2010 United States Department of Education meta-analysis found that college student outcomes in online classes were generally as good as—or better than—their face-to-face counterparts, other research indicates that online instruction may negatively affect the outcomes of young male students, those from

underrepresented groups including African-Americans, and lower achieving students (Castillo, 2013). Additionally, there is considerable concern that attrition may be higher for online courses than for face-to-face courses (Hachey et al., 2013; Johnson & Berge, 2012). Angelino, Willimas, and Natvig (2007) and Hachey, Wladis, and Conway (2012) reported evidence suggesting that attrition rates for undergraduate distance students average 7- 20% higher than for students enrolled in traditional, face-to-face courses. As noted by Hachey et al. (2013), the effects of these combined trends may be a significant concern for community colleges where online offerings and underrepresented minority enrollments are both high.

Student Success

In considering the literature related to alternative pathways in STEM education, it is important to understand how the construct of student success has been conceptualized within prior research. In this section, literature related to student success and barriers to student success in postsecondary STEM education is discussed.

Student Success in STEM: A Multi-Faceted Construct

In a recent review of literature concerning student success in engineering, van den Bogaard (2012) reported that “ student success is a broad concept that can be operationalised in many different ways” (p. 60). In this review, van den Bogaard (2012, p. 60) discussed multiple approaches for defining student success/failure that have been applied in the postsecondary STEM education research: student attrition characterized as

“dropouts” or “switchers” (Beasley & Fischer, 2012; Pierrakos, Beam, Constantz, Johri, & Anderson, 2009; Seymour & Hewitt, 1997; Tinto, 1987), degree attainment (Boswell & Passmore, 2013; Moller-Wong & Eide, 1997; Wirth & Padilla, 2008), student intentions to persist in STEM or progress within a set period of time (Cech, Rubineau, Silbey, & Seron, 2011; Lent et al., 2013; Litzler & Young, 2012), course completion, course grade achievement or overall grade point average (Baldwin, 1993; Boswell & Passmore, 2013; Bruinsma & Jansen, 2007), and continued re-enrollment (Ohland et al., 2008).

Moreover, since the construct of academic success is highly contextual (van den Bogaard, 2012), several researchers have operationalized the construct of student success as combinations of factors. For example, Haemmerlie and Montgomery (2012) operationalized student success in a freshman engineering class using combined measures of student academic achievement (end of second semester grade point average) and re-enrollment in engineering majors during the fall of the following academic year. Suresh (2006) investigated the link between two common measures of student success by exploring how student academic achievement (course grades and number of course repeats) in engineering “barrier” courses (e.g., calculus, physics, and statics) affected student intentions to persist in engineering after their first two years of engineering study.

As van den Bogaard (2012) discussed, the ethnographic work of Seymour and Hewitt (1997) helped to uncover the contextual, multi-faceted nature of student success in STEM education. van den Bogaard (2012) stated:

They [(Seymour & Hewitt, 1997)] add to the complexity of the issue of ‘student success’ by observing that good students seem to leave engineering, so ability alone is not enough to stay in engineering. Switchers and non-switchers share

concerns, but for some students this leads to a decision to switch. Students need to develop effective strategies to deal with these concerns and the competitive culture in engineering programmes. Student dispositions play an important role. (pp. 70-71)

Seymour and Hewitt (1997) reported that they did not find that students who persisted in STEM disciplines (i.e., non-switchers) were inherently different than students who changed majors (i.e., switchers). Rather, both groups shared common attributes and abilities. Moreover, these groups also shared complaints about STEM education including inadequate teaching practices and support provided by STEM faculty and advisors, a pervasive weed-out culture, and an overwhelming curricular pace and workload. Similar to the non-switchers, the majority of switchers were found to have spent considerable, time, money and effort on their STEM education.

Seymour and Hewitt (1997) concluded that what appeared to separate these two groups was the ability of non-switchers to develop effective attitudes or coping strategies and, in many cases, instances of chance that positively affected students at a critical juncture in their education. Similarly, Pierrakos et al. (2009) found that undergraduates who persisted in engineering after their first year had engaged in engineering-related activities and formed a social/professional network within engineering while students who switched out of engineering during their first year did not. Together, these studies suggest that student success in STEM, as measured by persistence, may be a strong function of student satisfaction related to STEM education processes, support structures, and culture. During situations in which students decide to switch out of STEM due to dissatisfaction with STEM education or culture, it seems likely that these students do not

judge themselves as unsuccessful, but rather as no longer interested in pursuing STEM degrees or careers.

Nontraditional Student Success

Defining nontraditional student success. The literature indicates that nontraditional students often use highly personalized and broad-minded measures to consider and evaluate their own success. It is important to note that many nontraditional students can be characterized as “adult” learners because they are “self-directing” and possess “[self-concepts] of being responsible for [their] own lives” (Knowles et al., 2005, p. 64). Knowles et al. (2005) suggest that most people become adult learners as they leave school or college, seek full-time employment, get married, and start a family (p. 64). Personal definitions of success held by adult students may be incongruent with common ideas of student success in higher education (e.g., grades or degree attainment) that are based on the traditional college student archetype.

For example, Wirth and Padilla (2008) found that community college students took a wider view of success and used goal realization and course completion as indicators of their personal achievement. Johnson and Berge (2012) emphasized that goal realization may include attainment of specific skill sets or knowledge needed to progress at the workplace, regardless of whether the student chooses to complete the specific course or degree. Hagedorn (2005) reported that, while getting a degree was the strongest reason for adult community college students (ages 22 to 45) to enroll, the relative importance of this reason decreased as the age of the student respondents increased. As the age group increased, the importance of other factors in the decision to enroll,

including lack of employment, proximity of college to work, encouragement of an employer, and pursuing a credential needed for work, grew. In fact, for the oldest students (age 46 and above), getting a degree was no longer the primary impetus for enrollment.

Women, as a group, may also hold alternative views of success concerning their experiences in college. Enke and Ropers-Huilman (2010) found that the understandings of success for female students grouped around several themes: success is internal; success is subjectively defined; success involves a balance between work and family; and success involves contributing to a community. As these authors noted, the women in this study did not hinge their views of personal success on measures commonly used in higher education. The authors recommended that factors of balance, relationships, community contribution, and goal orientation should be taken into account when assessing success for female college students.

Barriers to nontraditional student success. In addition to differences in the ways that nontraditional students view success, it is argued that nontraditional students also face distinct, unique barriers to academic success. Spellman (2007) categorized the major obstacles faced by nontraditional students as a) barriers to enrollment and b) barriers to retention. Barriers to enrollment can be *situational*, *institutional*, or *dispositional* (Cross, 1981). As Spellman (2007) described, situational barriers result from a student's "...circumstances in life at a given time..." as "...the life roles of parent, spouse, and employee sometimes clash with college program expectations" (p. 67).

Institutional barriers derive from programmatic policies and practices that impede

students' ability to take part in academic requirements or opportunities. Examples of institutional behaviors include "a lack of evening or weekend courses for working students or a lack of financial assistance" for low incomes students (Spellman, 2007, p. 67). Availability of financial assistance for nontraditional students is becoming a major issue; Bailey (2005) argued that current federal financial aid requirements are out of touch saying,

Overwhelmingly, ... federal student grants and loans are organized to meet the needs of younger, full-time students, and not low-wage-earning adults or even traditional-aged part-time community college students who must work. Improvements might include aid to non-credit programs, more attention given to the support of part-time students who are employed, and new definitions of "progress toward a degree." (p. 18)

Spellman (2007) further pointed out that, especially for financially self-supporting students with families, "making a salary that exceeds the financial aid guidelines does not necessarily translate into being able to afford college tuition" (p. 68). Brock, Matus-Grossman, and Hamilton (2001) reported that low and limited income students, especially those receiving welfare, may be discouraged from enrolling in college due to registration fees and other school-related expenses. Moreover, these students may be unaware of or intimidated by the financial aid process. McKinney, Mukherjee, Wade, Shefman, and Breed (2015) found that community college students tended to borrow to pay for immediate financial needs (e.g., housing, food, transportation) without adequate information concerning the long-term implications of their loans.

Dispositional barriers relate to the limits that nontraditional students place on themselves based upon their own "...self-perceptions and attitudes about their ability to succeed" (Spellman, 2007, p. 67). Other barriers to enrollment experienced by

nontraditional students include being academically un- or under- prepared, cultural barriers (e.g., cultural stereotypes, immigration issues, language limitations), and personal barriers (e.g., health issues, issues substance abuse, relationship difficulties, and issues related to criminal records) (Spellman, 2007, pp. 68-69).

Spellman (2007) noted that the barriers to enrollment faced by nontraditional students are often the same obstacles that impede their attempts to complete the educational programs in which they have enrolled. Coley (2000) suggested seven factors that place students (in general) at risk for not attaining a degree or completing a program once enrolled. These factors (in order of descending risk) include delayed entry, part time enrollment, full-time employment, being financially self-supporting (i.e., “financially independent” for the determination of financial aide), having dependents, being a single parent, and not earning a high school diploma (p. 15). As Spellman (2007) discussed, these factors closely reflect the characteristics of nontraditional students proposed by Horn (1996), suggesting that the degree to which a student is considered nontraditional (i.e., minimally, moderately, or highly) itself presents a graduated risk factor for degree or program completion.

Spellman (2007, p. 69) suggested additional barriers to nontraditional student retention including academic failure, social isolation, family responsibilities, and time. Academic failure is considered a risk for older students who may be academically unprepared for college as the result of a break in education; these students commonly need remedial work when entering college. Although Richardson (1995) found that adult learners take a more comprehension-based or deep approach to learning than their

traditional counterparts, he suggested that older students may fall behind when studying for rote recall. Nontraditional students, whose time on campus is often limited due to familial and work responsibilities, may take longer than traditional students to develop autonomy and self-efficacy in their studies. Nontraditional students may also suffer from the negative effects of social isolation if consistently separated from classmates and instructors (Macari, Maples, & D'Andrea, 2005-2006).

Work and family responsibilities often mean that nontraditional students cannot attend school full-time. Moreover, managing multiple roles as spouses, childcare givers, employees, and students is a substantial source of stress for nontraditional students, especially women. Women with older, more independent children may persist while those with younger children may delay or end their education altogether due to their family responsibilities (Carney-Crompton & Tan, 2002, pp. 148-149). Yet, as Boswell and Passmore (2013) reported, factors affecting nontraditional student success are “...more complicated than having biological children, being married or cohabitating, early family configuration at age 12, and hours worked” (p. 14).

Summary

The outcomes of this literature review substantially impacted the design of this study. First, the literature review revealed the increasing presence of nontraditional students in higher education and the crosscutting nature of the term ‘nontraditional’. The literature related to nontraditional students in STEM pointed to use of Horn’s (1996) continuum model as a framework for describing and characterizing the nontraditional

students participants in this study. Horn's model, which characterizes nontraditional students based upon socio-economic, educational, and age-related factors, was used in the selection and description of the study participants. Its use was important to this study due to the overall lack of racial, ethnic, and gender diversity within the sample population.

Additionally, the literature review exposed the broad, multi-faceted nature of the construct of student success as it has been previously operationalized within the STEM higher education literature. It has been important for the researcher to consider how a nontraditional student's "failure" to achieve a 4-year baccalaureate degree in engineering may have resulted as much (or more) from a conscious choice by the student to switch out of STEM due to individual dissatisfaction or disinterest, as from the student's inability to perform or achieve. Most importantly, the researcher took note of the highly personalized views of success that are often held by nontraditional students (e.g., singular course completion, attainment of a needed skill, progression towards a degree) and how the measures of success adopted by nontraditional students may contradict or conflict with ideas of success commonly held by traditional students and STEM faculty (e.g., overall academic performance, GPA, baccalaureate degree attainment, and time to degree). Findings discussed in the literature review guided the researcher in designing the research questions and methods for the proposed study so as to enable participants to describe their individual successes—and barriers to success—within the alternative engineering transfer program. In this way, measures by which the nontraditional student participants judged their own participation and progress in the program were uncovered and offered as insight for future design of alternative engineering degree programs.

CHAPTER III

METHODOLOGY

Introduction

The purpose of this qualitative research project was to explore the ways in which nontraditional students defined and experienced educational success while participating in an alternative, distance-delivered, undergraduate engineering transfer program. Qualitative inquiry is a well-established method of research that can be recognized by several defining characteristics including naturalistic research settings; use of multiple types and sources of textual or image-based data; employment of a complex mix of inductive and deductive reasoning; emergent and evolving research designs; and holistic, reflexive accountings of complex, multi-faceted issues or problems (Creswell, 2014, pp. 185-186). Qualitative inquiry has been called “open and supple” based upon its welcoming acceptance of multiple theoretical perspectives, theories, methodologies, and methods (Freeman, deMarrais, Presissle, Roulston, & Elizabeth, 2007, p. 25). As Crotty (1998) discussed, the quality of qualitative research depends on the qualitative researcher’s understanding and open expression of the epistemological and theoretical underpinnings of the study throughout the research process.

Research Questions

In this study the researcher employed qualitative inquiry to describe and understand the experiences of nontraditional students who have participated in an

alternative, distance-delivered engineering transfer program. Two primary research questions guided the study:

1. Within the context of alternative engineering transfer program, how do nontraditional engineering students define success?
2. Within the context of alternative engineering transfer program, how do nontraditional engineering students experience success?
 - a. Sub question: What are the major barriers to success experienced by nontraditional students?
 - b. Sub question: What are the actions and base of knowledge that enable nontraditional students to overcome these barriers?

Prior to beginning the research, the researcher received permission from the university's Institutional Review Board (Appendix A).

Research Methodology

Epistemological and Theoretical Underpinnings

Interpretivist research paradigm. This study focused on understanding the multiple, lived realities of nontraditional students situated within an alternative, distance-delivered undergraduate engineering transfer program. Based on this focus, the researcher adopted an interpretivist approach (Glesne, 2011; Jawitz & Case, 2009; Koro-Ljungberg & Douglas, 2008; Lincoln, Lynham, & Guba, 2011) and openly assumed that the participants "...experience the world around them in different ways" (Jawitz & Case,

2009, p. 152). Within the interpretivist paradigm, “reality is socially constructed” and “variables are complex, interwoven, and difficult to measure” (Glesne, 2011, p. 9).

Constructionism is the epistemology— the “nature of knowledge” or “how we know what we know”—embedded within the interpretivist paradigm (Crotty, 1998, p. 8). In keeping with constructionism, the researcher accepted that “there is no objective truth waiting for us to discover it. Truth or meaning comes into existence in and out of our engagement with the realities of our world” (Crotty, 1998, p. 8). As Glesne (2011) explained, the role of an interpretivist researcher is “...that of accessing others’ interpretations of some social phenomenon and of interpreting, themselves, others actions and intentions” (p. 8). Guided by this perspective, this research was performed in partnership with the participants; the researcher worked closely with the participants to co-create detailed, holistic narratives based upon their reflections upon their lived-experiences within the engineering transfer program. Ultimately, the researcher presented these contextualized, co-created narratives as responses to the research questions.

Narrative inquiry. By articulating the research methodology used in this study, the researcher explicitly connects the constructionist epistemology, interpretive theoretical perspective, and qualitative research methods that were used in this study. This study took the form of a narrative inquiry and the researcher employed a narrative research methodology (Case & Light, 2011, p. 203; Creswell, 2013) to explore the experiences of nontraditional students situated within an alternative engineering transfer program. Polkinghorne (1995) described narrative inquiry as “a subset of qualitative research designs in which stories are used to describe human action” (p. 5). Chase (2011)

explained “narrative inquiry is a particular type—a subtype— of qualitative inquiry... [that] revolves around an interest in life experiences as narrated by those who live them” (p. 421).

Narrative inquiry was appropriate for the purpose of exploring situated student experience because “...narrative is the linguistic form uniquely suited for displaying human existence as situated action” (Polkinghorne, 1995, p. 5). Moreover, narrative inquiry is expressly fitting for research related to nontraditional student experience in engineering education because, as Foor et al. (2007) described, “narrative is a means through which those who have been historically marginalized can be heard” (p. 104). Chase (2011) emphasized the “sense of urgency, of the need for personal and social change” that is a hallmark of narrative inquiry (p. 427). Several of Chase’s (2011) characterizations of narrative urgency, particularly the urgency of speaking, the urgency of being heard, and the urgency of collective stories, ring true for this project (p. 427).

Together, the works of Felder (1989), Foor et al. (2007), and Pawley (2013) established precedent for use of narrative inquiry within engineering education research. Felder (1989) used students narratives to develop fictionalized composites of undergraduate chemical engineering students. Foor et al. (2007) employed a narrative methodology to examine the experiences of a single, female, multi-minority, socio-economically disadvantaged engineering student within an undergraduate engineering program at a large public university. Pawley (2013) presented methodological challenges encountered in analyzing narrative interview data collected from minority engineering students, as well as discussed alternative analytical approaches used to interpret them.

Thus, as these scholars have shown, narrative methodologies may be useful for exploring the varied ways in which students experience engineering education.

Theoretical framework. In considering the “place of theory” within narrative inquiry, Clandinin and Connelly (2000) wrote:

One of the central tensions at the boundary [between thinking narratively and thinking formalistically] is the place of theory in inquiry. Formalists begin inquiry in theory, whereas narrative inquirers tend to begin with experience as expressed in lived and told stories. (p. 40)

Clandinin and Connelly (2000) discussed how this tension “exists not only in the beginnings of inquiry but throughout” the research process (p. 41). Interestingly, these authors point out that narrative inquiries are often, in the end, “judged to be important when they become literary texts to be read by others not so much for the knowledge they contain but for the vicarious testing of life’s possibilities...that they permit” (Clandinin & Connelly, 2000, p. 42). While adding to the tensions that exist between narrative and more formalistic inquiry approaches, these “literary uses of narrative” can be seen as the “narrative inquirer’s counterpart to generalization” (Clandinin & Connelly, 2000, p. 42).

Despite these tensions between narrative and formalistic, theoretical thinking, the researcher cannot overlook how theory took a place within the proposed narrative study; theory set in as the researcher considered applicability of several theories in the midst of crafting the research study. Two theories in particular, adult learning theory and the theory of place, appeared as having strong potential for making the experiences and actions of the nontraditional students participating in this study more “understandable or researchable or interpretable...” (Clandinin & Connelly, 2000, p. 145) based on the researcher’s experiences instructing and mentoring students in the program. These

theories, undoubtedly, left their marks on the researcher and are acknowledged not only for the role they have played in the design of this study, but also for the role they play in the interpretation of the narrative data.

Adult learning theory. Adult learning theory (Knowles et al., 2005), as pioneered by Malcolm Knowles, proposes that there are fundamental differences between the ways that adults approach learning and the ways in which learning experiences are often provided by the pedagogical practices prevalent in higher education. Adult learners are considered to be different from traditional college students because they are “self-directing” and possess “[self-concepts] of being responsible for [their] own lives” (Knowles et al., 2005, p. 64). It is theorized that young people become adult learners upon leaving school or college, seeking full-time employment, getting married, and starting a family (Knowles et al., 2005, p. 64). Thus, nontraditional students are often considered to be adult learners.

In Knowles’ “Andragogical Model” (Knowles et al., 2005, p. 64) of adult learning, life experience and self-concept play important roles in the attitudes, perceptions, and motivations that adults bring to their learning and education. Other key elements of this model include the importance of an adult learners’ “need to know” (Knowles et al., 2005, p. 64) related to the topics and concepts presented, realistic learning experiences that provide for the individual and personal discovery of adult learners, and the level of control that adult learners can exert over their own, individual learning experiences. Adult learning theory, therefore, has relevance for promoting understanding and

interpretation of the experiences of the nontraditional student participants within the alternative engineering program.

Theory of place. The work of Chesbro (2013), which explored how rural agrarian students successfully navigated differences between home and university settings, inspired the researcher to consider how a sense of self, as derived through place, may also influence the actions, experiences, perceived successes of the subset of nontraditional students participating this study. Chesbro (2013) explained that the research literature related to rural and agrarian students “makes clear that place is important,” yet quickly adds, “but what exactly does ‘place’ mean?” (p. 3). Does place necessarily or simply imply physical location?

Chesbro (2013) discussed that the effects of place on students may manifest from physical locations, such geographic regions (e.g., the South) and even architecture (e.g., school buildings), as well as from social relationships that “are not necessarily tied to a specific physical location...[yet] reflect the kind of place participants prefer” (p. 3). Malpas (1999) theorized that physical location can itself have “character and identity” (p. 34). It is interesting to consider that, if geographical identity transfers to the people of a region, how the resulting regionally-defined identity may influence the actions, experiences, and perceptions those who leave the region, or simply mix with others from different regions, to pursue postsecondary education. The conclusions of Chesbro (2013), “...that a student’s very identity may be threatened if they are displaced from the place they associate themselves with” (p. 3) may have strong implications for understanding the experiences of the nontraditional students who participate in this study.

Positionality

Researcher's role in qualitative inquiry. In qualitative research, the researcher is considered as the "...primary instrument for data collection and analysis" and, therefore, it is understood that all qualitative data is "mediated through this human instrument" (Merriam, 1999, p. 7). Thus, it becomes important for qualitative researchers to employ reflexivity in order to consider their positions within the research process and to articulate how these positions may ultimately impact their research participants, data collection, and findings. Hesse-Biber (2014) explains that reflexivity is the process through which a researcher "recognizes, examines, and understands how his or her own social background and assumptions can intervene in the research process" (p. 200). Reflexivity, therefore, is considered as the critical reflection of the researcher on her own "...biases, values, and personal background, such as gender, history, culture, and socioeconomic status..." (Creswell, 2014, p. 247) and how these biases, values and personal backgrounds may alter the interpretations of a study.

Researcher reflexivity. From the start of the associate's in preengineering program in January, 2009 until the its final term in the Spring of 2016, I—the researcher for this study—was an engineering instructor for over six years within the same alternative engineering program that serves as the context for this study. This deep understanding of the program's context, goals, administration, requirements, and synchronous broadcast method of distance-delivered instruction helped me to develop and strengthen my own "ethnographic sensibilities" (Gubrium & Holstein, 2009, p. vii) and provided me with an "ethnographic understanding of local contexts and interactional

circumstances” (Chase, 2011, p. 422) that is, as Gubrium and Holstein (2009) suggested, required for “understanding what gets said” (Chase, 2011, p. 422). I also conducted this study with a certain degree of “insider status” (Hesse-Biber, 2014, p. 210) among the nontraditional students I interviewed. I taught many—but not all—of the participants in at least one engineering course and several of the participants I had in multiple engineering courses. I enjoyed positive rapport with my former students and still keep in contact with several of them through professional social media sites (i.e., LinkedIn) and email. These pre-established relationships helped me to obtain interviews and to more fully “understand the situation of ‘the other’” (Hesse-Biber, 2014, p. 210). Overall, these relationships provided me privileged access to marginalized student experience that otherwise may have remained silenced.

While I undoubtedly benefitted from insider status as a researcher, Hesse-Biber (2014) reminded us that being an insider does not necessarily “guarantee a more valid or reliable interview” (p. 210). Despite my connections to my participants, it was important for me to reflect upon the experiences I shared with my participants as well as the differences between us. While I share common experiences with my nontraditional students based on being (or having been) the “underdog”—or marginalized “other”—within undergraduate engineering education (I graduated over twenty-five years ago from an engineering program whose enrollment was less than 5% women), I am different from my nontraditional former students in several ways. These differences include my position of power having been their instructor, my gender (all but one of my participants was male), my social class, my age and generational bias, and my religion (I am not of the

dominant faith of the area). While I worked to mitigate any potential harm done to the participants by limiting volunteers to those who had reached a substantial level participation in the program (i.e., volunteers were solicited from those who, at a minimum, had completed the Engineering Statics course offered in the second year of preprofessional study), I also recognized and closely monitored my personal biases that came as a result of having instructed many of the participants. Moreover, as Hesse-Biber (2014) explained that it may prove challenging to “[separate my] own cultural expectations from the narratives” told to me by my former students (p. 211); personal reflections on these differences were necessary to making it possible to do so. Through recognizing and fluidly negotiating similarities and differences by “doing reflexivity” within each individual interview, I was able to “gain access and obtain data that would not have been available...otherwise” (Hesse-Biber, 2014, p. 216).

Methods

Consistent with the interpretive perspective (Koro-Ljungberg & Douglas, 2008, pp. 167-168) taken toward this research, qualitative data was gathered for this study using in-depth interviews (Hesse-Biber, 2014, p. 195) of study participants. The data consisted of audio-recorded conversations transcribed into written form; supporting documentation (journey maps, emails, etc.) that students used to help describe their experiences; personal, post-interview memos (see section concerning data collections procedures) prepared by the researcher, and participant feedback on successive narrative drafts. All data was used in a dialogic process that combined data gathering with data analysis and

culminated in the shared (i.e., participant and researcher) development of a life history-style story for each participant.

Because the literature discussed in Chapter II suggested the existence of a highly contextual and tightly weaved interplay between the life circumstances (e.g., educational experiences of parents, socio-economic status, high school engagement and achievement, age, work experience, and family responsibilities) and educational outcomes of nontraditional students, the stories that were developed are lengthy and substantial. The purpose of the stories is to act as comprehensive retellings of experiences that led to, happened during, and resulted from the participants' engagement in the alternative engineering transfer program. The co-developed narratives for the participants are presented in Chapter IV.

Sampling Strategy. For this research, “purposive,” “judgment,” “purposeful,” or “selective” sampling (Creswell, 2014; Glesne, 2011; Patton, 2002) was used to select the individual participants from the population of students who had either graduated from the engineering transfer program or who had, at a minimum, completed the Engineering Statics course within the program since Fall 2009. The Statics course is commonly taken during the first semester of the second year of preprofessional engineering study. Because it is considered the first engineering course that most engineering students take, the course was valuable as a cut off point for selecting participants; minimum completion of the Statics course insured that all volunteers had experienced actual engineering instruction within the preprofessional program. In this manner, I purposefully included a wide range of student experiences from those who demonstrated prerequisite knowledge

and skills to engage in the program. Using this sampling strategy, I hoped to collect a rich and complex view of the varied ways in which nontraditional students measure and overcome barriers to success by way of their participation in the engineering transfer program.

As Patton (2002) described, “the logic and power of purposeful sampling lie in selecting information-rich cases for study in depth” (p. 230). Because the intent of the study was to answer research questions concerning nontraditional student success and to provide transferable insights for future design of alternative engineering pathways for nontraditional students, I used a purposive sampling strategy known as intensity sampling (Patton, 2002). Intensity sampling was used to select “excellent or rich examples of the phenomenon of interest, but not highly unusual cases” that are often found using extreme or deviant case sampling (Patton, 2002, p. 234). With intensity sampling, the researcher purposefully selected participants that “manifest sufficient intensity to illuminate the nature ...” of the phenomenon of being a nontraditional student rather than “extreme or deviant cases [that] may be so unusual as to distort” the experiences that are of interest to the study (Patton, 2002).

Screening Survey. In order to screen volunteers for sufficient but not extreme intensity of nontraditionality, those who volunteered to participate in the study were required to complete an online screening survey (Appendix B). The screening survey asked respondents’ to indicate which of the seven nontraditional student characteristics Horn (1996) they possessed while enrolled or taking classes in the associate’s in preengineering program. The screening survey was administered online using Qualtrics

software. Data from the screening survey was used to calculate the number of nontraditional student characteristics that each volunteer possessed, as well as to characterize each respondent as traditional (0 characteristics), minimally nontraditional (one characteristic), moderately nontraditional (two or three characteristics), or highly nontraditional (four or more characteristics) (Horn, 1996). Volunteers were accepted as participants if they responded as having between three and six characteristics.

Sample Size. Patton (2002) stated, “Qualitative inquiry is rife with ambiguities.... Nowhere is the ambiguity clearer than in the matter of sample size” (p. 242). Creswell (2013) agreed that sample size is an important sampling issue that does not have clear answers for qualitative researchers. To help mitigate this ambiguity, Creswell (2013) provided sample size recommendations based on the type of qualitative research approach. For narrative inquiries, Creswell (2013) cited ample precedent in the literature for “one or two individuals” (p. 157). Glesne (2011) reminds us that “for depth understanding, you repeatedly spend extended periods with fewer respondents and observation sites” (p. 46). Importantly, the work of Foor et al. (2007) serves as the precedent for small sample size (i.e., sample size of one) for narrative inquiries in engineering education.

Patton (2002) firmly stated that “there are no rules for sample size in qualitative inquiry” (p. 244). He explained:

Sample size [in qualitative inquiry] depends upon what you want to know, the purpose of the inquiry, what’s at stake, what will be useful, what will have credibility, and what can be done with available time and resources.... The logic of purposeful sampling is quite different [than the logic of probability sampling]. The problem is, however, that the utility and credibility of small purposeful samples are often judged on the basis of the logic, purpose, and recommended

sample sizes of probability sampling. Instead, purposeful samples should be judged according to the purpose and rationale of the study: does the sampling strategy support the study's purpose? The sample, like all other aspects of qualitative inquiry, must be judged in context—the same principle that undergirds analysis and presentation of qualitative data. Random probability sampling cannot accomplish what in-depth, purposeful samples can accomplish, and vice versa.... The validity, meaningfulness, and insights generated from qualitative inquiry have more to do with information richness of the cases selected and the observational/analytical capabilities of the researcher than with sample size. (pp. 244-245)

Thus, competing requirements for “breadth and depth” (Patton, 2002, p. 244) of data is seen to lie at the heart of the sample size issue within qualitative inquiry. Because the objective of this study is to explore and understand the construct of success as experienced by a subset of nontraditional students in an alternative engineering program, in-depth and finely detailed information related to each participant's lived experience in the program is necessary in order to carry out the proposed narrative methodology (i.e., co-create participant narratives). Therefore, both the objectives and design of the this study call for a small sample of participants who are each able to provide richly detailed accounts of their experiences as a student within the alternative engineering transfer program.

Based upon the insights related to purposeful sampling taken from the literature (Creswell, 2013; Patton, 2002), I set a minimum sample requirement of five study participants for in-depth interviewing prior to carrying out sampling. This “minimum sample” was expected to provide “reasonable coverage” of nontraditional student success as it occurred within the alternative engineering transfer program (Patton, 2002, p. 246) . When using a minimum sampling size criterion, as Patton (2002) described, the researcher understands that the final sample could be larger (but not less than) the

minimum criterion as the number and/or nature of the respondents to the sampling questionnaire and the research processes allowed. I provided a minimum sampling size criterion in order to facilitate review of the research proposal while allowing for the “emergent nature of qualitative inquiry” (Patton, 2002, p. 246).

Participant recruitment. To recruit volunteers for this study, I sent an email invitation (Appendix C) to the 55 students or former students who completed Engineering Statics within the associates in preengineering program in or after Fall 2009. The USU Brigham City engineering advisor provided a list of email addresses for these students; the advisor kept detailed records of all students who were recruited for, currently engaged in, prematurely left, or graduated from the associate’s in preengineering program. The Letter of Information (LOI) from the project’s approved IRB protocol (Appendix D) for the screening survey was attached to the email. The LOI explained how I—the researcher—planned to use an online screening survey to select participants from those who volunteered and how the data gathered with the screening survey would be handled. The LOI also explained that participation in the screening survey was completely voluntary, that the participants could stop participating at any time, and that a coding system would be used to maintain participant confidentiality.

In order to volunteer to participate in the study, students and former students were asked to read the LOI attached to the invitation email and reply to the researcher via email. There were no incentives provided for participants to volunteer or to fill out the screening survey. Of the 55 students who were sent the invitation email, 24 volunteered to take part in the screening survey by responding to the researcher via email. One

student could not be reached by email; I called this student and extended the offer to participate in the study over the phone. This student also volunteered to take the screening survey.

I contacted the 24 students who volunteered to take the online screening survey via an email (Appendix E) containing a unique web link to the screening survey within the Qualtrics Software. By providing each volunteer a unique survey link, I insured that survey responses could be linked to individual respondents within the Qualtrics software. For the student that could not be reached via email, I mailed the screening survey directly to the student, providing a self-addressed, stamped envelope for its return to the researcher. This student completed the survey by hand and mailed the completed questionnaire back to me.

Participant selection. Results of the screening survey are summarized in Table 1. Of the 25 screening survey respondents, five individuals did not meet the screening criteria (i.e., each of the five identified themselves as having less than three nontraditional characteristics while participating in the associate's in preengineering program). Of the 20 respondents who met the screening criteria, six individuals did not respond to or completely follow-through with emails requesting an interview from the researcher. Of a total sample population of 55 students and former students, 14 individuals (25.5%) became study participants. Since this number was above the minimum number of participants (five) set for this study, no further recruitment activities were conducted.

Table 1

Screening Survey Results

Respondent	Response Date	# of Nontraditional Characteristics	Passed Screen?	Scheduled Interview?
1	7-5-2015	6	Y	N
2	7-6-2015	6	Y	N
3	7-6-2015	4	Y	Y
4	7-7-2015	3	Y	Y
5	7-7-2015	1	N	N/A
6	7-7-2015	3	Y	N
7	7-7-2015	3	Y	Y
8	7-8-2015	5	Y	Y
9	7-8-2015	6	Y	Y
10	7-9-2015	5	Y	Y
11	7-16-2015	5	Y	N
12	7-27-2015	2	N	N/A
13	7-27-2015	3	Y	Y
14	7-30-2015	5	Y	Y
15	7-31-2015	2	N	N/A
16	7-31-2015	3	Y	Y
17	8-2-2015	1	N	N/A
18	8-3-2015	4	Y	Y
19	8-5-2015	5	Y	N
20	8-12-2015	5	Y	Y
21	8-13-2015	3	Y	Y
22	8-13-2015	3	Y	Y
23	8-14-2015	1	N	N/A
24	8-23-2015	5	Y	N
25	9-1-2015	5	Y	Y

Note. The response date for the 25th respondent is approximate.

Grey shading indicates those respondents who did not pass the survey screen or did not agree to schedule interviews.

At the beginning of the initial interview with each participant, I handed out a copy of the second LOI from the project's approved IRB protocol (Appendix F) that specifically addressed the research protocol for the interview phase to each participant. Using the LOI, I explained (a) the interview process, (b) that the goal of the interview process was for the researcher and participant to co-create a narrative story reflecting the

participant's experiences as a nontraditional engineering undergraduate, (c) that participation in the interview process was completely voluntary, (d) that participants could stop participating at any time or at any point in the interview process, and (e) that participants would be given a choice to select either a pseudonym to protect their identity or to use their real name in their story. Before participation in the interview process began, I required each participant to sign the Statement of Consent (Appendix F) that accompanied the LOI for the interview phase. I provided a \$30 gift card¹ to each participant upon completion of the second interview as incentive.

Data collection procedures. Qualitative data were collected individually with each participant during the interview phase of the research using the dialogic process shown in Figure 1. The process required participants and the researcher to complete specific activities prior to each meeting. Participant activities included completing the screening survey, preparing a journey map, reviewing and providing comments on the initial narrative draft, and reviewing and providing comments on revised drafts until the narrative was considered complete. Researcher activities included developing the protocol for the initial interview, completing a reflective memo after each meeting with each participant, preparing a path analysis map for each participant based on the interview one data, developing an initial draft of the storied narrative for each participant based on interview two data and the path analysis map, and refining the draft with the

¹ Participants who were USU students were given a gift card to the USU bookstore. Participants who were no longer USU students were given gift cards redeemable on Amazon.com. On request, one participant was given a Wal-Mart gift card.

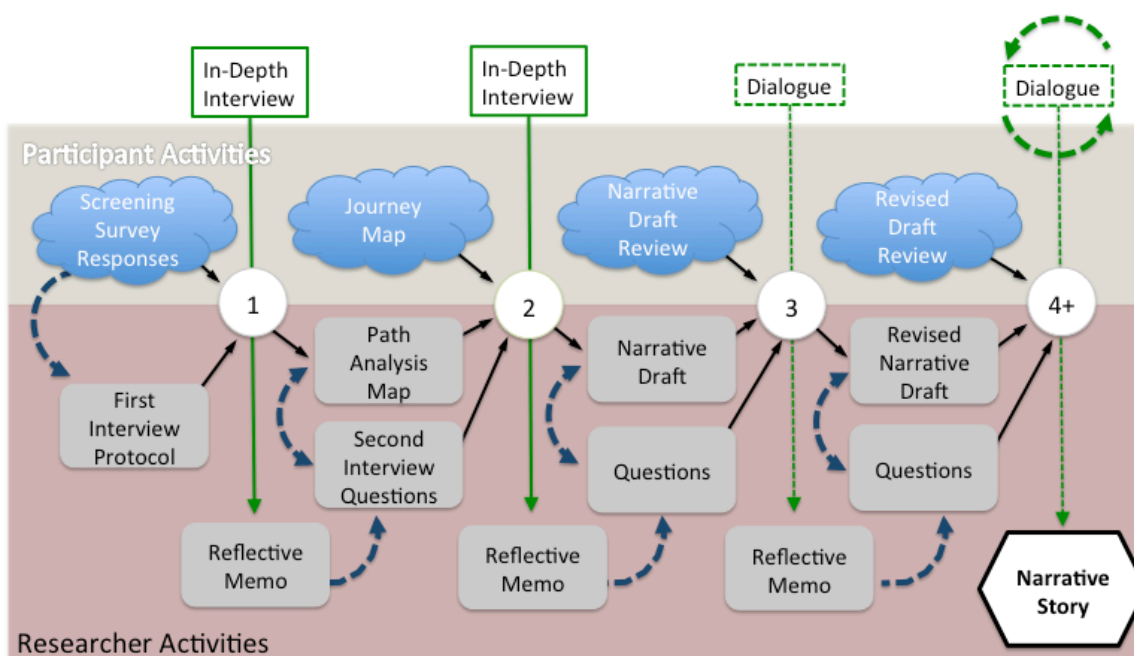


Figure 1. Dialogic qualitative data collection process used to co-create participant narratives.

participant. Data collection procedures are individually described in the following sections.

In-depth interviews. Two in-depth interviews were conducted with each participant approximately one month apart. The participants and the researcher mutually agreed upon interviews times and dates. Twelve participants, who resided within commuting distance of Logan, Utah (where the researcher lived), completed in-person interviews. The participants selected where they preferred to meet for the interview (either the USU Logan or the USU Brigham City campus). These in-person interviews were audio-recorded using Garage Band software on an Apple Macbook Air portable computer. The remaining two participants were interviewed via videoconferencing software (Skype) due to a) one participant's preference and b) one participant's location

out of state. The video-conferenced interviews were audio-recorded using Ecamm Call Recorder software for Skype on an Apple iMac computer. After each interview was completed, the audio recording was transcribed by a professional. The researcher verified the transcribed interview data by checking them against the interview recordings prior to using in analysis.

Because the study required finely descriptive and richly detailed accounts of the experiences of participants, I provided participants substantial freedom in our discussions to reflect and share not only the details of their experiences but also the associations that existed between the experiences they shared. As Polkinghorne (1995) described, storied experiences occur naturally from personal interviews as long as interviewers do not suppress participant responses using narrowly specified lines of questioning. Thus, in order to exert “some control”—yet only the amount needed to access the participants’ authentic experiences and address the research questions—I used a “semistructured interview” approach (Hesse-Biber, 2014, p. 186). Researchers conduct semi-structured interviews using interview guides or protocols that list important questions to ask (Hesse-Biber, 2014). The order of the questions is not too important as long as all of the questions or topics are covered. Hesse-Biber (2014) explained that, when using a semistructured interview approach, the researcher has “an agenda:” However, the agenda is not “tightly determined” and there is “room left for spontaneity on the part of the researcher and interviewee” (p. 187). Researchers who conduct semistructured interviews attempt to maintain the “flow of the interview” and ask questions (i.e., agenda questions) when there is “new space” in the “conversation” (Hesse-Biber, 2014, p. 187).

First interview. During the first interview with each participant, I used the protocol provided in Appendix G as a guide for conducting the interview. This protocol is a revised form of the protocol used by Pawley (2013) for narrative research related to the experiences of underrepresented minorities in engineering education. I revised the original protocol to include a) a review of the screening survey results with each participant at the beginning of the interview and b) questions that specifically address the research questions concerning success and barriers to success. The average duration of the first interview was 1:29 (hours : min). Metadata from the first interview are provided in Table 2.

Table 2

First Interview Metadata

Participant	Date	Duration (hour:min)	Location
Mike	8-11-2015	1:45	USU BC Faculty Conference Room
Cade	8-12-2015	1:20	USU BC Faculty Conference Room
Skyler	8-12-2015	1:25	USU BC Faculty Conference Room
Daniel	8-13-2015	1:25	USU Logan, ENGR Room 401
Tom D.	8-14-2015	1:10	USU Logan, ENGR Room 401
Clair	8-14-2015	1:50	Skype
Connor	8-17-2015	1:50	USU BC Faculty Conference Room
Jaxon	8-18-2015	1:10	USU Logan, ENGR Room 401
Tom W.	8-20-2015	2:00	USU BC Miller Building Room 162
Brad	8-21-2015	1:15	USU Logan, ENGR Room 401
Tom A.	8-24-2015	1:10	USU BC Faculty Conference Room
Cooper	8-24-2015	1:36	USU BC Miller Building Lobby
Joe	8-28-2015	1:14	Skype
Kay	9-17-2015	1:32	USU BC Faculty Conference Room/ Faculty Center Room 106
Average duration		1:29	

Second interview. I developed the questions that I posed to each participant in interview two individually while reviewing the data from interview one (listening to the audio recorded interviews and reading the transcripts) and constructing a path analysis map for each participant. During the second in-depth interview, I asked each participant to share the journey map they had been asked to prepare. Following the discussion of the journey map, I shared the path analysis map with the participant and asked the questions that had emerged while preparing it. The average duration of the first interview was 1:08 (hours : min) Metadata related to the second interview are provided in Table 3.

Table 3

Second Interview Metadata

Participant	Date	Duration (hour:min)	Location
Cooper	9-22-2015	1:50	USU BC Faculty Center Room 106
Tom D.	9-23-2015	1:00	USU Logan, Sant Room 105
Skyler	9-23-2015	1:07	USU Logan, Sant Room 105
Cade	9-24-2015	0:51	USU Logan, Sant Room 105
Brad	9-25-2015	0:56	USU Logan, Sant Room 205
Kay	9-28-2015	1:20	USU BC Faculty Conference Room
Joe	9-29-2015	0:53	Skype
Daniel	9-29-2015	1:05	USU Logan, Sant Room 205
Connor	9-29-2015	1:50	USU BC Faculty Center Room 106
Jaxon	9-30-2015	0:32	USU Logan, Sant Room 105
Clair	10-02-2015	0:58	Skype
Tom A.	10-05-2015	1:02	USU BC Faculty Center Room 106
Mike	10-06-2015	1:03	USU BC Faculty Center Room 106
Tom W.	10-06-2015	1:19	USU BC Faculty Center Room 106
Average duration		1:08	

Reflective memoing. Shortly after each interview session (within the next day), I completed a post-interview reflective memo, based on Miles and Huberman's (1994, p.

53) contact summary form, as proposed by Pawley (2013). The reflective memo format is provided in Appendix H. I used this reflective memoing procedure to capture immediate details concerning the interview as well as to create a plan for follow-on interviews. Memos were also used as sources of qualitative, textual data during the construction of the narrative draft.

Path Analysis Map. After the first interview and in preparation for the second, I prepared a path analysis map for each participant (Figure 2). I developed the technique of preparing a path analysis map as a way to piece together each participant's chronological journey to, through, and sometimes out of engineering education from the richly detailed interconnected yet individual stories that the participants shared during their first interview. In keeping with Polkinghorne's (1995) description of narrative construction, the path analysis maps became the researcher's method for synthesizing the complex, myriad data into a "coherent, developmental account" of each participant's experiences (p. 15).

To prepare a path analysis map, I began by listening to the audio-recorded first interview. As I listened intently, often going back in the recording to catch details and embedded nuances, the researcher identified major events, pivotal moments, goals, successes, barriers, and setbacks within the stories each participant told. As I identified each important piece of the participant's narrative, I wrote it on a color coded, self-adhesive Post-it note and attached it to a poster board. I often rearranged the notes on the poster board as I began to understand each participant's experience more deeply. When the path analysis map was complete, quite often I had identified holes in the narrative or



Figure 2. Path analysis map used to synthesize stories from the first interview into a chronological narrative.

areas that needed further clarification or detail. These areas became questions for the second interview and the path analysis map served as the basis for the narrative draft.

Journey Map. According to Nyquist et al. (1999), a journey map is a pictorial and/or text-based representation of a personally experienced process or journey. Journey mapping was used by Nyquist et al. (1999) to study the current and on-going experiences of students midway through their graduate school program and by Meyer and Marx (2014) to retrospectively examine the experiences of engineering undergraduates who left the engineering field. Nyquist et al. (1999) noted that simply leaving "...participants

alone in a room for 10 minutes with a sheet of paper and a pencil ...provided powerful glimpses into the realities of graduate student lives today” (p. 18).

At the conclusion of the first interview, I asked each participant to prepare a journey map about their experiences in the associate’s in preengineering program and to bring it to the next interview. Although the final participant narratives extended beyond (before and after) the timeline of the preengineering program, I focused the scope of the journey mapping exercise to the preengineering program so as to draw out details, goals, successes, and barriers (i.e., topics related to the research questions) experienced during this time. So as not to limit participant responses or overly prescribe to participants how to represent their journey, I provided open and flexible guidance to the participants (Appendix I). This approach was modeled after that of Nyquist et al. (1999):

Take a few minutes to think about your personal journey as a graduate student, on your way toward your professional goals as a teaching scholar. How would you describe the process you've been going through? You may want to capture this visually or with words—whichever is helpful for you. (p. 18)

An example of journey map prepared by one of the participants is provided in Figure 3. I used participant journey maps as sources of qualitative data during the construction of the narrative draft.

Narrative Draft. After the second interview with each participant, I prepared a draft of the narrative story for each participant. I used the path analysis map, the audio recordings and transcripts from the second interview, and the participant journey maps to write the participant’s story with the goal of capturing an authentically emic perspective.

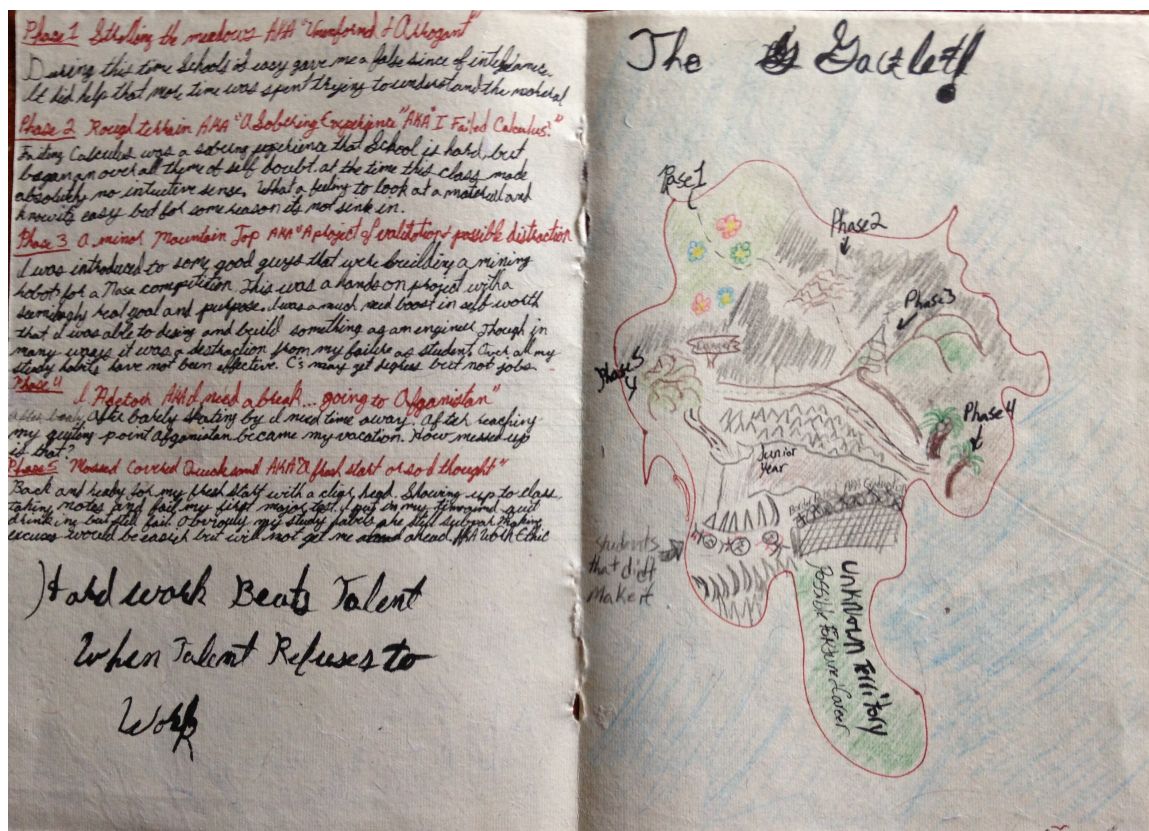


Figure 3. A journey map prepared by a participant.

Once written, each narrative draft was emailed² to its participant as a Microsoft Word file for review and feedback.

I emphasized to each participant that the story should be an accurate reflection of each participant's experience and strongly encouraged feedback on narrative details, sequence, and tone of the story. I suggested several ways in which participants could provide their feedback: using track changes in the draft file, creating a separate list of changes in another document, or handwriting comments directly on a printed copy of the draft and emailing a scanned image of the markup copy. Each participant responded with

² One participant could not be reached via email. A hard copy narrative draft was mailed to this participant along with a self-addressed stamped envelope for return of handwritten feedback.

comments and suggestions for clarifying and changing the draft as shown in Table 4.

While the form of this feedback varied by participant, each used one of the feedback mechanisms that I had suggested.

Table 4

Narrative Draft Feedback Metadata

Participant	Date Draft Sent	Draft file	Date feedback received
Cooper	10-31-2015	Draft 1.doc	10-31-2015
	11-05-2015	Draft 2.doc	11-16-2015
	12-11-2015	Draft 4.doc	12-19-2015 (✓)
Tom D.	11-09-2015	Draft 1.doc	11-16-2015 (✓)
Skyler	11-20-2015	Draft 1.docx	12-07-2015 (✓)
Cade	11-22-2015	Draft 1.docx	1-28-2105 (✓)
Brad	12-02-2015	Draft 1.docx	12-20-2015 (✓)
Kay	12-06-2015	Draft 1.docx	1-07-2015 (✓)
Joe	12-13-2015	Draft 1.docx	12-28-2015
	1-03-2015	Draft 2.docx	1-04-2016 (✓)
Daniel	12-18-2015	Draft 1.docx	1-04-2016 (✓)
Connor	12-27-2015	Draft 1.docx	12-30-2015
	1-03-2016	Draft 2.docx	1-19-2016 (✓)
Jaxon	1-03-2016	Draft1.docx	1-08-2016 (✓)
Clair	1-15-2016	Draft1.docx	1-20-2016 (✓)
Tom A.	1-17-2016	Draft 1.docx	1-22-2016 (✓)
Mike	1-18-2016	Draft 1.docx	1-19-2016 (✓)
Tom W.	1-24-2016	Draft 1.docx	1-24-2016 (✓)

Note. Check mark (✓) indicates draft approved by participant in date indicated.

Narrative Story. After receiving the participant feedback on each draft narrative, I worked to incorporate the feedback into draft narrative. The number of feedback loops that a draft narratives went through was left up to the participant; the stories weren't considered complete until the participants were satisfied that the stories represented their

experiences from their perspectives. I sent the final version of the narrative story to each participant once it was considered to be complete.

Data Analysis

Seidman (1991, p. 116) suggested “it is difficult to separate the processes of gathering and analyzing [qualitative] data” and pointed to several authors (Lincoln & Guba, 1985; Maxwell, 1996; Miles & Huberman, 1994) who “urge that the two stages be integrated so that each informs the other.” The analysis of the data gathered in this study was carried out in three phases and a substantial proportion of the analysis work was directly integrated with the data collection. As the researcher, I conducted narrative analysis by synthesizing the richly detailed and complex qualitative data for each participant to co-produce a narrative story from an emic perspective for each participant. During this phase of the research, the narrative analysis of the data was deeply embedded within the data collection process (see Methods section and Figure 1). Next, I documented and analyzed the evolution of my own perspective of nontraditional student experience and success as I engaged with my participants, collected data, and co-developed the narrative stories. Finally, I analyzed the completed stories for general narrative outcomes that held for most or all of the stories in light of educational theory and the literature in order to provide transferable conclusions and recommendations for future nontraditional student programs.

Narrative analysis. I conducted a “narrative analysis” (Polkinghorne, 1995) to analyze the complex and richly detailed data gathered in this study. In narrative analysis, the researcher “gathers events and happenings as its data and uses narrative analytic

procedures to produce explanatory stories” (Polkinghorne, 1995, p. 5). As Polkinghorne (1995) described,

Narrative analysis is the procedure through which the researcher organizes the data elements into a coherent developmental account. The process of narrative analysis is actually a synthesizing of the data rather than a separation of it into its constituent parts. (p. 15)

Narrative analysis stands in contrast to an “analysis of narratives” (Polkinghorne, 1995, pp. 5-6) in which the researcher—instead of synthesizing data into explanatory stories—attempts to break down storied data into chunks that can be used for building categories and later generalized themes that hold across the data. Unlike narrative analysis, an analysis of narratives “uses only pieces of [participants’] stories intermingled with researcher words and analysis” (Chesbro, 2013, p. 4).

Rather than breaking down or chunking the participants’ descriptions of their experiences (i.e., analysis of narratives), I chose to use narrative analysis to create representative, experiential narratives of—and in collaboration with—each participant. As Polkinghorne (1995) explained,

In research that employs narrative analysis as distinguished from analysis of narratives, the result is emplotted narrative. The outcome of a narrative analysis is a story—for example, a historical account, a case study, a life story, or a storied episode of a person’s life. In this type of analysis, the researcher’s task is to configure the data elements into a story that unites and gives meaning to the data as contributors to a goal or purpose. The analytics task requires the researcher to develop or discover a plot that displays the linkage among the data elements as parts of an unfolding temporal development culminating in the denouement. (p. 15)

As developed, each narrative stands on its own as a research finding by “answer[ing] how and why...[each] outcome came about” (Polkinghorne, 1995, p. 19) from an emic perspective. In this manner, the narrative outcome is “...a means of making sense and

showing the significance...” of the “...thoughts and actions of the protagonist”

(Polkinghorne, 1995, p. 19).

Clandinin and Connelly (2000) described the work of doing narrative analysis as a “...back and forth of writing research texts...” (p. 138). These authors describe how the narrative inquirer’s task is to take the field data and “...compose a text [narrative] that at once looks backward and forward [in time], looks inward and outward [within and from researcher and participant], and situates the experience in place” (Clandinin & Connelly, 2000, p. 140). The development of analytic narratives in cooperation with study participants necessitated a robust and detailed dialogic process (see Methods section and Figure 3-2). Clandinin and Connelly (2000) described how the writing of such narratives is “...made more complex as they [narrative inquirers] search for ways to convey the stories, lived and told, with participants. Matters such as voice, signature, narrative form, and especially audience must be attended to” (p. 146).

Narrative researchers are required not only to authentically represent their participants’ voices and “speak to” an audience, but also to clearly express their own voice “in the midst” of the telling the participants’ stories (Clandinin & Connelly, 2000, p. 147). The issue of signature often refers to how a writer positions herself within the text (Geertz, 1988), yet also holds implications for how the participants are positioned within the narratives and how participant identities are portrayed by the researcher (Clandinin & Connelly, 2000, p. 148). The signature of the participants was closely communicated and agreed upon; as Clandinin and Connelly (2000) suggested I asked the participants questions such as “Is this you?”, “Do you see yourself here?”, and “Is this the character

you want to be when read by others?” as they reviewed the successive narrative drafts of the storied narratives (p. 148). In keeping with a constructionist epistemology, I asked each participant to choose between using their own identities within the narrative and providing a pseudonym for use during the reporting of the results. Thirteen of the 14 participants chose to use their real name. I asked one of these 13 participants to use a pseudonym instead based on the nature of the information presented in the narrative.

Recognizing that “reaching for form is part of what narrative inquirers do,” I organized the final participant narratives within a single chapter this final research dissertation (Clandinin & Connelly, 2000, p. 153). Taken together, the side-by-side narrative outcomes provide a more in-depth understanding of nontraditional student experience and success in the alternative engineering transfer program than any single narrative can when taken on its own (Seidman, 1991).

Emic essay. Ever since Pike (1954) first coined the terms, “emic” and “etic” have been used in the fields of cultural anthropology (Harris, 1976), folklore (Dundes, 1962), and the social and behavioral sciences (Jardine, 2004) to describe two opposing yet often complementary viewpoints (Jingfeng, 2011) that can result from research with human participants. Jardine (2004) succinctly described the individual characteristics of and competitive relationship between emics and etics stating:

In 1954 Kenneth Pike distinguished etics, the application of our theories in analyzing others’ behaviour and institutions, from emics, the interpretation of others’ worlds as they appear to them.¹ Pike’s distinction ... has occasioned prolonged and heated debate among anthropologists.² What are the limits of emic interpretation and etic analysis? Should etics or emics have priority? Can emics dispense with etics? How far need etic analysis of a culture respect its emics? (p. 261)

Jardine (2004) views the “emic/etic debates” as “central issues” based on their importance to “interpretation and analysis of others’ perceptions, skills and institutions” (p. 261).

While it is widely accepted within the field of qualitative research that the researcher is the “...primary instrument for data collection and analysis” and that qualitative data is “mediated through this human instrument”(Merriam, 1999, p. 7), it has been noted that:

That approach is limited because it fixes the worldview of the researcher at a given point in time. As a human being and as someone trying to deeply understand the phenomenological perspectives of others over time, [the researcher’s] perspective changes as a function of engaging with data collection and analysis. (Feldon, January 21, 2016)

The purpose of the emic essay, therefore, is to document the changes in my perspective as a researcher over the course of my interactions with the participants in order to provide “context for [my] thinking” (Feldon, January 21, 2016). In this way the emic essay serves as an analytical bridge between the emic perspective presented in the storied narratives and the etic perspective likely to be held by the readers of this work.

Comparative analysis of narrative outcomes. As is common among narrative analyses (Polkinghorne, 1995, p. 21), I have provided a commentary chapter in this final dissertation text to highlight similarities and differences between the individual narrative outcomes as well as between the narrative outcomes and theory/literature. The analysis of crosscutting narrative outcomes follows after the introduction of the participants’ stories. The aim of this chapter is to develop transferable insights for the broader engineering education community.

Qualitative Research Validity

Lincoln et al. (2011) discussed the “extended controversy” related to qualitative research validity, naming it an “irritating construct” that is “neither easily dismissed nor readily configured” within non-positivistic inquiry (p. 205). In considering this almost unwieldy, ongoing debate concerning the ways in which a term (i.e., “validity”) that has been constructed for quantitative research can be applied to qualitative research they stated, “At issue here is not whether we shall have criteria [of validity in qualitative inquiry], or whose criteria we as a scientific community might adopt, but rather what the nature of social inquiry ought to be...” (Lincoln et al., 2011, p. 205). While an important part of this debate is whether qualitative validity comes as a result of judiciously applied research methods or from analytical interpretation, the researchers noted that no consensus has been reached although interpretive rigor “...has received the most attention in recent writings...” (Lincoln et al., 2011, p. 205)

Qualitative methods-based validity. Acknowledging this debate, Creswell (2014) proposed a methods-based definition of qualitative validity. He stated that qualitative research gains validity as the researcher insures “accuracy of the findings by employing certain procedures” (p. 201). Using this methods-based definition of qualitative validity, I employed several qualitative research “validity strategies” (Creswell, 2014, pp. 201-202) to insure accuracy of the research findings. These strategies included data triangulation (i.e., using more than a single data source—including data from in-depth interviews, participant journey maps, reflective memos, and participant narrative feedback), member checking and co-development of narratives outcomes, and prolonged field time (the

researcher taught teaching in the program for over six years) to improve the accuracy and resonance of the narratives and findings. These methods-based strategies added to the qualitative validity of this research.

Interpretive procedural validity. Borrego (2007) concluded that "...the field of engineering education has not yet developed its first paradigm," that is, its first "...consensus with regards to standards of rigor..." (p. 627). Moreover, Walther, Sochacka, and Kellam (2013) argue that questions of research quality related to *interpretive research* in the field of engineering education are "particularly contentious" due to the a) relative unfamiliarity of engineering researchers to the epistemological and paradigmatic underpinnings of interpretive research and b) lack of consensus concerning interpretative research quality in other fields that more broadly accept interpretive approaches to research (p. 627). To this end, Walther et al. (2013) proposed a quality framework for interpretive engineering education research, based on the metaphor of quality management and the concept of process reliability, that "...[shifts] attention away from assessing research quality of the final product...[and] provides guidance to systematically document and explicitly demonstrate quality considerations throughout the entire research process" (p. 626). Moreover, their use of the term "validation" to replace "validity" brings focus to the process-oriented aspects of research quality; research validation is viewed on a continuum rather than a state of being (or of not being).

Within this quality framework for interpretive research, validation is improved through procedural assurance that the research findings adequately represent the important aspects of the social reality being observed (Walther et al., 2013). Walther et al.

(2013) described several key aspects of validation (i.e., theoretical, procedural, communicative, pragmatic) and process reliability in order to define specific procedural strategies for improving interpretive research quality with respect to each aspect of validation. In keeping with this framework, I incorporated several of these quality strategies in this research including purposive sampling (theoretical validation), data triangulation (procedural validation), development of shared narratives, member checks, and ongoing engagement with the data (communicative validation), prolonged exposure to practice (pragmatic validity), and transcript checking and standardized memos (process reliability). (Walther et al., 2013, p. 640)

Narrative Validity. Chase (2011) suggested that there are a certain set of methodological issues, including research relationships, ethics, interpretation, and validity (p. 423), that are of particular importance within narrative inquiry. These issues derive from the requirement for narrative researchers to work closely with their participants and their participant's stories. (Chase, 2011) explained:

When narrative researchers gather data through in-depth interviews, they work at transforming the interviewee-interviewer relationship into one of narrator and listener. This requires a shift from the conventional practice of asking research participants to generalize about their experiences (as qualitative researchers often do) to inviting narrator's specific stories (Chase 2005). It also requires a shift from the conventional practice of treating the interview schedule as structuring or even semi-structuring the interview to treating it as a guide that may or may not be useful when one follows the narrator's story. Amia Leiblich (in Clandinin & Murphy, 2007) suggests that narrative interviewing requires emotional maturity, sensitivity, and life experience, all of which may take years to develop. (p. 423)

In addition, narrative researchers face distinct ethical issues because their work is concerned with presenting detailed, individual, and personal stories about their participants. These long, singularly focused works may cause narrative research

participants to feel “vulnerable” or “exposed” (Chase, 2011, p. 424). Lieblich (Clandinin & Murphy, 2007) argued that narrative researchers should insure that their participants understand precisely how and with whom their stories will be shared. This may require narrative researchers to go back to their participants, after the research is complete, to ask again for permission to present participant stories if details about publication or performance change or come to light (Chase, 2011, p. 424). Narrative interpretation requires researchers to “move away from a traditional theme-oriented method of analyzing qualitative material” and “listen first to the voices within each narrative” (Chase, 2011, p. 424; Riessman, 2008, p. 12) . This is the same distinction that Polkinghorne (1995) made between the act of conducting a “narrative analysis” and an “analysis of narratives” (pp. 5-6) and, as Chase (2011) noted ,“ for Polkinghorne, this is what distinguishes narrative inquiry from qualitative inquiry generally (in Clandinin & Murphy, 2007, pp.633-634)” (p. 424).

Narrative validity, as with research validity in general, is concerned with whether the narrative interpretations that are presented in the research text are sufficiently supported by evidence (Polkinghorne, 2007, p. 474). Polkinghorne (2007) likened the process of narrative validation to “an argumentative practice” that can “convince readers of the likelihood that the support for a claim is strong enough that the claim can serve as a basis for understanding of and action in the human realm” (p. 476). Polkinghorne (2007) emphasized that ““the truths sought by narrative researchers are ‘narrative truths,’ not ‘historical truths’ (Spencer, 1982)” and that “storied texts serve as evidence for personal meaning, not for the factual occurrence of the events reported in the stories” (p.

479). Polkinghorne (2007) outlined four threats to narrative research validity that derive from the insufficiencies of language to provide a “mirrored reflection” of meaning: a) the limits of language to convey complex, deep meaning, b) the limits of reflection to access “layers of meaning” existing “outside of awareness,” c) participants’ resistance to fully communicate felt meaning (i.e., social desirability), and d) the complexities of language and meaning induced by the co-creation of narratives (p. 480). Polkinghorne (2007) argued that, “because stories are simulations of participants’ meaning and not the meaning itself,” the four threats to narrative validity “cannot be eliminated” (p. 482). In order to lessen the effects of these narrative validity threats, Polkinghorne (2007) provided the following guidance for narrative researchers: a) maintain an “open listening stance,” being mindful of “unexpected and unusual participant responses” that can help to insure that the final text honors the participant’s voice, b) present arguments to show that the stories, while partial representations of meaning, do “not overly distort participants’ meaning” b) describe actions taken to lessen the four narrative validity threats in order to instill confidence to the readers, c) use an iterative process of returning to the participants for clarification during the narrative interpretive process, and d) allow participants to provide feedback on preliminary versions of generated stories in order to “more closely display their meaning” (p. 482).

In this study I—the researcher— took several actions to reduce the threats to narrative validity. I met with the participants in person or a face-to-face video environment in order to improve the sense of connection and interaction we shared and to allow me to access visual cues to how the stories were being told and when the

participants may have been holding back or unclear in their expression of meaning. I met with the participants, most of whom I already knew, more than once to listen to their story³. I allowed the participants to set the pace and length of the interview, using my initial protocol and later questions loosely as a guide that were easily diverted from and returned to as the conversation allowed. I allowed sufficient time in between interviews to enable participants to more deeply reflect on the stories they shared in the first interview. I actively encouraged this reflection by asking participants to complete a journey map in between the first and second interviews and then to share it with me in the second interview. At every stage of the research process (i.e., path analysis maps, narrative draft, and revised narrative drafts), I presented my current narrative interpretations with my participants and sought their feedback in order to more closely represent the meaning they held for the participants.

³ While Seidman (1991) recommends interviewing participants at least three times to gain trust and confidence in the interviewer and gain access more open and free responses, I felt as if the prior relationships I shared with most (12 of 14) of my participants, my substantial reputation as a caring and concerned instructor, and my own ethnographic understanding of the research context enabled this to happen in only two interviews.

CHAPTER IV

NARRATIVE OUTCOMES

Background to the Alternative Engineering Transfer Program

Utah State University (USU) was founded in 1888 as the land grant institution⁴ for the State of Utah. In January 2009, USU began a major effort to improve statewide access to undergraduate engineering education by implementing its Associates in Preengineering program. This alternative, distance-delivered engineering transfer program targets the Utah residents consistently underrepresented in USU's undergraduate engineering programs: geographically-dispersed rural residents, employed skilled professionals working within the science, technology, engineering, and mathematics (STEM) sectors, and women reentering the workforce. Graduates of the program earn an associate's degree in preengineering while fulfilling all requirements of the university's preprofessional engineering curriculum⁵. Graduates are eligible to transfer to the Logan university campus to complete their studies for an engineering bachelor's degree. The success of the Associates in Preengineering program depends on its ability to reduce obstacles to accessing

⁴A land grant university is a U.S. institution of higher education designated by a state to receive the benefits of the Morrill Acts of 1862 and 1890. The original mission of land grant institutions was to teach agriculture, military tactics, mechanical arts, and classical studies so that members of the working classes could obtain a practical education.

⁵Engineering bachelor's degrees at USU are administered in two parts: the preprofessional program administers the first two years of curriculum, and the professional program administers the final two years. Students who complete the preprofessional program must apply and be accepted into the professional program for their intended disciplinary engineering major. Individual professional programs may require minimum grade-point averages or other departmental specific requirements for admission to the professional program.

engineering education experienced by the aforementioned underrepresented students groups.

The Associates of preengineering program was funded through the Utah State Legislature by a House of Representatives bill. The program was jointly administered by the College of Engineering Associate Dean for Undergraduate Affairs, the Department Head of the Engineering Education Department, and the Deans of each regional campus. The Associate Dean for Undergraduate Affairs and the Department Head of the Engineering Education Department were located on the main university campus. The Associate Dean for Undergraduate Affairs was responsible for the preprofessional engineering curriculum. The Department Head of the Engineering Education Department oversaw faculty who instruct the preprofessional undergraduate courses.

Between 2008 and 2010, four nontenure-track engineering instructors were hired within the Department of Engineering Education (EED) to teach the engineering courses for the Associates of preengineering program. While the instructors were administratively assigned to EED on the main university campus, they were physically located at a regional campus. Their teaching assignments and performance evaluations were jointly prepared by the Associate Dean, the Department Head of Engineering Education, and the Dean of the regional campus at which they are located.

The Associates in Preengineering program was a distance education program that supported all USU engineering bachelor's degrees in biological, civil, electrical, environmental, and mechanical engineering. The program was delivered to students throughout the state by "synchronous broadcast" via a statewide broadcast capability

provided by the Utah Educational Network (UEN)⁶. Synchronous broadcast education combined traditional face-to-face instruction with interactive video conferencing to enable a single instructor, located at an origination site, to simultaneously and in real-time instruct groups of students physically located at the origination site and at other geographically remote sites (Figure 4).

Synchronous broadcast instructors concurrently taught students located at origination sites as well as students located at several remote sites distributed throughout the state. Students who were located at an origination site experienced instruction in much the same way as they would in a face-to-face classroom; remote students interacted with the instructor and other students via video monitors and an audio system.

The instructor displayed notes and worked problems for the students to view using a projector linked with a touch screen-capable computer or a document camera.

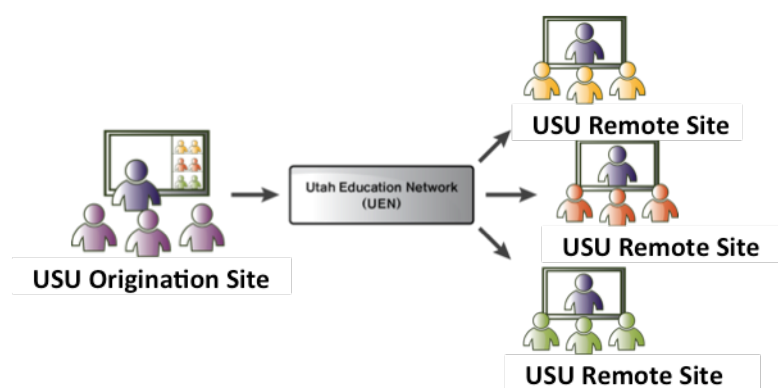


Figure 4. Synchronous broadcast instruction.

⁶The Utah Educational Network (UEN) is a nonprofit broadband and digital broadcast network that provides video conferencing infrastructure and support for education and public broadcasting within the State of Utah (Leasure & Griffin, 2013).

Origination classrooms were equipped with desktop push button microphones that students enabled prior to speaking to the class. In some classrooms, automatic overhead student microphones that did not require activation prior to speaking were available. Students who attended class at remote sites experienced instruction using the real-time video and audio system. Remote-site students saw students from any site through the use of voice-switching technology (i.e., the camera view changed to the site that where the someone was speaking). With this configuration, students at the remote site had visual access to students located at the origination site (or other remote sites) when the latter used the microphone. Students at the remote sites were equipped with the same desktop microphones as those at the origination site.

Students participated in the alternative engineering transfer program from classrooms located at several USU regional campuses and education centers (Figure 5). For synchronous broadcast classes (origination and/or remote) with large enrollments, classroom facilitators were present during class to handle all technological issues in real time. For classes with small enrollments, facilitator assistance was available but was not always immediate; facilitators of small classes usually supported more than one classroom at a time. The number of students located at any site varied from as few as one (common for geographically remote sites in western and southern Utah) to as many as 30 or more students (classroom and equipment permitting).

Description of the Sample Population

Enrollment and degree attainment data for students in the alternative engineering

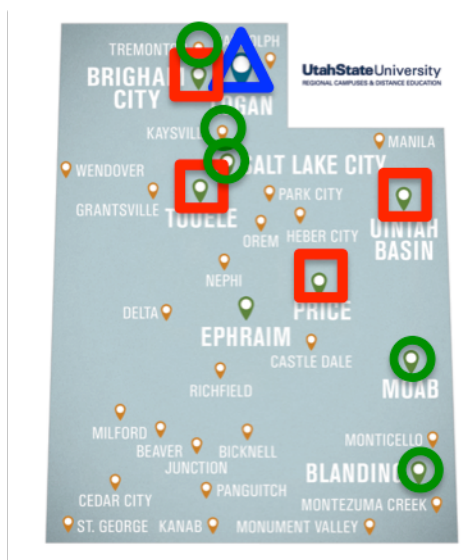


Figure 5. Map of Utah State University (USU) campuses and education centers. The main university campus is designated as ▲. Regional campuses that serve as origination sites for the Associates in Preengineering program are marked ■. Other education centers that participated as remote sites in the program are marked as ○. Unmarked education centers also served as remote sites on an as needed basis.

transfer program between the years 2010-2015, as reported by the USU Office of Analysis, Assessment, and Accreditation (Crump, 2015), are provided in Table 5.

Between 2010-2015, there were 135 new students enrollees in the alternative engineering transfer program. During this same time, 47 students graduated from the program and earned an associate's degree in preengineering. These data, which suggest *low and/or potentially slow* (i.e., occurring after a number of years) graduation rates from the alternative preengineering program, make sense in light of reports in the literature of high attrition rates in engineering calculus courses taught as part of the alternative

Table 5

USU Associate's in preengineering Program Data, 2010-2015

Students	Enrolled	Awarded associate's degree
Female	5	0
Male	130	47
Nonwhite	29	6
White	106	41
Total	135	47

2010-2015, none were female and 6 (12.8%) were nonwhite. Additionally, 16 of 47 students who completed the program listed Brigham City as their major campus, 16 students listed Price, 9 students listed Logan, 1 student listed Uintah Basin, and 5 students did not specify a major campus.

Introduction to the Study Participants

The 14 current and former USU students who participated in this study had completed the first engineering course in the preprofessional curriculum, Engineering Statics⁷, at the time of the study. All participants had taken most, if not all, of their preprofessional courses at the Brigham City regional campus. All participants were white and one was female, suggesting that the participants represented the larger population of students in the preengineering program on these characteristics. All participants were considered to be moderately to highly nontraditional⁸. Nontraditional student traits shared by many of the participants were having had extensive breaks between high school and

⁷ Engineering Statics is taken during the first semester of the second year of study. Calculus I and II are prerequisites.

⁸ The degree of participant nontraditionality was determined through a screening survey administered to all participant volunteers (see Methods Section in Chapter III).

attending college, working, and being financially responsible for themselves and dependents.

Several key characteristics of the participants in this study are summarized in Table 6. In Table 6 and throughout this document, participants are referred to either by their given name or a personally selected pseudonym. The choice between using their own name and using a pseudonym was left up to each participant.

As shown in Table 6, at the time of this study all but two (Cooper and Kay) of the 14 participants had graduated from the alternative preengineering program and enrolled in a professional engineering program at the USU main campus. At the time of the study, Cooper was still enrolled in the preprofessional program and planned on graduating within a semester. Kay had stopped taking classes in the preprofessional program. Of the 12 participants who had transitioned to the main campus, 6 (Mike, Clair, Tom A., Jaxon, Brad, and Daniel) had graduated with an engineering bachelor's degree and an additional 3 (Cade, Skyler, and Tom D.) were on track to do so within a semester or two. Another, Joe, had just transferred to the main campus and expected to graduate with his engineering bachelor's degree in three years. All of the six who had graduated with their engineering bachelor's degree found employment as engineers upon graduation. Five of the six graduates were employed in north-central Utah and one was employed in Arizona.

The remaining two participants, Connor and Tom W., had different outcomes after transitioning to the main campus. Conner was expelled from the mechanical engineering professional program for course failures during his first semester. He moved

Table 6

Characteristics of Study Participants

Name/ pseudonym	Sex	Nontraditional Category	Age at start	Years to associate's	Additional years to engineering bachelor's
Connor	M	Moderate (3)	20	4	NA
Cade	M	Moderate (3)	21	2	3.5 (expected)
Mike	M	Moderate (3)	22	2	2.5
Clair	M	Moderate (3)	22	2.5	2
Tom A.	M	High (5)	22	2.5	3
Jaxon	M	Moderate (3)	22	3	3
Skyler	M	High (5)	23	5	3 (expected)
Cooper	M	Moderate (3)	24	4.5 (expected)	NA
Joe	M	Moderate (5)	29	6	3
Brad	M	Moderate (4)	31	5	3
Daniel	M	High (5)	33	3.5	2
Tom D.	M	High (5)	41	7	3 (expected)
Tom W.	M	High (5)	44	3	NA
Kay	F	High (5)	48	NA	NA

Note. Connor left the mechanical engineering professional program to pursue a bachelor's degree in mechanical engineering technology at another institution.

Cooper had not completed the preprofessional program at the time of the study.

Daniel completed the concurrent bachelor's/master's program in electrical engineering.

Tom W. left the mechanical engineering professional program and graduated with a bachelor's of science degree in geology three years after earning his associate's degree in preengineering.

Kay never officially enrolled in the alternative preengineering program since she already had an engineering bachelors degree.

on to pursue a bachelor's degree in mechanical engineering technology at another institution. Tom W. left the mechanical engineering professional program midway through his first semester on main campus. He moved to the College of Science and graduated with a bachelor's degree in geology with an engineering emphasis.

In examining the data presented in Table 6, it is important to note that the average time to completion for the 12 participants who completed the "2-year" alternative

preengineering program was 3.8 years with a completion range of 2 – 7 years across the 12 participants. This finding supports those of Hagedorn et al. (2006) who stated that, while community colleges are considered 2-year institutions, they often “...require students to persevere much longer” than two years (p. 237). The average time to complete the “2-year” professional program for the six participants who had gone on to earn an engineering bachelor’s degree was 2.6 years. The participant narratives presented in the following sections do much to explain how and why the preprofessional program offered in a community college setting may take longer than two years for nontraditional engineering students and that extended time to completion is not necessarily a signal of poor performance, lack of ability, or waning motivation.

Presentation of Narrative Outcomes

In the following sections of this chapter, the narrative outcomes of the study are presented and summarized. First, the narratives of seven participants are presented in their full form, as co-developed by the participant and researcher, in order to highlight common nontraditional student life experiences uncovered during the narrative development process. At the conclusion of each highlighted narrative, a table summarizing the measures of success, barriers to success, and actions taken to overcome barriers to success as described by the participant during the our interviews and interactions is presented. Importantly, while this study does not intentionally focus on gender, I have chosen to present Kay’s narrative as the final highlighted narrative. Her narrative brings visibility to the unique barriers she faced, as a highly nontraditional

female engineer, while attempting to re-enter the engineering workforce by taking classes in the alternative engineering transfer program.

After presentation of the highlighted narratives, the success measures, barriers to success, and actions taken to overcome barriers to success for the remaining seven participants are summarized and presented in tabular form. The seven co-developed narratives that are not highlighted in the main body of this chapter are provided in full-form in Appendix J for those desiring access to them.

Highlighted Narratives

Cooper: An Unstoppable Adventurer and Future Aerospace Engineer

With tousled blonde hair and blue eyes sparking, Cooper eagerly made his way across the main university campus toward the engineering building. On this warm September morning, things—by all accounts—were looking up. Back from a volunteer deployment with the U.S Air Force Reserves, Cooper felt better than ever—especially about school. His six-month, “all expenses paid Afghanistan vacation”—as he liked to call it—had been a break from the mounting stresses and uncertainties of his engineering studies. “It was a cool, high altitude experience,” Cooper said, with a wink and a grin, to anyone who asked. “And the ‘fireworks’ on Christmas and New Year’s Eve were spectacular.”

By the time Cooper left for Bagram Air Base, located approximately 50 km north of Kabul in the Parwan Province of Afghanistan, his characteristic easy smile and adventurous spirit were showing signs of strain. On the day of his departure in early

October of 2014, Cooper was just three classes (one semester) shy of completing his Associates Degree in preengineering and becoming eligible to transfer into the professional program on the main university campus. Yet, despite being so close to tangible evidence of progress toward his goal of earning an engineering bachelor's degree, he decided to take a leave of absence from school.

From an early age, Cooper could handle disappointment and take setbacks in stride. Yet, despite his genuinely positive outlook and laid-back demeanor, inside Cooper knew he was struggling. Even with the money coming in monthly from his GI bill benefits, Cooper's cash reserves were running low from paying the mortgage and keeping up with repairs on the older, one-story home he shared with his mother and sister. Generally, he hadn't been doing as well in his classes as he knew he needed to. Regrettably, he let Physics II get away from him last semester—and failed it— while concentrating hard on Calculus III. And, although he knew he could do well in Physics II when he repeated it, he was concerned about using the second of three course repeats allowed in the preengineering program. Cooper used up one repeat early on in the program when he struggled with Calculus I. He'd have one more to use, if needed, to make the 2.8 grade point required for acceptance into the aerospace engineering professional program. It seemed doable to him. Yet, as uncertainty and self-doubt crept in, Cooper decided that taking some time away now might do him good in the long run.

So Cooper packed his bags, said goodbye to his mom and sister, and spent the fall/winter of 2014 and the spring/early summer of 2015 at the U.S. airbase right outside Bagram, Afghanistan. During those six months, he felt himself relax—despite the

frequent incoming mortar rounds that got his heart jumping. He was back working with his hands on F-16 engines amid the familiar ebb and flow of aircraft maintenance. The “hurry up and wait” atmosphere of the military base provided him plenty of time to think and plan between inevitable periods of high operational tempo.

Of course, Cooper faced challenges in Bagram. He blamed his major challenge simply on dumb luck; somehow, when he arrived in Bagram, he had been assigned to the flight line. While on active duty several years before, he had been a back shop engine mechanic. The differences between the two were substantial. As a back shop mechanic, Cooper never worked on engines that were installed on aircraft like they were on the flight line. But the differences went beyond just “stuffing engines.” The flight line was an entirely new environment with its own tempo, work practices, paper work, and manuals. The two seemed only to share basic engine theory. As Cooper explained it: “It was like joining a Nascar pit crew when all you’d ever done was work in a tear down shop.”

As an E-4 studying to become a Sergeant E-5, Cooper admitted that, at times, he was little embarrassed by an E-2 Airman “who really knew his way around the flight line.” He sometimes regretted not feeling the same sense of pride in his work or the respect of his fellow mechanics as he had on active duty. While he found the situation in Bagram challenging, Cooper focused on learning and concentrated on taking the criticism he received constructively. He did his best to show a willingness to improve rather than “taking the criticism personally and retreating.” Cooper explained it this way: “in the military, we’re all in training. If you don't get it right the first time, you get retrained until

you do.” With this attitude, Cooper had a positive experience in Bagram, as he did during most of his “adventures.”

In fact, Cooper had grown very accustomed to—even comfortable with—military style training during his active duty service in Okinawa, Japan and later at Nellis Air Force Base in Las Vegas. Jessie enlisted on active duty at twenty years old when a good friend finally convinced him that joining the military was the only way to get real money for college. Although he resisted his friend’s idea for nearly two years, Cooper finally agreed.

Cooper put up a good fight. After graduating from Harker Heights high school in Ft. Hood, Texas, he took every opportunity, no matter how difficult or uncomfortable, to get money for college. At eighteen, while working at a local restaurant in nearby Killeen, he heard of an opportunity to make \$28/hr. with the ironworkers union in Seattle. Motivated by the possibility of earning such a high wage, he moved to Washington State to try-out. The union try-out consisted of a number of construction related tasks, such as welding, tying rebar, climbing vertical I-beams, and using cutting torches. With no prior experience, Cooper wasn’t surprised when he was not one of the ten selected—out of more than one hundred volunteers who tried out. Because the union encouraged people to stay around and continue to try out, Cooper took a low wage job with a nearby lawn care company with plans to try again. Soon, however, he decided the union wasn’t a good fit and moved back to Texas.

Back in Ft. Hood, Cooper’s mom passed on some news about a job doing heating, ventilation, and air conditioning (HVAC) work at a company owned by an old friend of

hers. The kicker was—the job was in Utah. With no other immediate prospects, Cooper made his way up to Utah and began simultaneously working the HVAC job and living in his new bosses' unfinished basement. Although he found the living and working conditions horrendous, Cooper kept at it until he had saved up enough to move out on his own.

Cooper found a better paying job at Feature Films for Families about thirty miles away, near the university in Logan, and moved into an apartment there. A few months later, when a fellow employee complained about him to management for dozing off at his computer during a night shift, he was let go. After that, the only work Cooper could find in the area was selling phones at the mall. Unfortunately, the sales job paid on commission and Cooper found it hard to make enough money to both live and save for college at the same time.

Admitting to himself that he wasn't "making it" and that his dream of becoming an engineer was in jeopardy, Cooper finally agreed with his friend that the military might be their ticket into college. Together, they went to the local recruiter and enlisted in the Air Force. Each enlisted for four years—the minimum enlistment period needed to qualify for GI Bill benefits.

Cooper wanted to go to college because he wanted to be an aerospace engineer. For as long he could remember, he had been interested in space. Since the time he was four, Cooper would race to the library to check out books about space. When he was still very young, he just looked at the pictures of satellites, space probes, and rovers until the day came when he started reading the words too. Later, Cooper became a self-proclaimed

“space junkie” and read everything he could about space science and space exploration. When Cooper was in high school, an aerospace engineer visited his class carrying two thin aluminum plates attached by a honeycomb web. To Cooper, the structure “looked like something you’d see in a spacecraft.” It was at that moment that Cooper learned the name of what he wanted to be: an engineer.

Now, back from Afghanistan, Cooper felt ready to finish his preengineering studies. Primarily, he was concerned with getting his grade point up. He knew that he struggled more in the preengineering courses in which he wasn’t located in the same room with the instructor. In fact, distance delivery was one of his biggest complaints about the preengineering program. Personally, he was too easily distracted— by conversations with other students, by his phone, by his laptop— if the instructor was not physically present. Now more determined than ever to complete the preengineering program and continue on to complete his degree, Cooper made an important decision about the rest his education. He decided to transition to the main campus in Logan when he started back in the fall.

As summer waned, Cooper went in to see to the regional campus engineering advisor and together they figured out that all three of the classes Cooper had left to take in the preengineering program were only offered via synchronous broadcast delivery in the fall. That meant that, if he completed the preengineering program at the regional campus, Cooper would have to take the distance education courses. In order to have traditional face-to-face instruction he’d have to transfer to the main university campus.

Transferring to main campus earlier than necessary was not an easy decision for Cooper to make. He was comfortable at the regional campus and felt as if he benefitted from the preengineering program in many ways. The regional campus was close the home he shared with his mom and sister. While his home was only five minutes away from the regional campus building, the meandering—and downright treacherous during inclement weather—mountain highway connecting his town to the main campus took nearly forty minutes to traverse, one-way.

Living close to where he went to school, he spent less time on the road commuting and had more free time to study. He saved on gas money and car maintenance—with his tight budget every penny counted. He also felt that received personalized attention at the regional campus. When Cooper began the preengineering program, he had only a conceptual idea of what college was going to be like. His high school experience had been “chaotic” and he did not feel well prepared for undergraduate studies. He appreciated the small classes, extended contact hours, and committed instructors he found in the preengineering program.

Perhaps most importantly, the preengineering program had provided Cooper an opportunity to do something that, at the time, he desperately wanted: a hands-on engineering project. Cooper considered himself behind his peers, mostly in the areas of studying and grades, and wanted to do something more than coursework to “make up for” what he felt his resume lacked. When an engineering instructor at the regional campus generously offered to support a small group of preengineering students who were

interested in participating in the NASA Lunabot Robotic Mining competition, Cooper enthusiastically joined the team.

The Lunabot competition required each university team to design and build a mining robot able to traverse a simulated lunar landscape, excavate lunar soil called “basaltic regolith”—or, as Cooper preferred to call it, “moon dirt”— and deposit the soil into a collection bin. While the competition was not a part of the preengineering curriculum, the regional campus administration supported the project with working space, instructor support, and funding for supplies and travel to the competition.

After a year’s worth of work, forty-four teams from all over the world competed at Cape Canaveral to see which robot could mine the most “moon dirt” in a ten-minute period. Dressing up as a masked superhero complete with a billowy blue cape, Cooper, along with the team’s Lunabot, was a favorite among the support staff even though the robot didn’t win any of the competitions in the simulated regolith pits. In the end, the experience of working as part of a team to create a complex machine for a mission scenario and against real constraints fired Cooper up and gave him an experience that sustained him throughout the rest of the preengineering program. He considered the Lunabot experience a highlight of the four years he has spent in the preengineering. And, although participation in the Lunabot competition took a substantial amount of time for over a year, Cooper felt it gave him focus and the vision he needed to persist in engineering.

Now, as he entered the four-story engineering building on main campus and walked through its spacious halls to his classroom, Cooper smiled thinking back to his

first experiences there. Back when he was selling cell phones a few miles away at the mall, he remembered how desperate he had been to get himself into college and yet how clueless he was about “what that meant or how to do it.” His parents couldn't help him; his dad didn't go to college and his mom had attended community college only for a semester to two. “She knew that college was a good thing, but that was about it.”

Hoping to figure out “a way in,” Cooper remembered how he started “hanging out” on main campus. He would go into random campus buildings and strike up conversations with anyone he could. His easy way of talking with people helped him strike up conversations with maintenance workers, office staff, undergraduates and graduate students. In fact, being nineteen at the time, Cooper was often mistaken for a student. Undergraduates casually chatted with him and some even invited him into their dormitories. His keen interest in science led to a long conversation with a biology professor who invited Cooper into his office to show off his research. By the time Cooper started taking classes at the main university that fall, it turned out he knew his way around campus.

Cooper entered Engineering Room 108 and quickly maneuvered down the wide, shallow stairs to the front of the lecture hall, side stepping around other students who milled about. The professor was already there, booting up the computer and fidgeting with the display and projector controls. Cooper found his usual seat in the first row. As he pulled out his chair to sit down, he noticed a stack of stapled papers spilling out of his professor's satchel. “Are the exams graded?” Cooper blurted out to the professor who

was standing behind the podium just a few feet away. He couldn't help asking but, immediately, he regretted it.

The professor smiled knowingly and nodded, while the echo of Cooper's question wafted up and down the rows as more and more students became privy to the news. To begin class, the professor flashed up the class's exam statistics on the projector screen. The large room went suddenly still as students deciphered the statistical clues concerning their exam performance. The professor used the quiet to his advantage and started calling out names and handing out graded exam papers. Cooper sat there, feeling as if a giant was standing on his chest. This had been the first exam he had taken since being back from Afghanistan.

One of the benefits of sitting in the front row in a large college lecture hall is not having to get out of your seat to get your exam when the professor calls your name. Cooper, in fact, never heard his name. In an instant, a stapled exam packet was gently placed face down on the table in front of him. He looked down and, for a moment, considered not turning it over at all. Yet, he was encouraged by the expressions on the faces around him. Holding his breath, he quickly flipped over his exam packet and there it was. His hand fell into his lap and his vision blurred. He had failed the first exam.

Cooper didn't hear much of what was discussed during the rest of class that day. On the ride home, his carpool buddy noticed that he seemed less animated than usual.

"What's up?" she asked.

"I didn't do so hot on my Strengths exam."

She glanced at him and then fixed her eyes back on the winding road.

“Oh yea? What are you going to do?” she asked.

It was a reasonable question and one that Cooper had thought long and hard about during and since his deployment to Afghanistan. While a fear of failure always dogged him when it came to school, he could never forget what it was like growing up poor in central Texas. His dad had been a contractor and his family moved frequently as they attempted to stay above the poverty line. Employment for Jesses’ dad had always been boom or bust and getting work meant moving periodically across five states: from Texas to Louisiana, Iowa, Colorado and Minnesota and back. There were several times that his family moved year three times in a year. Growing up, Cooper’s family lived in two story houses, tents, and everything in between. At one point, he remembers living in the back of the family car as his parents pulled opposite shifts at a gas station to make ends meet. During those times, gas station hot chocolate was considered an expensive treat.

Cooper attended five high schools in four years and remembers being so grateful for a counselor who once offered to buy him shoes because his were falling off of his feet. He often thinks about how, as he sat in the auditorium at his Harker High graduation ceremony, he hadn’t been entirely sure that he had earned enough transfer credits to graduate. Luckily, there had been a diploma there with his name on it. For this, Cooper gives a lot of credit to that same high school.

“Nothing crazy,” he said. “I mean, I’m doing alright. I’ve got my mom and sis out of the trailer park, out of Joe Dirt’s back yard. That’s an accomplishment.”

He sat quietly for a moment and then continued, “ You know, I’ve seen a lot of other kids, kids who were a lot smarter than me, quit engineering because it’s too hard. What they don't know is that school is just training for the real job.”

His car pool buddy looked over at him and smiled.

Cooper smiled back and said ruefully, “I’ve got some things to work on, sure. I’m working on how I study. Going to try to not use solutions manuals so much. I need to slow down. I’m looking for good study partners. People whom I can pick up good habits from; ones that will rub off on me. Mentors even.”

Cooper looked out the window at the mountain peaks that now looked close enough to touch. “The challenge that makes the university interesting is how much you have to learn on your own. It’s different than the military. Less one-on-one. I can see that now. “

Cooper sighed, his eyes sparking in the softening afternoon light. “I’m figuring it out. I’ve got a plan. I’m surviving. If they end up telling me I can’t cut engineering and have to choose another major or leave the university even, o.k. Fine. I know they’re not the only school with engineering. I’ve done research and there are other places I can go. I’ll make a path for myself in engineering one way or another.”

They canyon opened up and they both gazed out at the expansive valley below. Cooper’s friend punched the gas pedal with her foot. “If anyone will Cooper, you will.” she laughed, as the two sped toward home.

Table 7

Narrative Outcomes: Cooper

Definitions of Success
<ul style="list-style-type: none"> • Survival/persistence in quest to become an engineer
Barriers to Success
<ol style="list-style-type: none"> 1. Poor high school preparation/poor study skills 2. Lack of engagement and instructor interaction in synchronous broadcast classes 3. Feeling out of place in an academic environment 4. College of Engineering Administrative course failure rules
Actions Taken to Overcome Barriers
<ul style="list-style-type: none"> • Re-took classes for better grades ad understanding (1) • Sought out mentors (1) • Self-reflection (1, 3) • Developed own course schedule, took classes at own pace (2) • Transitioned to main campus early to get face-to-face instruction (2) • Participated in extracurricular engineering projects to gain confidence, mentorship (3) • Stopped out with a military deployment (3) • Researched policies at other institutions/ made contingency plans to pursue engineering elsewhere (4)
Note. Number in parenthesis matches the action taken to overcome a barrier to the numbered barrier listed above.

Cade: Found his Niche at the Regional Campus

“I remember most of my teachers.”

Cade grew up on the north side of Brigham City, Utah, closer to mountains that separate Brigham City from the larger town of Logan than to the smooth spread of the Salt Lake Valley, flowing south and west toward the Great Salt Lake. The youngest of six children, Cade didn't have a firm sense of what he wanted to be when he grew up. His parents seemed to support his interests, regardless of what they were. Yet, he always knew—even from a young age—that going to college was in his future. While both of Cade's parents went to college, only his dad—who studied electrical engineering—“made it all the way through” to earn a bachelor's degree.

With his dark, wavy hair and thin frame, Cade stood out at Box Elder high school in a few ways. A soft-spoken and thoughtful student, Cade received the single grade below an 'A' on his high school transcript when he failed to turn in an important assignment in English⁹. To this day, Cade feels the disappointment that rushed over him the moment he found his completed assignment still neatly placed in a folder in his backpack. “I thought I had turned it in,” he explained with an ever-so-slight grimace.

Cade also wrestled with shyness growing up. He struggled getting to know someone new but, once he knew that person, he could be outgoing. Cade discovered that, at least initially, getting to know his teachers was usually easier than getting to know his peers. He learned that if he talked to his teachers frequently, these conversations helped

⁹ Cade received a D in this course. The paper dropped his final course grade from an A to a D and as it was late it could not go higher than a D.

him get past the apprehension and discomfort he often experienced in school. As a result, his teachers have played a particularly important role in his education.

Cade graduated from Box Elder High School in the late spring of 2009. His first goal after his graduation was to serve a mission for his church, The Church of Jesus Christ of Latter Day Saints. Cade spent the next seven months earning money and making the necessary preparations for his mission call. He left for Santo Domingo, the capital of the Dominican Republic, in January 2010.

When Cade returned stateside two years later on February 1st, 2012, he moved back in with his parents and spent some time “getting used to normal life again.” Then, as spring gave way to summer, he quickly set about his second goal of earning a bachelor’s degree. During his mission, Cade had decided to pursue a bachelor’s degree in electrical engineering, hoping to find his “niche” there or possibly in the related field of computer science. A big part of the reason he chose engineering was that he had heard that engineering, as a career, could be very “flexible.”

Cade is quick to point out that his father never pushed him into electrical engineering and that, rather, his own interests and experiences led him there. Cade fondly remembers the times when his dad cleaned out the VCR and “I got to see some cool stuff.” But that was on and off. Cade credits a shop/computer class he had at Box Elder Middle School with Mr. Williams for further piquing his interest in electrical engineering. Mr. Williams’ class was a computer coding class. In addition to coding, Mr. Williams’ had his students take apart a computer and examine the mix of electromechanical parts inside.

Cade vividly remembers those experiences “looking inside” and noticing how the electrical circuits and hardware all worked together. It fascinated him.

Now, the question that remained was: where would he go to study engineering? Cade had received his share of recruitment letters from out-of-state colleges during his senior year of high school. While he did consider going out of state, in the end Cade decided to remain in Utah—closer to family where “if I messed up it wouldn't be the end of the world.” As the last child in his family to start college, Cade knew that his parents would help him out financially if he asked. However, since four of his siblings before him had put themselves through college, Cade felt a responsibility to do so, too.

With four possibilities for colleges within the state offering bachelor's degrees in engineering (i.e., Utah State University (USU), Brigham Young University, University of Utah, and Weber State University), Cade began to do some “concrete looking” to select an institution. Ironically, he didn't have to look far: as soon as he visited the USU regional campus located in his home town of Brigham City, he knew that that was where he wanted to go. In fact, Cade didn't choose engineering at USU and then opt for the regional campus engineering program: Cade chose engineering at Utah State, in large part, because of the way the regional campus made him feel.

When Cade visited the main USU campus, he was overwhelmed by the complexity of the 400-acre maze of buildings and green space. Cade remembers that, as he walked around the Logan campus, all he could think was, “Where am I? This is H-U-G-E!” He felt out of place, out of sorts, lost.

When Cade visited the USU Brigham City campus, it just “felt different—like I could actually go there.” At that time, the Brigham City campus was comparatively tiny, made up of just three interconnected buildings— formerly a retail shopping center—that had been extensively renovated and outfitted with the networking and video/audio equipment needed to conduct distance education. Yet, apart from its compact size, Cade considered that the inviting campus feel came from something less tangible: the depth of care he received from the regional campus staff and, particularly, the engineering advisor Mrs. Merrill. During his visit, the engineering sat down with Cade and helped map out a plan for his first two years that would allow him to stay on track for both electrical engineering and computer science. In this way, she had explained, he could complete his first two years of engineering coursework, earn his Associates degree, and then make a more informed decision between the two majors as he transitioned to Logan. This level of personal attention made Cade feel secure and added substantially into his decision to come to the regional campus.

The more he considered it, the more Cade liked the idea of taking his first two years of engineering education close to home and then transferring to the main campus after he got some courses under his belt. Although an Associates’ degree had never been one of his goals, Cade started to think that earning one en-route to his bachelor’s degree may be a good idea— as a backup plan. He figured that he could “get the Associates and then, if needed, get a job at that point in time when I had something to my name— something that was concrete, solid, but not just, oh, I’ve been to college for two years.” If

he didn't need to get a job at that point, he could transfer to Logan and know that his Associate's Degree would transfer into his bachelor's degree requirements.

Cade began his engineering studies in the preengineering program at the Brigham City regional campus in fall of 2012. He was twenty-one years old and had been out of school for three years and a summer. After taking the math placement test three times and then completing a one-week math refresher course, Cade tested into Calculus I the week before fall classes began¹⁰. After more than three years out of school, Cade had to work himself back into a routine of going to class and studying. "It helped that the campus was so inviting," he explained. "That helped me be able to deal with the transition back to school. It didn't feel weird or anything."

After he got settled into the semester, Cade started looking for regular employment, other than just summer jobs, to fund his education. His cousin told him about the UK2 Group, a global web hosting company based in the United Kingdom, where she had worked. The local data center was located in Providence, Utah, about halfway between Brigham City and Logan. He suggested that Cade apply since the company, which provided 24/7 networking support, was very flexible assigning working hours to students. Cade applied, was hired, and began working for UK2 late that first semester. He worked part time, twenty to twenty-five hours a week, with a schedule that varied semester to semester to accommodate his preengineering course schedule. Sometimes he took weekend shifts to allow him to have more time to spend at school.

¹⁰ Math placement into calculus as an entering freshman is required in order to stay on track within the preengineering curriculum.

Even during that first semester, Cade found talking to his peers at the regional campus to be easier than he remembered it. Part of this new ease he credits to the experience of his mission. Another reason he feels it was easier was the size of classes at the regional campus. Especially in his engineering-related courses, class sizes at the regional campus were much smaller than those at Box Elder High had been.

Cade also felt the regional campus instructors could take time with each student and cared that each student learned. Cade's electrical engineering instructor in the preengineering program had an especially important impact on his experiences there. Dr. Blake had substantial engineering experience in industry and often shared with his students which of the concepts taught in class he had used a lot in industry, which things he hadn't used a lot, and why. In those classes, Cade felt that he learned not only the material being taught, but also about the field of electrical engineering and what real practice was going to entail. He found this insight very useful as he narrowed down his major.

Cade also credits Dr. Blake with teaching him the "rule of halves" as related to troubleshooting electrical circuits— where you can't physically see what the electrical signals are doing—or not doing. This technique had a big impact on him during the rest of engineering education. Cade ran into some difficulty in some of the distance education electrical engineering labs. Parts of the equipment were brand new and the teaching assistant at the Brigham City campus was learning how to complete the circuits for the labs himself. One time, when Cade was having a good deal of trouble finishing a circuit

and the lab assistant was stumped too, Dr. Blake took some time to explain the rule of halves to Cade over the synchronous broadcast network¹¹:

If the signal looks right at the beginning but the circuit isn't working, look right in the middle. If the signal looks right there, you know the problem is in the later half of the circuit. If not, the problem is in the first half. And so on.

Learning the rule of halves turned out to be a transformative experience for Cade. The fact that his instructor took the time to help Cade diagnose his circuit when he was the only student having trouble had a huge impact on him. “It showed me that just because I hadn't figured this out didn't mean that he didn't care” and that, “while there will always be another student,” this instructor wanted to help all students succeed. Second, it turned out that the rule of halves helped Cade on numerous other occasions- not just this one lab. Cade used it later on when he went to Logan campus. There were so many students in the electrical engineering labs that waiting for help from a lab assistant was futile. Cade also used it in a networking class to help his friend troubleshoot some non-working code. “If I hadn't learned the rule of halves, I probably would have looked at another major.”

Cade progressed through the preengineering program pretty smoothly after that. At times he found the synchronous broadcast style of education a bit burdensome, at other times he was inspired by the educational experience received by networking with students across the state. The learning experience varied, depending on the course itself, the instructor, the facilitator, and even the type of camera being used. Of all of the glitches that can occur during a synchronous broadcast class sessions, the worst for Cade

¹¹ At that time, Dr. Blake originated his courses from the Tooele regional campus.

was when he felt like he was missing something that the rest of the class got. He explained:

The times in class that made me the most stressed were when the teacher or facilitator forgot to unmute the mic after a break. That was one. Or if the teacher was pointing something out and you couldn't see it depending on the camera placement or maybe the camera wasn't moving when it needed to. Those two gave me stress. If you feel like you missed something. A lot of teachers get on a roll. And they keep going. And even if you stop them and say, hey, I missed that, sometimes they can't go back. That would be the big one that would cause stress— if you feel like you missed something.

Yet Cade, knowing what he knows now about synchronous broadcast course delivery, would still decide to come to the regional campus if he had to do it all over again. As he explained, “The feel of the regional campus was really great to introduce me to college and to engineering. Yes, the technology had trouble. But when it was done just right, I was amazed at what you could do with it.”

Cade graduated with his Associate Degree in preengineering in May of 2014, two years after he began the program. Because he worked part time, Cade always took one or two classes less than the curriculum called for. He was able to graduate clean in two years by taking a course in the summer. He worked closely with the engineering advisor to make sure he knew which classes would be offered in the summer and make sure he was staying on track for both the electrical engineering and computer science programs.

When asked about his successes during the program, Cade humbly lists the fact that, by a very “close call,” he was the Valedictorian for the Associates in Preengineering program the year he graduated. But more than measuring his success by his grades, Cade emphasizes that, despite engineering classes being “really hard,” he was able to think through and understand them. “I think understanding it is really a key point in an

engineering field. That, I think, is one of my biggest successes.” Finally Cade points to the fact he did not incur debt while going to school. Not going into debt was something that he had been taught from a young age. “I’ve been able to pay for college pretty much by myself. Every now and then my parents help a little bit. I’ve paid for almost all of it myself and don’t have any student debt at all.”

Cade transferred to the main campus in the fall of 2014. He found the transfer to the Logan campus to be much harder than his earlier transition into college at the regional campus. Academically he felt “as academically prepared as anyone else for junior year,” but the social environment “was different. The regional campus was a lot calmer—you could talk to people.” Cade discussed how it was attending the Logan campus at the first:

The engineering students who had been going to the Logan campus from the start, they had their groups who they work with and do assignments with. And then you’re coming in late. For me, actually, the people that were in my preengineering classes, none of them went up to Logan with me. One of them couldn’t continue with the major. Another one, I don’t remember if he was changing or what. But as I went through the preengineering program, people either switched degrees, got a class behind, or something. There were some who went up that were from a different regional campus. But I really didn’t know them. I didn’t even know their names. There was one person I met in Logan that I recognized from a different regional campus. He said, “Oh, yeah, you were in so and so’s class.” I said, “Yeah, I recognize your name.” And that’s about as far as we could go. I felt kind of like I was going to a new school when transferring up to Logan.

Slowly, Cade built a study group just by “putting out feelers” and starting casual conversations with other kids in class—something he’d gotten a lot better at doing having had his regional campus experience. He explained it like this:

I happened to sit in the right place next to somebody who has a similar sense of humor. As soon as you could talk to each other, then it kind of sets itself up. As soon as you can talk to each other and you’re willing to ask questions, then the group will just form.

Even though Cade found that a lot of study groups had already been formed, he saw that there was room for him. Students changed majors or didn't pass a required class and were held back. "So, there are people out there. If there's already a group you can join in that group. It's the same thing with making friends, I guess."

Cade's ability to build a study group with other electrical engineering students in Logan was important because he didn't feel as comfortable talking with his professors in Logan than he did at the regional campus. And it wasn't that the professors at the main campus weren't kind or interested. It was more that their expectations were different- that they didn't expect to get to know all of their students. They weren't as personable.

Cade is considered a late junior or early senior in the electrical engineering program. He has completed all of his required classes, except for one, and only needs to complete a few electives. He still works at UK2 and has recently moved out on his own, closer to Logan campus, to see if he has time to participate in more social activities without the forty-minute one-way commute to and from school every day. "I applied for and received a Pell grant¹². I calculated that it, along with gas money I won't have to spend, would offset my rent."

Cade's epilogue. Cade plans to graduate with his Bachelor's degree in electrical engineering in May of 2017, three years after starting the professional program. He will also graduate with a minor in computer science. "Programming is one thing I need to get better at and is in pretty high demand, I hear. If I can't get a job in electrical engineering, I may be able to as a programmer. So, we'll see."

¹² A federally subsidized Pell Grant, unlike a student loan, does not have to be repaid.

Cade's plans after graduation hold several contingencies. He would like to find a job, or internship, in Utah with a company such as L3 Communications, Boeing, or Northrup Grumman. In case the job market doesn't hold, Cade is also considering staying on at USU for a Masters Degree, in electrical engineering or perhaps business. He'd like to stay in Utah to be near family or perhaps go to Portland where his brother-in-law works with an engineering company. "I like contingency plans. So, we'll see."

Table 8

Narrative Outcomes: Cade

Definitions of Success
<ul style="list-style-type: none"> • Achieving good grades with understanding • Relating what you learn to the real world • Staying out of debt while going to college
Barriers to Success
<ol style="list-style-type: none"> 1. Technology issues associated with synchronous broadcast system 2. Electrical engineering labs had new equipment and weak base of support 3. Main campus engineering culture
Actions Taken to Overcome Barriers
<ul style="list-style-type: none"> • Took classes at a slower pace (1) • Took classes in summer (1) • Talked with his instructors (1, 2) • Learned from his instructor how to troubleshoot lab equipment (rule of halves) (2) • Kept his flexible job throughout the preprofessional and professional programs (3) • Worked weekends to be on campus during the week (3) • Built a study group (3) • Moved close to campus to spend more time there (3)

Note. Number in parenthesis matches the action taken to overcome a barrier to the numbered barrier listed above.

Clair: A Top Performer who Clashed with the Traditional Engineering Culture

With his wife McKinzie seated comfortably nearby on an overstuffed sofa, Clair appeared the epitome of contentment as he laughed and played with their thirteen month-old daughter, Kendall. Stretched out on the living room floor of their Tuscon, Arizona home, the structural analyst for Raytheon Missile Systems thought back to the time when he and his wife, as young newlyweds, were undergraduate students at the Utah State University (USU) regional campus in Brigham City, Utah. Shaking his head with a half-grin, half-grimace he remarked, “Those were the longest days of my life. We both look back and think that was a miserable point in our lives.”

The irony of “those” days was not lost on Clair. Finally getting about the business of becoming an engineer—the thing he had wanted to do since he was a young boy building his inventions in his parents’ backyard—Clair was “scared to death” for at least the entire first year. He explained how he enrolled at USU Brigham City “not knowing how I was going to accomplish my goal but knowing I had to take a step forward.” To Clair, taking that first step felt like jumping off the edge of the world.

Clair grew up on the famous King Ranch, located in south Texas near Corpus Christi. He fondly remembered his childhood in Texas, especially the times he spent building and creating in the backyard.

Even when I was really, really young, I’d be out back building my ideas and coming up with how to do things differently. And I remember that I asked my mom, “Who does this type of stuff in the real world?”—because people would ask me and I would have no idea what to say. I was in first grade and people asked me “What do you want to do when you grow up?” I didn’t have the slightest clue. At that point, I had no idea what I was good at. I asked my mom and she said, “You know, engineers do that type of thing.” And so after that I said, “I want to

be an engineer.” And I told everybody for the rest of my life that I wanted to be an engineer.

Remembering the words of a famous neuroscientist as he debated his career choice, Clair laughingly admitted that he wasn’t sure if he stuck with engineering all those years “...out of stubbornness or because that’s what I had told everybody.”

During his freshman year of high school, Clair moved with his family from Texas to Blackfoot, Idaho when his father, an animal physiologist, took a new position on a ranch near there. The move was hard on Clair and he lost much of his motivation for high school because of it. A self-described “terrible student in high school,” Clair could usually just “sit down one night and figure it out—right before the test—and then ace the test.” Clair “didn’t try” because, as he explained, “I had very few subjects in high school that really interested me.”

One of the few classes that did spark Clair’s excitement was automotive class. As Clair explained, “I did extremely well in automotive class because it interested me.” Clair, in fact, was so fascinated by this class, that he signed up to do automotive competitions in a school-wide program ran by the automotive class teacher. Clair explained,

When I was a sophomore, I decided to participate in the automotive competition program at my high school. I wanted to be as smart as my dad was when it came to fixing cars because I helped him do some stuff on some cars at home. I quickly learned that my dad really didn’t know anything. I quickly surpassed his knowledge. He was just fiddling around he didn’t know what he was doing. That’s why I started, but then I found out that I was actually really, really good at it and I stuck with it.

While Clair participated in “a whole bunch of automotive competitions,” the ones in which he had the biggest successes were sponsored by Ford /American Automobile Association (FORD / AAA) and Skills USA.

Typically these competitions would consist of two parts. First they would give a written test and then they would ask you to fix a bugged car. Everybody had a car that was exactly the same and it had the exact same problem—like a plugged vacuum line, a bad relay, or a bad fuse. I remember one year we all had Crown Victorias.

In his senior year of high school Clair won scholarships from both the Ford/AAA and Skills USA competitions. He chose to accept the Ford Asset Scholarship from Ford/AAA. It was a 2-year scholarship that provided full support to earn an associate's degree in automotive technologies. "Ford/AAA provided a list of eligible schools and I was planning on going to one down in Texas."

Clair knew that, before he went automotive school, he was going to serve a 2-year mission for his church, The Church of Jesus Christ of Latter Day Saints. Soon after winning the award, he contacted FORD / AAA to ask for an extension on his scholarship:

Ford/AAA was nice. When I won the scholarship, I was already planning on going on a mission a year later. I emailed them and said, "Hey, I'm planning on going on this mission, can you hold off on it until I get back?" And they wrote me back and said, "Ok."

Clair graduated from Blackfoot High School in May 2004. Fourteen months later, he left for his 2-year mission to St. Petersburg, Russia. At that time, Clair's long-term plan was first to get his automotive associate's degree using the scholarship after he returned from his mission. Once he earned his associate's degree and had marketable skills for a "decent paying job," Clair planned to go to a university to study engineering. He wanted to pursue a degree in automotive engineering or mechanical engineering with an automotive emphasis. Clair always planned to work to fund his way as his family was unable to pay for him to go.

Clair's ultimate goal was to work as an engineer in the automotive industry. Because he sometimes "struggled working for other people," he hoped one day to start his own company that designed and fabricated its own products. He remarked, "I love the fact that when you are an entrepreneur, your motivation goes hand in hand with your success."

Clair remembered, "The whole time I was on my mission I thought, 'I'm going to use that scholarship down in Texas.' The whole time, that is, until my mom got cancer again." About 16 months into his mission, when Clair received word in Russia that his mom had breast cancer, he feared the absolute worst. He explained,

She had cancer before I was born and due to that she had other health implications. When she got cancer the second time, I thought that there was no way she could make it through that type of thing again. When I came home to Idaho after my mission, she was into recovery at that point. I thought, just to be safe, I'm going to forgo that scholarship down in Texas. I'm going to stick around here.

After completing his mission and returning to Idaho, Clair found a job nearby doing house restoration. He also met and started dating a young woman three years his junior named McKinzie from nearby Idaho Falls, Idaho. The restoration job suited its initial purpose of keeping Clair close to his mom well. However, as his mother's health improved and his relationship with McKinzie grew, Clair started thinking seriously again about his long-term goals. He said,

Restoring houses was something I loved. I love using my hands. I loved building. But deep down in my soul I knew that I had something that a lot of the other people I worked with didn't have— like a drive, for one, and an innate ability to understand and comprehend. I'm not saying they didn't have it. I just don't think that they believed that they could have it.

And I thought that I needed to take advantage of that. When I was on my mission to Russia, I realized that Russians don't have the opportunity to be

whatever they want to be. So when I came home, I knew I wanted to become something. I knew I wanted to take advantage of the fact that in America we have the opportunity to do whatever we want.

One and a half years after returning to Idaho, Clair decided it was time go to college.

Although he lived in Blackfoot, Idaho, Clair chose to apply to USU in Logan, Utah because of its proximity to Idaho and its excellent reputation in mechanical engineering. Clair considered USU to have a better reputation in engineering than the universities in Idaho. He found a full-time job at Gossner Foods in Logan, working the midnight to 8am shift that would allow him to go to school during the day. At this point, everything was set for Clair start school in Logan in the fall semester of 2008.

Then, after carefully considering what his life was soon going to become, Clair stopped short and considered an alternative approach.

I decided that it was going to be a miserable semester. I hadn't been to school for almost four and a half years. I was engaged to a girl that lived two hours away from Logan in Idaho. I was going to be working a full-time job, starting at midnight and going until eight in the morning. I thought to myself, "This going to kill me. I can't do it." So I postponed school for a semester. I decided to get married and then start school.

Clair and McKinzie were married in Idaho in November of 2008. Soon after that, they moved down to Utah to start school together. Clair was twenty-two years old.

Heading down to Utah, without money, a job, or a place to live, Clair was "scared to death." Hearing of Clair's plan to move to Utah and attend USU, Clair's grandmother offered to let Clair and McKinzie live in her home in Honeyville, Utah¹³ rent –free, paying only for utilities and maintenance repairs.

¹³ Honeyville is located 25 miles south west of Logan and ten miles north-north west of Brigham City, Utah

My grandma lived in Honeyville, Utah but she was getting to the point where she couldn't live at home any more by herself. She lived with my aunt a good portion of the year and then in the winter she would stay with my family, my parents in Idaho. So my grandma's house in Honeyville was vacant. She said "Hey, you can live at my house as long as you pay for utilities and for anything that breaks and mow the lawn." And I thought, "This is a great opportunity because I don't have any money."

She also mentioned, "Hey, there's a regional campus here in Brigham City, so you should think about it." I remember at first I thought, "No, I'm not going to." But then when I thought more about it, I started to wonder, "How am I going to get to Logan every day?" How much would the commute cost?" The engineer in me came out -- does this make sense?

And then I looked into what the Brigham City regional campus offered and I found out they actually had the preengineering program. And I said to myself, "Why not? I mean if it's the exact same thing, why not?" And it turned out honestly to be an amazing opportunity for me. It turned out to be a much better opportunity than going over to Logan first. I mean, way better.

Clair accepted his grandmother's offer and he and McKinzie moved into her home in Honeyville. They decided to attend USU Brigham City during the next semester in January of 2009. Clair planned to enroll in the Associates in Preengineering program, knowing that he would have to transition to the Logan campus after completing the preengineering curriculum. McKinzie planned to study elementary education.

Clair remembered how he and McKinzie walked into the advising office at the USU Brigham City campus to enroll having "no idea what they were doing." They sat down with an advisor and, once they did, "it turned out being pretty easy." The counselor helped them pick their first semester classes. She had Clair and McKinzie take general education courses that first semester just to get back into school mode. The advisor quickly transitioned Clair to the Brigham City campus engineering advisor to help him develop his academic plan moving forward.

While McKinzie found a part-time job at the Little Brigham Aggies Daycare facility located on campus, Clair also felt very lucky to find part-time employment as a Brigham City campus Facilities Assistant. Having campus-based employment was important because it meant that neither Clair nor McKinzie had to travel between work and school. When he was off work, Clair often studied on campus before classes started in the evening. Clair's job also came with a lot of flexibility; Clair's boss was a lifelong educator and adjunct instructor on Brigham City campus who really wanted to see Clair succeed.

My boss let me work less when I needed to work less so that was kind of a big plus for me. But I still struggled with that a little. I couldn't just say to him, "Oh, I can't work, I have to study for this test." Usually my boss would ask me what tests I had and what other big assignments I had coming up. He noticed that I would still do my job even if I was stressed out over a test because I felt like I was hired to do something and I needed to go do it right away. On days like that he would usually tell me, "Do these couple things but these others aren't that important. You don't need to do them right now. Just go study." He was an excellent boss.

While the job began as part-time, twenty-hour per week employment, over time Clair was allowed to work more hours as he could fit them into his class and study schedule. This arrangement turned out to be a helpful one for Clair. As he explained, "I wanted to work more because I needed the money."

Clair and McKinzie needed more than what they each made put together to pay for school expenses, including tuition and books. As Clair remarked, "That was the hard part. I didn't know how I was going to pay for school." The obvious solution—student loans—was not an option that Clair entertained. He explained,

I looked for opportunities to pay for school without having to go into debt. Lots of people think of going to school and are okay with going into debt because they

are going into school. I hate debt and I don't want to pay it back. Paying it back sounds terrible. My goal was to never take out a student loan.

Instead of taking out loans, Clair and McKinzie augmented their part time pay to get through school during those first two years with scholarships. Clair's first scholarship came from an old family friend from Texas.

When I was young I got my Eagle Scout. There was a good friend of our family's—an oil tycoon down in Texas who actually owned some of the land on the ranch—and I invited him to the ceremony. After the ceremony he said, "For doing such a good job at a young age, I'm going to give you this \$2000 scholarship for school." So I kept that offer on the back burner. When I finally went to college, I sent him a letter and said, "Hey, remember this?" And he said, "Oh yeah, sounds good." And he sent the \$2000 to the school. And that got me started on my first semester.

After that initial scholarship, Clair struggled finding other funding.

I didn't get any really big scholarships from the Brigham City program. I wasn't odd enough I guess you could say. I wasn't a single mother, for example. Brigham City had a lot of benefits for people like that. They didn't have many benefits for people like me necessarily. I was able to get a few smaller scholarships based on the fact that I worked at USU and had a gap in my education that got me through that first semester. But that was about it.

In order to raise more money for tuition, Clair and McKinzie decided to run for the Brigham City campus student government—and won. Clair served as President and McKinzie served as Vice-President during the 2009-2010 academic year. Their service paid for their most of their tuition during that year. As Clair explained, "I did a lot of extracurricular things, because I saw opportunities to pay for school without having to go into debt." For their final semester at the Brigham City campus, Clair and McKinzie pieced together other small monetary awards and also worked more hours when they could them in order to get through the two and a half years they spent at the Brigham City

campus debt free. Clair remarked how he doubted he could have gotten through his first years at the Logan campus debt free using that same approach-

In addition to the challenge of funding school, Clair had to overcome the obstacle that his break from school presented. Clair commented, “Even though I studied every day on my mission because I had to learn Russian, it didn’t prepare me for studying engineering.” Clair described his transition to college classes as “nerve-wracking”—especially as he considered his neglected math skills and hypothesized how he stacked up against other engineering students who started college right after high school.

At the time I started at USU Brigham City it was four and a half years I hadn’t been in school—I hadn’t done math in four and a half years! Granted, I could do it back in high school but -- I’m embarrassed to say this— I couldn’t test out of trigonometry when I got to USU because I couldn’t remember it. All these kids going into the engineering program in Logan skipped out of calculus, you know? And I was starting in Algebra. I was scared because I wasn’t a very good student in high school and I just didn’t think I was smart enough to do it. It made me nervous to think that I just was going to get lost in the weeds.

Starting out that first semester, Clair reflected back on his overall high school performance and sincerely doubted his ability to do well.

Clair was also concerned about taking classes via the interactive video conferencing system that was used extensively at the regional campus. He explained,

At first I remember I didn’t like the distance delivery aspect at all. I really thought, “How am I going to learn as well as in a regular classroom this way?” And I think in some ways, in some classes, the distance delivery was a hindrance because it was difficult for the teacher to get students to interact if they were not all together in the same room.

Clair took classes taught by several of the academic departments in which his instructor was located at another site. He felt like, under these circumstances, things went alright when there weren’t students in the room with the instructor. If there were students in the

room with the instructor at the other site, the instructor tended to “pay attention to the students in front of him and ignore the students being broadcast to. It kind of sucked for the broadcast students—that part of it,” Clair reflected.

Despite Clair doubting his own intelligence and abilities to be successful in this type of college environment, something happened during that first semester at Brigham that Clair did not expect.

When I started taking the classes in Brigham, I realized that all of my classes interested me except for, maybe, psychology. I just needed some interest and I started doing real well. Initially, before that first semester, I thought that I wanted to do as well as I could. But I got all A’s that first semester and then I thought, “Oh, I can do this. I can— if I just sit down and work hard, I can get good grades.” Then that started it. I just worked my butt off the rest of the time.

After that first semester, Clair really took off in his studies as he got deeper into the preengineering curriculum. Realizing he could perform well, Clair revised his initial goal from doing as well as he could to doing well enough to fund his studies with scholarships, still trying to get through college debt free. Clair explained,

One of my earliest goals was to get *good enough* grades. Once I realized I could get good grades, then my goal became to get *really good grades* so that I could pay for school, because I had no other way to pay for school.

Clair concentrated hard on his classes and, although he experienced some frustration learning via synchronous broadcast delivery, he felt like his instructors “—minus maybe a couple— really got to know the students, cared about the students, knew what they were up to, and were available for questions.” Clair became a highly motivated student— just as he had been in his high school automotive class. He asked a lot of questions in class—one day to the point of annoying his Calculus III instructor. Clair explained his behavior saying, “I understood ninety percent of everything. But I wanted the last ten

percent and I was working my butt off to get it.” Clair seemed to experience a sort of synergy at the Brigham City campus; He commented that “people there saw me working hard to do this and they appreciated it. Their appreciation motivated me to work even more.”

Clair’s hard work at the regional campus paid off. Just shy of his 25th birthday, Clair graduated in May of 2011 and was named the Valedictorian of Associate’s in preengineering class. He remarked, “I was proud of what I accomplished at USU Brigham City. Being able to put valedictorian of the preengineering program on my resume was, I think, a great thing.” Clair remarked how he felt he had achieved success not merely because of his grades but more so because he came out of the preengineering program feeling competent in his knowledge of course material.

When I left the preengineering program, I felt like it was a success because when I was done I felt like if somebody asked me how to do something, I could do it. I remember loving thermodynamics and thinking, “I could dominate in the thermodynamics world. This is awesome.” And granted, that was a pretty basic class. As you get farther into it and you learn that there is way more to this. But that was one thing that I remember always feeling proud of—that I actually knew what I was doing.

Clair took the confidence and pride he developed at the regional campus with him as he transitioned to the Logan campus.

Riding the high of his successes in the preengineering program, Clair and McKinzie moved to Logan after Clair was accepted into the mechanical engineering professional program. He took one engineering class in the summer and officially began the mechanical engineering professional program in the fall of 2011. Clair’s academic success at the Brigham City campus earned him two major scholarships that completely

funded his tuition for his final two years at the Logan campus. To pay for their living costs, Clair and McKinzie took positions as co-House Directors of an on-campus sorority. As House Directors, they lived in the sorority house rent-free. In addition, they did not have to pay utilities. They earned a small stipend and were provided their breakfast and dinner meals five days a week. In return, Clair and McKinzie were responsible for maintaining the sorority house in good working order and providing support and mentorship for the young women who lived there. Clair thought it was “a screaming deal” until the frequent calls of distress from the sorority members started to become a “constant distraction” from his engineering studies.

I got texts from the girls in the middle of class, while I was studying and whatever. And they said, “Oh my goodness, the Internet shut down and nobody can do their homework!” And I said, “Oh okay, I have to get out of class and hurry back and try to get it fixed for you.” Or, you know, this is clogged or that’s an issue. Like holy crap, the dishwasher won’t work. And it was a constant— it was always dragging me, you know? I remember thinking one day I would probably be a little bit better in school if I wasn’t constantly distracted by the sorority. So the sorority job might have been a little bit of a hindrance to my performance in Logan but I don’t think it was a main one.

Yet, while the sorority frequently presented itself as nuisance, Clair felt there were bigger issues affecting him at the Logan campus.

From the very beginning, Clair noticed a distinct difference in attitude in the engineering college on the Logan campus—as if the instructors weren’t concerned about the students.

When I got to Logan, for some reason, the atmosphere changed to where it was as if nobody cares about you. You’re just a number. We’re just pumping you through. There were 120 students in my numerical methods class and there was no help for people that didn’t understand. It was just so different than the regional campus.

remembered one specific example of the change in campus culture: An instructor in one of his courses during his junior year told Clair and his classmates that this was their “weeding out period” and “if you have anything else you want to do right now, put it on the back burner.” Clair remembered thinking that that statement seemed rude and feeling like that instructor didn't care about him.

Clair also remembered having the feeling that a few of the instructors didn't necessarily buy-in to the idea of the preengineering program being taught at the regional campus. Clair remarked,

I told some of the instructors that I came from the regional campus program and they kind of got this look on their face—like depressed looking. And they said something like, “Oh, okay, well, yeah, good luck over here.”

The seeming uncaring attitude and the uncomfortable “vibe” he picked up concerning his regional campus preengineering education played substantially on Clair’s motivation in the professional program. Clair explained,

My motivation decreased in a major way when I went to Logan. And by that I mean the motivation to excel. The motivation to become an engineer and to pass and be decent was still there. The motivation to be at the top of my class left. I didn't try extra hard while I was in Logan. I just did what I needed to and I didn't go after that last ten percent like I did in Brigham. I settled for understanding enough to get a good grade, then that's all I cared about. And then I moved on.

Clair called his ultimate acceptance of “mediocrity as good enough” a “cancer” that affected not only him but also many of his classmates. Clair admitted that the “nobody cares, so why should I” attitude that he adopted after transitioning to Logan ultimately hurt him and he would have been off in the long run if he had worked harder.

Clair noted that his class behavior changed when he started taking classes at the Logan campuses. Even though he is a self-described “people person,” he found himself to

be embarrassed to ask questions in the large engineering classes common on the Logan campus. Sitting in class with a question on his mind, Clair often thought to himself: “I’m sure so many other kids understand it. I’m just going to go home and try to figure it out.” This approach was quite different than the way he had become used to learning at the regional campus. Clair remarked that in the professional program he “had to figure out how to learn without asking questions in class.”

For Clair, the one bright spot in the professional program was the time he spent in the senior capstone design course. Clair was the leader of a team of seven students made up of two female and five male mechanical engineering seniors. As part of the Crossing the Gap competition run by the Air Force Research Laboratory, the team was tasked with designing and building quickly deployable, collapsible structure that weighed approximately twenty pounds, measured under four and one-half cubic feet when collapsed, and could hold 350 pounds. The structure was intended for use by “U.S. Special Forces agents [who] need to scale a wall, traverse a canal, or cross between rooftops.”¹⁴

Clair described his senior design project as his “ideal” engineering experience in which he “freedom to create something that came from an idea that I had.”

When they came to us in senior design and said, “Hey, here’s a list of requirements figure out how to accomplish it,” that was really fun to me—I enjoyed that. I like the fact that somebody just said “Here are the requirements. Figure out how to accomplish it kind of creatively and inventively so.”

Even though senior design was super difficult and I felt like beating my head against the wall a lot of times, all my initial ideas were eventually polished because of the group discussions into something that was better than I had come

¹⁴ L. S. Hwang. (December, 2013.) Bridge in a Backpack. *Popular Science*.

up. No one part of that design was any one person's idea exclusively. The concept might have been one person's idea, but it all got improved because of everybody's work.

Despite the letdown he experienced in the professional program—apart from his senior design project that is, Clair graduated with his bachelor's degree in mechanical engineering in May of 2013. When he graduated, Clair had a 3.6 grade point average. He didn't attend his graduation ceremony and remarked that he has no sense of enthusiasm or loyalty for his alma mater.

Clair's epilogue. After graduation, Clair was hired as a structural analyst for Raytheon Missile Systems in Tucson, Arizona. Clair called it “a great job, better than most people dream of.” For him, it put him exactly where he wanted to be— except for the industry. Looking back, Clair realized that, in many ways, the USU mechanical engineering department lines students up to work in the aerospace industry. “If I had known that, I probably would not have gone to USU.” Clair continues to keep his entrepreneurial dream alive by working on his inventions nearly every day.

Table 9

Narrative Outcomes: Clair

Definitions of Success
<ul style="list-style-type: none"> • Try hard and do as well as he could • Earn a bachelor's degree in mechanical engineering without going into debt • Get a mechanical engineering job in the automotive industry • Become an entrepreneur
Barriers to Success
<ol style="list-style-type: none"> 1. Not having done math in 4.5 years 2. Lack of engagement and instructor interaction in synchronous broadcast classes 3. Financing school without loans 4. Main campus engineering culture
Actions Taken to Overcome Barriers
<ul style="list-style-type: none"> • Started over in MATH 1050 Algebra (1) • Took classes in summer (1) • Studied more than in high school (2) • Studied with a friend in the preprofessional program (2) • Maintained a flexible, on campus jobs (2, 3) • Participated in extracurricular activities to earn scholarships (3) • Found belonging and motivation on main campus in Senior Design Class (4)
<p>Note. Number in parenthesis matches the action taken to overcome barriers to the numbered barrier listed above.</p>

Brad: The Machinist Who Never Said Die

“Toolmakers—those guys always had the most fun.”

At 31 years old, Brad did what many people never do: he achieved a long-time career ambition by becoming a toolmaker for a major aerospace company. In 2008, ATK Launch Systems Group¹⁵ (formerly Thiokol, then ATK, now Orbital ATK) hired Brad as a tool shop machinist.

An affable guy with a boyish smile and memorable sense of humor, Brad was considered a natural born machinist. He excelled at—and thrived on— precise, meticulous work. Even from a young age, Brad liked to build intricate designs. Growing up, his passion was model airplanes. He especially enjoyed the painstaking work of adding the finest details to his carefully constructed models.

Brad was raised in the small town of Roy, Utah¹⁶, bordered by Hill Air Force Base to the east and the Great Salt Lake to the west. He attended Roy High School, located in the north-central part of Roy city. At the time it was constructed in 1965, Roy High— the town’s first and only—was the largest high school in the state of Utah.

Brad enjoyed high school. So much so, in fact, that he completed the high school curriculum halfway through his senior year. “I don’t know why I did that. I guess I liked school. During my sophomore and junior years I took early morning classes, extra classes. By the time I started my senior year all I needed was a half credit of gym.”

¹⁵ ATK System Launch Group designed and manufactured the solid rocket boosters for the Space Shuttle.

¹⁶ Roy is located about 7 miles west of Ogden, Utah and 50 miles southwest of Logan, Utah.

At the time Brad attended—in the early 1990s—Roy High didn't offer college concurrent enrollment classes or advanced training opportunities for seniors like it does today. “So I graduated early and went to work.” It wasn't that Brad was eager to get out of school and get a job. “That's just what I thought you had to do.” Neither of Brad's parents attended college and, not surprisingly, there was no talk within the family about college. His older sister enrolled in a local community college for a time, but not until she was well into her thirties.

In 1994, right after his high school graduation, Brad started work in the manufacturing trades. He pursued woodshop “for awhile” and later sheet metal “for awhile.” Brad excelled and didn't find trade jobs difficult to find. “I just applied and they hired me. But they were really low paying jobs.” After a few years, Brad's interests tended towards machining. He saw that machinists, especially tool shop machinists¹⁷, received challenging projects and “did more than just push buttons.” At the young age of twenty-one, Brad set a goal for himself to become a tool shop machinist before he was thirty.

Brad knew that “machining was harder to get into.” Unlike the other trades he worked, becoming a machinist required postsecondary training and a certification. In 1998, Brad enrolled in a machining certificate program at the Ogden Weber Applied Technology College (ATC) and continued his trade work to support his schooling. Brad earned his machinist certificate in March 1999 and worked as an apprentice machinist for

¹⁷ Toolmakers design and fabricate the precision tools, such as jigs, dies, and molds that are used to manufacture customer products. In earlier historical times in the United States, tool shop machinists often became engineers.

various machine shops until, in 2002, he was hired as a general machinist by Williams International¹⁸ in nearby Ogden, Utah.

The first few years at Williams were good. Brad gained experience operating a variety of machines and gained confidence. He excelled at the precise and detailed work and, within a few years, attained journeyman¹⁹ status. As more time passed, however, Brad began to grow restless. He saw the opportunities for moving into the tooling shop fizzle. He realized that, if he wanted to become a tool shop machinist, he would have to find an opportunity at another company. When he heard from friends that tool shop opportunities were expected to open up at ATK-Thiokol—a major aerospace firm located in Promontory, Utah—Brad set his sights on moving when the time was right.

During this same time, Brad went through a tough divorce. When the stress of it and his job dissatisfaction peaked, Brad abruptly left Williams and took a job as a machinist in Kenai, Alaska. There, Brad built components used to overhaul gas power turbines. Brad spent the days producing intricate engine parts and the evenings contemplating his future. One day, he came to a life-changing conclusion: he was “wasting his time working in machine shops.” He explained, “I did not want to be an old man still cranking handles in a machine shop. I decided I wanted an education and more opportunity.”

¹⁸ Williams International designs, manufactures, and provides maintenance support of small gas turbine engines for application within aviation, industrial, and military markets.

¹⁹ A journeyman machinist is a machinist who has completed an apprenticeship and is highly skilled on most machines and operations. A journeyman machinist is considered to be a professional machinist.

Brad just didn't want out of the machine shop—he wanted a new career as a mechanical engineer. His decision was neither random nor rash. Brad met many mechanical and aerospace engineers as a machinist. He worked with several of them on special projects. Many of them—his “engineer friends”—told him repeatedly that he'd enjoy engineering work and encouraged him to go to school. Once Brad made the decision to follow through on their advice, he immediately began to chart his new course.

So Brad packed up his things and returned to Utah in 2007— six months after arriving in Alaska. “My stay in Alaska was short—so short I remained a Utah resident.” Brad was thankful that Williams hired him back into his former machinist position. He wasted no time and enrolled at Weber State University (WSU), a 4-year undergraduate institution located near Williams in Ogden Utah, with the intention of studying mechanical engineering.

Brad found that he couldn't immediately enroll in the preengineering program at WSU because the entry-level mathematics course for engineering is Calculus I. Brad wasn't “calculus ready;” he “hadn't had much math in high school” and it had been over thirteen years since he had any formal mathematics training. Brad knew he would have to start at the very beginning: Math 0900, aka “Basic Math.”

Brad recalled, “In my mind, math was going to be a huge hurdle. I figured if I could not get through the math, there was no point in spending a lot of time and money taking other courses.” So he laid out his own plan accordingly. He decided to take one math and one general education course each semester²⁰. In the summer, when fewer

²⁰ Since math courses are sequential, Brad was able to take only one math course per

mathematics classes were offered, he tried to “knock out as many generals”—general education courses— as he could. He planned to take at least two classes a semester while working full time on swing or grave shift at Williams.

Things started off well and Brad had a positive experience that first semester. As part of his employer’s tuition reimbursement program, Brad attended the required “interview” with his supervisor to discuss his progress and get permission to continue taking classes the following semester. During the interview, Brad was shocked when supervisor advised him against going to WSU for engineering. The supervisor told Brad that Williams was unlikely to hire him as a mechanical engineer with a degree from WSU²¹. He advised Brad to transfer to an accredited engineering program, such as one of those offered at Utah State University (USU) in Logan.

Brad took the advice and immediately began to look into transferring to USU. Brad happened by the Brigham City regional campus because it was closer to where he lived in Roy than the main campus in Logan. He was relieved to find out that his WSU credits transferred to USU. And, as good luck had it, he learned about the preengineering program offered in the evenings at the regional campuses. Brad enrolled immediately at the Brigham City regional campus.

It was early in the next year when Brad received the opportunity to move to ATK and became a tool shop machinist. Although his career goal had migrated to mechanical engineering, Brad welcomed the new position that offered challenging work and higher

semester.

²¹ Weber State University does not offer an ABET accredited undergraduate degree in mechanical engineering. They offer undergraduate degrees in manufacturing technology and mechanical engineering technology, but these programs are not ABET accredited.

pay. Changing employers, Brad was obligated to pay Williams back for the tuition reimbursement he had received. Luckily, his new employer also offered tuition reimbursement and Brad was able to pay Williams back and still go to school on his new salary.

At ATK, Brad worked full time during the day as a tool shop machinist and continued to work his way through the prerequisite math courses at night until he was able to start Calculus I. He formally enrolled in USU's Associate's in Preengineering Associates in Preengineering program in 2009. Brad looked ahead and set himself up for the long haul from the start. He purchased a home in Tremonton, Utah, located nearer to the USU Brigham City campus and about halfway between his new job in Promontory Utah and the USU Logan campus—which he knew he'd attend after completing the preengineering program.

There were many aspects of the preengineering program that worked for Brad. He enjoyed the small classes and helpful instructors at the regional campus. He appreciated the timely feedback the instructors provided that helped him learn what he needed to learn amid his busy schedule. Brad enjoyed seeing older students when he went to class— students that looked like him and had similar experiences. Brad also found that the evening classes were key to his efforts. He explained,

By this point in my life, I had had ample time to make a good career. I was a career machinist, worked in the aerospace industry, and had a good relationship with my management. Even with all of that going for me, I still had to prove to my employer that I was serious about going to school and becoming an engineer. Being able to work full time during the day and attend school at night was a necessity in my new position at ATK.

Evening classes made it possible for Brad to balance his education and simultaneously continue to progress his career during those first few years back at school.

Although Brad hoped to graduate with his engineering bachelor's before his fortieth birthday, he didn't rush to get through the curriculum. His ultimate goal was survival. Brad tried not to think about grades too much. "I was just glad to be moving forward." He studied a lot—"more than most"—typically studying for twenty hours or more per weekend at the exclusion of other activities. Brad explained, "I learned by repetition. Doing math problems over and over. That was a huge investment of my time." Brad found that working by himself, mainly on the weekends, was hard. Sometimes he felt like he became over reliant on textbook solutions manuals to get through his assignments. He also felt like he didn't really have another choice.

Brad's low point in the program came when he earned C's in Calculus I and II. Despite his disappointment with these grades, he kept his head down and his feet moving forward. "You have to realize that it's the end that counts. Some people got really involved with the grades. I saw people dropping out of classes after the second test. I just kept going. Maybe it was dumb luck." His grades improved in Calculus III and Differential Equations.

Brad considered getting through engineering math—especially Calculus I—to be both a major obstacle and a major success along the way to getting his engineering degree. Brad considered math to be conceptually hard, and some math courses—such as Calculus I—came with an added stigma. He found out that he wasn't necessarily bad at

math; he was more afraid of it than anything. To Brad, getting past Calculus I meant, to him, that he could do engineering.

In addition to math, Brad found test anxiety to be an obstacle he struggled with. Having to be quick while taking timed exams was especially tough for him. Despite this difficulty, he never sought accommodation for his test anxiety. He explained, “I don't have a medical condition. I just get nervous.”

After five years, in the spring of 2012, Brad graduated with an Associate's Degree in preengineering. While the associates degree itself was never a goal for Brad, it turned out to be an important milestone. Immediately after graduation, Brad applied for and was accepted into the USU professional program in mechanical engineering. He transferred to Logan campus in fall of 2012.

Brad began the mechanical engineering professional program at Logan campus in Fall 2012. In making this transition, Brad's course schedule necessarily changed from evening classes to daytime classes. Fortunately, by this time, Brad proved his commitment and capability to his employer. He explained,

I am in the mechanical engineering professional program on main campus now, and my employer is working with me to maintain my full time employment while taking courses during the day. But this would not have been possible until I at least had the first half of my degree under my belt.

When Brad went in to discuss his next steps after earning his associates degree, his supervisor sat Brad and told him, “Get your forty hours a week and do what you need to do as far as school goes.” This newfound freedom—provided by his employer—made Brad's transition to main campus not only possible but also worthwhile: it meant that Brad could finish his engineering degree without jeopardizing the career he had worked

so long and hard to build. Brad felt extremely lucky. He remarked, “I’ve seen other employees ask for help with school and not get it. Finishing the Associates in Preengineering program proved I was serious.”

In moving to the main campus and a daytime course schedule, Brad made some changes. He made a point of studying more with other students. Although he was on campus for part of the day almost every weekday, he still found it hard to connect for study groups with students who didn’t work. Brad did find one strategy in particular that helped him work with more other students and feel less anxious on exams. He started taking off work in order to take part in the “big group study” that usually occurred the day (and night) before a major exam. He found that participating in these study sessions really helped him earn higher exam scores.

And, about two years into the professional program, something Brad made another change. Brad explained, “I started to think like an engineer. Before I was just a student solving homework problems.” He said that this change in his thought process was one of his major successes in the professional program and one of the accomplishments he is proudest of.

In November of 2014, two years after beginning the professional engineering program at USU and seven years after starting college at WSU, Brad was promoted from tool shop machinist to an engineering technician at ATK. In this new engineering position, Brad basically functions as a mechanical engineer. “They can’t call me ‘engineer’ until I get my degree. When I do get my degree, my title will automatically become ‘engineer.’ They say I’ll get a nice raise.”

Brad's epilogue. Brad graduated with a bachelor's degree in mechanical engineering from USU in December, 2015. He was 39 years old.

Table 10

Narrative Outcomes: Brad

Definitions of Success
<ul style="list-style-type: none"> • Complete the engineering program with no D's or repeats • Earn a bachelor's degree in mechanical engineering • Learn to think like an engineer
Barriers to Success
<ol style="list-style-type: none"> 1. Math—especially getting to and through Calculus I 2. Poor study skills and tendencies towards surface and strategic learning 3. Main campus engineering culture
Actions Taken to Overcome Barriers
<ul style="list-style-type: none"> • Started over in MATH 0900 Algebra (1) • Took classes at slower pace and on own schedule (1, 2) • Studied 20+ hours each weekend, used repetition to learn (1, 2) • Studied with friends from the preprofessional program in the professional program (3) • Strategically purchased a home equidistant from home, work and school (3) • Found belonging and motivation on main campus in Senior Design Class (4)
<p>Note. Number in parenthesis matches the action taken to overcome barriers to the numbered barrier listed above.</p>

Tom A: True Grit in the Professional Program

She startled when she saw him walk in to the Utah State University (USU) Brigham City campus student center. “Is that Tom?” she thought to herself. “I thought he was up in Logan.” She gave him a wave. Tom raised a hand in reply, nodding his head when he saw her. He slowly made his way, through the maze of tables and people, over to where she sat watching the snow fall outside. His 6’5” frame slumped as he walked, as if the weight of the world rested invisibly on his shoulders. His dark grey sweatshirt hung loosely on his thin frame, its hood partially obscuring his sunken cheeks and eyes. She wasn’t completely sure it was Tom until he got near. As he approached the table, his gauntness made her gasp.

“What happened? Are you ok?” She asked, trying not to barrage him with questions before he could sit down—but failing miserably. Her mind raced with more and more questions and then quickly escalated its thinking toward potential diagnoses—sickness, long-term illness,—please God not—cancer? He slouched in his seat with hands folded as he timidly looked at her around the edge of his hood. A faint resemblance of his usual bright smile crossed his face.

“It’s been a rough semester,” Tom remarked flatly as a single chuckle escaped his lips.

“I can see,” she replied. “In Logan?”

“Yea, yea. Logan.”

“What’s going on? Can you tell me?”

Well, you know I'm in the mechanical engineering professional program right? I went from –well, I followed the engineering advisor's advice and took the full load for junior year—five engineering classes— this semester. Last semester in Brigham I had three classes, but one of them was an elective. So I had two engineering classes. So I went from two to five engineering classes. My marriage was rocky and I got divorced— it was finalized last month. I'm failing two classes right now and finals are coming up. I'm really scared I'm going to fail out of the program.

“Are you still working?”

“Yea.”

“Full-time still?”

“Yea. Full-time. Still got the weekend graveyard shifts at the Wal-Mart Distribution Center in Corinne. Still live in my house in Perry²².”

“So you're commuting back and forth to Logan?”

Yea. I worked it out so all of my classes are on Mondays Wednesdays, and Fridays. I commute to school on those days. That takes about an hour and a half, total—both ways. I work twelve-hour graveyard shifts on Fridays, Saturdays, and Sundays. On Tuesdays I sleep all day since I have to go to school right after I get off of work on Monday mornings. I do homework all day Thursdays, and on Wednesdays and Fridays between and after class.

“How are you doing it?” she said with her eyes wide.

“I don't know,” he said shaking his head and staring down at his lap. “I probably have ulcers now and just don't know it.”

Tom's first semester in the mechanical engineering professional program—the first semester of the notorious engineering junior year— was indeed “rough.” Feeling

²² The city of Perry, Utah is located three miles south of Brigham City, Utah.

“pushed into” taking a full load by the engineering advisor, he had five classes: Mechanics of Solids, Numerical Methods, Thermodynamics II, Fluid Dynamics, and Engineering Ethics. Halfway through the semester, he felt like he “was sinking.” While he considered going to see the engineering advisor for help, he figured “what she’s going to do for me besides tell me to step it up?” He didn’t drop any of his classes; he felt like he could pass everything if he just held on and kept going. He lost over twenty pounds and, although he was “never diagnosed with anything,” looked to be—and felt—physically ill all the time by the end of the semester.

Tom finished out that first semester of his junior year and ended up failing just one class, Fluid Dynamics. He recalled, “I remember logging in and checking my final grades. Oh my gosh, I was already feeling sick, so I didn’t think I could feel much sicker. But oh man, that was bad.” Fluid Dynamics is a required course for all mechanical engineering majors. Since he failed only one class, Tom was allowed to continue in the program. But, because Fluids was offered only once a year in the fall semester, there were several follow on-classes that Tom had to delay taking until he passed Fluids. As a result, Tom had the distinction of having “two junior years.”

Failing classes was not something that Tom was used to experiencing. A “really good” student in high school, Tom graduated from Box Elder High School in Brigham City in 2005 from with a 3.9 grade point average. He explained how he came to have “straight A’s and one C+” saying,

I graduated high school with a 3.9 grade point average. I had straight A’s and I played basketball and baseball. Now, I think I would have had a 4.0, but I had a history teacher that didn’t like me. I honestly know that she didn’t like me because she pretty much told my mother this. I missed a lot of her class because

of basketball and she wouldn't let me make up my work for missing class. I ended up with a C+ in her history class. So I graduated with straight A's and one C+.

Although Tom did study in high school, his classes came pretty easily to him. He wanted to get good grades and was motivated to put in the work if needed to. Tom took advanced math in high school. He completed MATH 1050 College Algebra and MATH 1060 Trigonometry during his junior year in high school. In his senior year he took Calculus I along with some other USU concurrent enrollment classes.

While Tom had always been interested in becoming a pilot, Tom's father was a professional chemist and always encouraged Tom to go to college and study something in "the sciences." Both of Tom's parents had Bachelor's degrees—his father in chemistry and his mother in family living with a special education endorsement—and encouraged him to go to college. With the intent to pursue advanced education, Tom was excited to be awarded the Dean's scholarship²³ by USU due to his outstanding high school academic performance. Yet, despite having the interest and funding, Tom immediately deferred the scholarship based on his plans to serve a mission for his church, The Church of Jesus Christ of Latter Day Saints, first. Waiting to be called on his mission, Tom found a full-time job at the Wal-Mart Distribution Center .

Tom was 19 when he started working "weekends" at the Wal-Mart Distribution Center. He recalled what it was like working there:

²³ The USU Dean's scholarship is awarded on scholastic merit and funds 100% tuition for two years.

It was Saturday, Sunday, Monday, or later it was Friday, Saturday and Sunday, that they considered the weekend shift. We basically worked three eleven or twelve-hour shifts over the weekend and in a row and it was considered full time. I had full benefits, including medical and retirement benefits. I had 401K. It was really good for my situation at the time. I mean I was nineteen, making good money, and contributing to a 401K.

It was a good job for anyone, and Tom felt proud to be actively contributing to saving for a stable future at such a young age.

That summer Tom had a change of heart and, instead of waiting for a mission call, decided to get married. With his mission plans cancelled²⁴, Tom enrolled at USU and attended at the Brigham City campus²⁵ that fall semester of 2005, declaring the Professional Pilot program as his major. His parents paid for his tuition that semester; USU revoked Tom's scholarship upon determining that he had not served a mission prior to enrolling.

During that semester several people, including Tom's grandfather and a long-time friend who was just finishing the program, talked him out of trying to become a professional pilot. They warned Tom that he'd end up with a burdensome amount of student loan debt and that starting salaries for pilot weren't great—less than what he was currently making at the Wal-Mart Distribution center. Tom remarked, "That got me discouraged a little bit, because becoming a pilot was what I'd wanted to do for years and years. After that, I was kind of lost."

²⁴ First-time missionaries for The Church of Jesus Christ of Latter Day Saints cannot be married.

²⁵ USU's Professional Pilot program is only offered at the Logan campus.

With his scholarship revoked and his plans to take pilot training cancelled, Tom left USU after a single semester. He was married early in the spring of 2006, just before his twentieth birthday. He and his wife bought a house in Perry. Tom explained,

We decided to buy the house. The idea was— we'd made this decision together—that we were going to pay extra on the house and that I'd just take loans out for school if I needed to. We were thinking that someday the home would be an investment property. So we'd try and get the home paid off as soon as possible. We were making extra payments every month.

Tom continued to work at the distribution center and pondered what to do next. One day he took an interest-based career survey and “radiology technician popped out.” Tom checked around and found that Weber State University (WSU), located in nearby Ogden, Utah²⁶, offered a very competitive 4-year program in that field. Tom enrolled and was accepted into the program at WSU for the fall semester of 2006, earning a ½ tuition scholarship to boot. The rest he paid on his own, because he wanted to set that sort of example for his future kids. As he explained, “I want to tell my kids I paid for this, you can do it too.”

Tom stayed in the program at WSU for two semesters. While he did well, something about it didn't click. When he had an internship at a local hospital during his second semester, he talked to a few of the “rad techs” employed there about their careers. Tom came away from that internship disappointed with the earning potential of the qualification:

I didn't feel that the earning potential was there. I remember talking to one of the rad techs about it. He told me if I specialize I can make this and this, and I'm thinking in my head – that's what you top out at? I could work my Wal-Mart job and go get a job for the summer and make that kind of money. I didn't know if I

²⁶ Ogden, Utah is twenty-five miles south of Brigham City, Utah.

wanted to go to school for four years to make the kind of money I was already making.

Tom quit the program at WSU after completing the spring 2008 semester.

Tom spent the next full year working at Wal-Mart and figuring out what to do about his education. As he recalled, “I was done. I had had a full year of college and I still didn't know what I wanted to do.” Tom picked up a second job as a concrete finisher, working Tuesdays- Fridays “not for the money, but rather to just to learn a new skill and keep the pace up.” Tom continued this “summer work habit” throughout the time he was in school, gaining experience in trades like framing, sprinklers, and excavation.

Early into Tom’s “year off,” his father started nudging him about going back to school. Tom’s father told him, “Take some math, it’ll be valuable.”

My dad told me that even if I don’t know what I want to do now, I could do any of the sciences. That was his big thing – that’s what he kept pushing for— the science thing. And he said in any of the sciences you can use math. Just go and take math and then it’ll come to you.

Tom eventually heeded his father’s advice and enrolled at the USU Brigham City regional campus in fall semester of 2008 to “take some math.” Throughout his schooling, continued to work on the weekends at the distribution center. While he tested into Calculus II, Tom knew he didn’t dare take it. Although he took Advanced Placement (AP) calculus I as a senior in high school and got an ‘A,’ Tom “froze up” during he AP Calculus I exam and didn't pass it. So Tom enrolled in Calculus I that fall semester.

Tom did well in calculus. He did so well, in fact, that the instructor quickly offered him the paid campus math tutor position— tutoring all math classes below calculus—that semester. Being asked to be the math tutor was a big boost to Tom’s

confidence. He remarked, “When someone else thinks you can do something, it’s a big reassurance, you know?”

Tom enjoyed being the math tutor and getting to know his Calculus I instructor. From their conversations, Tom learned that his math instructor actually had an undergraduate degree in engineering and had worked in industry as an engineer before getting his advanced math degree and starting to teach math. Sensing Tom’s interest, the instructor encouraged Tom to check out the new engineering program that was being offered at the USU regional campuses.

Tom enrolled in the Associates in Preengineering program at the Brigham City campus in spring semester 2009. He was twenty-two years old. Tom admitted that he had a lot of self-doubt when he began the engineering program. “I didn’t know if I could do it. The classes were hard and time consuming.” Once he got going in his courses, however, he really enjoyed them. He was— and still is to this day— especially proud of a project he completed in his freshman solid modeling class. He explained, “I modeled a single cylinder, small gas engine, every piece of that thing. It was a real confidence boost. I felt like I really mastered the software.” Tom also appreciated working on the “first real engineering paper” he wrote in his manufacturing processes class about the processes used to manufacture automobile tires. It was the first time he remembered saying, “Wow, this stuff is real. I might actually use this someday.”

Tom did very well that first semester and began to feel like the engineering program was doable—just that it would take time. While Tom “didn’t have the best distance experience” taking broadcast courses, he felt like whether or not synchronous

broadcast delivery was a barrier depended on who was teaching. He explained that “I think distance broadcast courses would be great if you had somebody as an instructor that was actively engaged.” He felt like too many times he had instructors with not enough experience to “pull it off.”

Despite his not so stellar experiences with broadcast delivery, Tom was sold on the regional campus preengineering program. He continued,

It’s not face-to-face, but I would have continued to take distance courses at the Brigham City campus if I could, I really would have. I would have done nights, distance and finished my whole degree there. It’s not ideal, it’s not face-to-face, but ninety percent of your learning in these engineering classes comes from your own study time, I think.

While distance delivery was a barrier that Tom felt he could rather easily get around just by studying more, the obstacle he faced balancing his marriage, work, and school proved much more difficult for him to overcome. Working graveyard shifts on the weekends, he slept during the day on the weekends when his wife was at home. During the week, he was home studying while she worked during the day. At night when she was home, Tom was either at work (weekends) or at school (weekdays). Their schedule was completely opposite and ended up being too much for their young marriage to handle. Tom explained that he felt that “she didn’t really understand what the deal was”—that is, what pursuing an engineering degree entailed—and that when he was home studying during the weekdays he really was studying and not “playing video games” like a lot of the guys he worked with on “graves” did. Tom also found it hard to find enough uninterrupted time to study, especially as his classes got more time intensive.

Working full time was a struggle. A lot of the guys I remember saying, “Yeah man, I’ve got all weekend to do my homework.” Because of my work schedule, I

never touched a book on Saturday, Sunday and Monday. For six years I never touched a book on the weekend, unless I took the day off from work.

Tom managed to do his studying and homework on Tuesdays-Fridays before, and sometimes after, his evening classes.

Despite these obstacles, Tom continued to get good grades in the preengineering program and graduated with an associate's degree in preengineering in spring semester 2011. While he was "embarrassed to walk for an associate's degree" at graduation because he "felt silly" walking for something less than a bachelor's degree, he felt "really proud" that he'd earned the associates degree. He explained how he felt saying, "I had it under my belt; they can't take that away from me."

Tom was accepted into the mechanical engineering professional program for the fall 2011 semester. While he considered his transition back into school at USU and the Associates in Preengineering program "a little rough" due to his own self-doubts and difficulties managing his schedule, Tom called his transition professional program on the Logan campus "horrible." He remarked, "I don't know how I lived through that first semester" in Logan.

During the winter break following his first semester in Logan, Tom steeled his resolve to continue in the professional program. He explained,

I just decided I was going to keep going. I would just take what I could in spring. I just decided junior year is going to be spread out over two years. I remember – kind of remember talking to somebody—that was a horrible time. But I don't remember if I talked to somebody or I just thought through it in my head. I thought, "This will be alright because now— for the rest of the program—I'm only going to have three classes all semester and sometimes just two. I won't have five classes along with working full time."

Tom felt a “huge relief” once he figured this out and things progressed much better for him in the following semesters. His health improved and he started to feel like his old self. He started dating his current wife, Shay, during the middle of his “second junior year.” A schoolteacher, Shay was “very supportive” and thought his homework “was cool.” Having “her in the picture” gave Tom even more “motivation to do good.”

Tom took the classes he could— those that didn’t require Fluids—during spring semester 2012 and returned to Fluids that fall, earning an A- in the course his second time through. Tom described his senior year as “a breeze” saying, “My spring senior semester I had the math class I needed for a math minor and senior design. I went up to Logan twice a week – that was really nice.”

In considering his engineering education, Tom has no regrets— just a few things he wished he had “done differently.” He explained, “I wish I would have known what I wanted to do earlier on, because I’d be that much further ahead.” Tom also wished he would have thought more about what he could realistically handle, as far as classes go, going into his junior year in Logan. He said,

I wasn’t prepared for five classes. My marriage was on the rocks, I’d never taken five college classes all at once, and I was working full time. Looking back, I should have said to the advisors, this is what I want to do, I want to do three classes, what can we do?

I’d never had a class with 110 kids in it, and all of a sudden all of them were – the teacher didn’t know my name or who I was or cared who I was. I mean that was a big deal in Brigham, instructors working with us individually and knowing our names when we came to class, seeing us in the hall and saying “hey.” Stuff like that, made me – and I know other people—want to do better.

He felt as if he met his initial goals in the Associates in Preengineering program: to make good grades in his engineering classes and really understand the material and “how things

work.” In the professional program, he is glad he survived. Tom graduated with a bachelor’s degree in mechanical engineering in May 2014 . He married Shay in July, becoming a stepfather to her two daughters. He was twenty-eight years old.

Tom A.’s epilogue. When Tom graduated he had four engineering job offers: two different mechanical engineering positions at Raytheon Missile Systems in Tucson, Arizona, an industrial sales position at Holbrook and Associates in Salt Lake City, Utah that came out of his work as an intern there, and a position in the Mechanical Engineering Facilities Department at Hill Air Force Base in Ogden, Utah. Not wanting to move his new family so far from home, Tom took the position at Hill. “It was the hardest decision I ever had to do,” Tom remembered.

At Hill Tom functioned “more as a project manager than an engineer.” He was in charge of the compressed air loop for thirty buildings and the plating shop. The highlight of Tom’s time at Hill was landing a 1.2 million dollar grant to totally revamp the entire ventilation system in the plating shop. It was the end result of a six-month study that went to the highest levels of management for approval. In October of 2015, Tom was hired at Orbital-ATK near Promontory, Utah²⁷ as a Test Engineer in their Non-Destructive Testing facility. He commented, “I’m excited. It was the job I wanted.”

²⁷ Promontory is approximately thirty-two miles west of Brigham City, Utah.

Table 11

Narrative Outcomes: Tom A.

Definitions of Success
<ul style="list-style-type: none"> • Get good grades in engineering classes • Earn a bachelor's degree in mechanical engineering • Learn how things work
Barriers to Success
<ol style="list-style-type: none"> 1. Break between high school and college—especially break in math 2. Competing requirements of work, marriage, and school 3. Engagement and instructor interaction in synchronous broadcast classes 4. Main campus engineering culture
Actions Taken to Overcome Barriers
<ul style="list-style-type: none"> • Started in Calculus I even though had passed AP test in high school (1) • Became a math tutor to gain confidence (1) • Took classes at a slower pace in the preprofessional program (1, 2, 3) • Divorced and remarried (2) • Took out student loans and worked to keep home as an investment for family (2) • Studied more than in high school (3) • Studied with a friend in the preprofessional program (3) • Studied with friends from the preprofessional program in the professional program (4) • Took classes at a slower pace after failing a course in the professional program (4)

Note. Number in parenthesis matches the action taken to overcome barriers to the numbered barrier listed above.

Tom W.: Cut His Own Path to a Better Future

At 44 years old, Tom hadn't set foot in a classroom in almost 25 years when he decided to go back to college and get his engineering degree. Being a man who had done it all—or at least a good piece of it— Tom was tired of being on the road, working construction. He explained,

I got tired of being gone all the time—having two lives. I'd leave at four o'clock on Monday morning and come home Friday night. So then, I don't know, I just decided that I don't want to do this the rest of my life. And so that's when I ended up coming back here, to school.

When it was all said and done, Tom wanted a better job. And, as he came to realize, “a better job requires a degree.”

Tom was born in central California but grew up in northern Utah. Mostly in Utah that is—his parents lived in Brigham City, Utah for the better part of his life. Tom's dad²⁸, a mechanical engineer for Firestone in California when Tom was born, transferred to Thiokol in Promontory, Utah²⁹ when Tom was just a baby. When Tom got older, every summer his parents “shipped him off” to live with “distant relations” on a ranch in Montana. Tom spent summers riding and training horses, a pastime he still enjoys.

Tom graduated from Box Elder High school in Brigham City in 1981. During the summer after graduation, he spent his time “chasing a rodeo circuit around:”

I went all over Wyoming, Montana, Idaho, Washington, everywhere, riding bulls and broncos. I blew three discs and broke a vertebra right down at the bottom of my back. These days it causes me a little bit of trouble. Broke pretty much everything, I guess. I was doing some construction work too, because I wasn't

²⁸ Tom's father graduated with a bachelor's degree in mechanical engineering from California Polytechnic State University.

²⁹ Promontory is approximately thirty-two miles west of Brigham City, Utah.

particularly good at rodeo. I wasn't making a lot of money there, you could say. So every now and then I had to go get a construction job.

Tom came home to Brigham City in August, right about the time that the nearest university, Utah State University (USU), was starting back up for fall semester 1981.

Tom recalled,

My mother³⁰ had been getting on me about going to college. I told her, "Nah, I'm just going to do what I'm doing for a while." She said, "Why don't you just go up there and check it out? They're having some sort of an orientation or something." So I went up there. And the place was just crawling with girls. I said, "Oh, man. This is the place for me."

So I signed up for all kinds of crazy classes, hoping to get a civil engineering degree. I made it through about a year of that. But I just wasn't really into it. My interests were, well let's just say they were elsewhere. So after about a year of basically floundering around up there, I was in way over my head. So I left and just went to work.

After that year taking classes at USU, Tom began what turned out to be a long and lucrative career in construction.

Tom had a buddy from his rodeo days who ran federally funded construction jobs in Idaho. Tom asked the guy if he had any work. Tom vividly remembered his friend pointing up to a motor grader and saying, "Can ya run that?" Tom, who had "always been good with machines," eyed the 45,000 pound, eleven foot high machine for a moment and replied, "Hell yea, I can run that." On the fly, Tom got it started. That not-so-small feat earned him the job. "I can tell you don't know how to run the thing, but you'll figure it out," his friend said. "You did pretty good up there."

³⁰ Tom's mother earned a bachelor's degree in English from the University of Southern California.

After a few years running the motor grader and other heavy construction equipment in places up north in Idaho to down south in St. George, Utah, Tom went home to Brigham City for a visit. There, he happened to meet one of his dad's friends who was, at that time, "the number one guy for what was then Thiokol³¹ in Florida." One thing led to another and, when he heard that Tom was "still driving a truck," his dad's friend offered Tom a job working in California "building rockets" for the space shuttle. At that time, NASA was preparing to fly space shuttles out of Vandenberg Air Force Base and needed shuttles built on the west coast. Tom, "who hadn't done that yet," accepted the offer and went to work for Thiokol in California. It was 1985.

The Challenger disaster of Jan 28, 1986 ultimately led to the cancellation of the space shuttle launch program in California and to the end of Thiokol's work there. In the disaster's aftermath, Tom was transferred to the Thiokol facility near Promontory, Utah and moved back to Brigham City. For Tom, the cancellation of the program was "a ticket home."

Tom worked as test technician, setting up and testing rockets, 1/5 size to full scale, in various configurations and environments. He also ran qualification tests and flight verification requirements tests on the motors and for the shuttle. Thiokol "pushed him through a bunch of schools;" Tom learned I-DEAS solid modeling software. As he recalled, "Back then, it was the only software of its kind." Tom even did some moonlighting using I-DEAS, making solid models for a startup company. Tom continued to work at Thiokol until the early 1990s when he was laid off. He explained, "Once the

³¹ At that time, the Morton-Thiokol Company supplied the solid rocket boosters for the U.S. space shuttles.

shuttle was flying again, Thiokol began to reduce their work force since there was less need for testing. It took several years, but they finally got my number.”

Taking the layoff package from Thiokol, Tom started his own construction company, almost entirely by accident. He explained,

I had over forty acres out in Mantua³² and I bought this backhoe, right? My intention was never to start a construction company but, if you parked a backhoe in your yard, you could do it too. People will come over to your house and want to know, “Hey can you come dig this for me?” or “Can you do this? Well, yeah. I'll do that. And so it kind of morphed from there.

At first, Tom used his construction company to supplement his income from his “day job” working at local company, Vulcraft, as a welder. Later on, when his construction company got big enough—topping out at twenty employees, it became Tom’s sole means of income. Tom ran the company for about more five years and then began to think about what he was doing.

I got tired of it because you'll never work as hard for anybody else as you will for yourself. My girls were little and I came close to getting divorced a second time because I was never there. I was working ten or twelve hours a day. Then I'd have to go home and fix all the stuff the guys broke during the day. It was always one thing or another.

So then I put a pencil to it and figured out I could probably make just as much money working for somebody else when it was all said and done. I had one year where my company made a million dollars, 1.2 million dollars actually. I got to keep about \$60,000 out of that. You know, for \$60,000 -- I'll make \$60,000 running somebody else's company.

At that point, Tom decided to close down his construction business.

Having made the decision to shut down his company, Tom called a buddy and was hired on the spot to work in his buddy’s pipe company. For this job, Tom constantly

³² Mantua, Utah is a small town (population 687 in the 2010 census) located seven miles east of Brigham City.

traveled to places in Utah, Wyoming, Idaho and Nevada to deliver and lay pipe. As Tom noted,

We were usually within three or four hours of home. But four hours away is far -- you're staying -- you're not going to make that commute. So I eventually got tired of that, too.

It was about that time that Tom decided to go back to school. He was forty-four years old. Tom called another buddy at Staker Parson, a local construction services company. Tom asked his friend if he had a job that would keep Tom near home so that he could go back to school. His buddy replied, "Sure. Come on down."

When Tom decided to go back to school "to get a degree," he didn't pursue "just any degree." As Tom explained, he had to get a "useful" degree, one that would lead to a better job than he could currently get. Tom "did a little checking" to see which majors tended to "stay busy" and have the easiest time finding jobs; Tom chose engineering because he found that "engineers in general tend to stay employed." So Tom's goal became to get an engineering degree. Tom explained, "Because that was kind of the whole point. When you're in your forties, you go to school because you want a better job, not because mom's making you go."

Although he had a lot of background in construction and civil engineering trades, Tom decided to pursue a mechanical engineering degree instead of a civil engineering degree. This choice was substantially influenced by the fact that Tom's father was a mechanical engineer. Tom recalled, "I said to myself, 'You know, dad's a mechanical engineer. I'm sure if he can do it, I guess I can do it.'"

Tom had definite expectations for his education. For him, neither time nor money was a limiting factor.

I had the money to do it. It wasn't like money was going to be a problem. And I wasn't who I was thirty some odd years ago, you know, when I said screw it—I don't want to do this anymore. Making a commitment to finishing the degree was in my mind going into this program. I was going to start it and I was going to finish it, you know. I didn't expect to get through it in four years. I certainly didn't expect all the shit that happened to me in the six years that I did it. But I had no illusions about the fact that it was going take me more than four years to do it.

Tom enrolled at the USU campus in Brigham City because it made the most sense—it was a quick, five-minute drive from where he and his family lived outside of Brigham City. Tom worked for Parson's about fifty hours a week and fit classes in classes at the Brigham City campus during the evenings, Monday-Thursday.

Tom started in the fall 2007. During his entire first year he focused on remedial math—Math 0990 Beginning Algebra, MATH 1010 Intermediate Algebra, MATH 1050 College Algebra and MATH 1060 Trigonometry—in order to “catch up with the kids coming out of high school.” Tom joked, he had to make up for “nearly thirty years of hard living.” During this time he also worked on getting his required English, history, and humanities completed. After his “catch up year” when he had the course prerequisites for Calculus I under his belt, Tom enrolled the Associates in Preengineering program in fall 2008.

At that time, the associates in preengineering program was young enough that many of the courses Tom took, especially the engineering courses, were not yet being broadcast and were still taught by traditional “face-to-face” instruction. Tom enjoyed those classes he took early on in the program and pointed out that it was important to him

that all of his instructors on the Brigham City campus “knew him by name.” Tom, in fact, didn't realize he was signing up for distance delivery when he signed onto the Associates in Preengineering program. He recalled,

The distance broadcast class thing was something I didn't even know about really until the first time I took one. Given the choice again, I'd probably do the same thing and go to the Brigham campus instead of Logan. I can't say that I liked the broadcast classes all that well, but they weren't bad.

The thing that concerned Tom most about his synchronous broadcast classes was the difficulty that many instructors seemed to have “seeing” when students at the remote locations were lost or confused. Tom commented that, in the broadcast mode, “It could be hard to stay engaged” when he got lost and the instructor kept going. He explained,

In the small, face-to-face classes, the instructor can look around the room and tell if we are getting it or not. He can tell by the look on our faces whether we're stumped. And, you know, maybe he could go over it a little bit more. When you're on the screen and not in the room, the instructor is just carrying on and doing whatever. Even if he cares, he can't really see what's going on, you know. I didn't really like those broadcast classes for that reason.

Yet despite his dislike for synchronous broadcast delivery, Tom persevered in the program.

Tom's perseverance was tested to its very limits early in March of 2010. On a sunny spring afternoon, Tom's son from his first marriage was killed in a tragic automobile accident that occurred on a winding canyon road through mountains in central Utah. A senior at USU and president of the Gamma Kappa chapter of Sigma Chi fraternity, Tom's son was well known and highly respected for his intellect, leadership abilities, athleticism, and willingness to reach out to anyone. A hugely attended memorial service was held in his honor on the USU Logan campus in the aftermath of his passing.

Tom was devastated by the loss of his son. It took all of his strength, as well as the support of the local community and countless family friends, to make it through those last two months of the spring semester. Through sheer will, Tom graduated in spring 2010 with his associate's in preengineering class. He was chosen to give the commencement speech at the USU Brigham City graduation.

While he earned an associate's degree in preengineering, Tom admitted that he never tried to "put that degree to use." He said, "I never really thought about it since the bachelor's degree had always been the goal. At the time, I looked at the associate's degree as a certificate of completion for the pre-professional program." Considering it now, Tom realized it could have qualified him for a job as a draftsman.

After graduating from the preengineering program, Tom applied and was accepted into the mechanical engineering program on the USU Logan campus. Yet, while Tom was intent on "finishing what he had started," he was still reeling from his loss as the start of the fall 2010 semester drew near. All in all, it took him an entire year to be able to tackle going back into the classroom again.

Tom started the professional mechanical engineering program on the Logan campus a year later, in fall 2011. Based on the advice he received from his Logan campus engineering advisor, he enrolled in the "standard" junior year curriculum for mechanical engineering—which, at that time, consisted of five engineering courses: (Fluid Dynamics, Mechanics of Solids, Advanced Dynamics, Thermodynamics II, and Professionalism/Ethics)—even though he was still working at Parson's. Tom explained,

When I got into the professional program, the advisor there said "Well, you need to take all of the junior year classes for fall semester." She said, "Your junior year

is the hard year for you. You need to take all of those classes.” She was adamant that I take all of those classes. I told her that I was okay with going longer than the two years. She knew I was working. I mean, I told her. I laid it out pretty well for her. But basically the advisor didn’t -- she didn’t care about that. She said, “You might want to cut back your work hours,” which I ended up having to do.

Part of the reason why these courses all had to be taken was that each was only taught during the fall semester and many of them were pre-requisite courses for other courses in the mechanical engineering curriculum. As Tom explained, “If I skipped one or more, it was going to add another year to getting my degree. Might not have been such a bad idea in hindsight.” Tom attributed this schedule as “one of the reasons why I ended up not liking the mechanical engineering professional program as well—because it was a heavy load.”

Tom’s work schedule necessarily changed when he started the professional program in Logan. His boss at Parson’s was willing to work with him to help him get through. Tom’s boss told him, “Do what you need to do. You can come back to full time when you’re done with school.” So, instead of working his typical ten-hour days and going to school at night as he did in the pre-professional program, Tom carefully managed his work schedule so that he could handle the heavy course loads (i.e., nineteen to twenty credit hours). Tom explained,

I would tell my boss to leave me laid-off until the end of spring semester. Either that, or sometimes he’d let me come out, work a day, one day a week or something like that. I was still drawing unemployment so it wasn’t that big of a deal. In the fall especially, I was only working – sometimes I was only working two days a week in the fall.

Tom’s work was sporadic enough that he frequently had to dip into his savings to pay the bills. Tom’s lack of the regular income caused tension between him and his wife. As he

explained, “My wife got a little irate because the money wasn’t coming in. Sometimes I’d forget to get money out of the savings account.”

Tom found the professional program in Logan, as compared to the pre-professional program in Brigham City, to be a “night and day difference.” He remarked, “I don’t think there’s anything that was really an obstacle in the preengineering program. I could list obstacles I faced all day long in the professional program.” High on his list of obstacles were the large classes in his year mechanical engineering courses and the overall lack of “help worth having.” He explained,

I didn't like the way they taught up there in Logan in the professional program. They had 130 kids in a room, you know, and the professor can't look at you and see that you're not getting it like the way they used to be able to do in Brigham City. And they just -- they carry on. They have their agenda.

Trying to get any help if you're behind or you're not getting it is pretty tough there. I worked with the guys that I knew either from Brigham City that I met while I was in there. In class that they said “Hey, we’re going to go study over here, do you want to come over later?” That helped a little but, you know, if everybody was stumped, and nobody could figure it out it was like “Okay, now what?” Now you have to go find professional help and that usually proved to be pretty difficult.

If you went to office hours, there are twenty kids trying to get into the office with probably the same question that you have or, you know, something similar. They took kids in there one or two at a time. You had to wait in line, you had to wait for an hour, you know, and then by the time you got there, “Oh, guess what? Office hours are over, sorry.”

One day, about mid-way through that first fall semester, Tom decided to look for something else. Back when he was at USU in 1981, Tom took a basic, entry level geology class back and really enjoyed it. Also, as he pointed out, “Over the course of my working career, everything I do is outside involving rocks and rock formations.” All in all,

Tom was pretty enthused by geology. So that day, in his frustration, Tom took a walk to visit the geology department that is housed across campus in the College of Science.

I was looking for help one day and I couldn't find anybody to help me. I was having trouble in Thermodynamics II and failing Mechanics of Solids. I was really having a struggle with trying to learn the material. The engineering college had some TAs who were supposed to be the tutors, but they were busy doing other stuff; they weren't interested in helping. Then screw it – I just kind of went looking to see what else was out there. So I wandered down to the geology department. I talked to the advisor. I said, "Alright, look I'm getting, you know, I'm annoyed with the engineering program. What do you guys got?" The advisor laid it all out for me. He said, "We have this engineering plan." He asked me some questions and whatnot, and then he said, "It fits in really nicely with what you're doing. It gives you the geology degree, but an engineering course drive, which you've already got."

With the engineering courses he had taken to earn his associates degree in preengineering, Tom was within two to three semesters of graduating with a bachelor's in geology. Tom told the geology advisor, "Sounds good to me."

Later, Tom sat down with his engineering advisor and told her of his decision to change majors and move out of engineering altogether. She helped him withdraw from his engineering classes prior to the withdrawal deadline. He was refunded his tuition for that semester.

Tom started working toward his geology degree in spring 2012. Immediately, he noticed "big differences" between the engineering and geology culture. Tom explained that in geology you could easily find a professor and see him at office hours, and the classes averaged thirty or less students, except perhaps for a few classes fulfilling general education requirements. Tom continued,

Every one of the professors in geology was very approachable and easy to find. If they said they were going to be in their office, that's where they were with usually not more than one or two people standing there, you know. And they'd answer the

questions. If there was a question that a bunch of people got hung up on— I had one instructor that would say “Alright, everybody seems to be having a problem with this concept. I’ll tell you what. I’ll come up into the break room at, you know, right after this class,” or he would take a poll, “What time works for everybody?”

The geology program was small enough -- it was like Brigham City— it was small enough that the instructors knew you by name, generally. They said, “How are you doing? You got it? What are you having trouble with it?” They could look at you and tell if you were confused just by the look on your face. And I like that—I like that a lot. That means a lot. It’s a better way to learn for me.

In this environment, Tom “started to enjoy himself again” and started to do well in his studies. Tom made the Dean’s List for two semesters. He remarked, “I was pretty proud of that.” He graduated with a 3.4 grade point average and a bachelor’s of science degree in geology in the summer semester 2013. He was fifty years old.

Reflecting on experiences, Tom saw much success even though he did not earn his bachelor’s degree in engineering. He is particularly satisfied with how he became “a better person” by “expanding” his mind in many of the engineering courses he took in the preengineering program. He explained,

There was stuff in the preengineering program that, you know—in Strength of Materials and Material Science—that I never knew—that never even occurred to me. The problems that were presented there I wasn’t even aware of were problems. I didn’t know such things even existed. The preengineering program opened my eyes to a lot of things that are going on. Strength of Materials came in handy in geology because all of the different stresses and shearing that goes on in rock.

Tom also saw a great deal of success in having learned how to learn—“the whole learning thing” as he called it. Tom continued, “I can sit around and help my kids do their homework now. Which, had I not done all this, I’d be going crazy with this common core math.” Finally, Tom felt successful because, by getting his bachelor’s degree, he had finally finished something he’d started back in 1981. He said, “I left something undone,

and I don't really like leaving things undone. Not something that was in my control to finish.”

Tom W.'s epilogue. Another success that came as a result of earning his bachelor's degree was evident in Tom's new ability to land employment that was technically challenging and had higher earning and advancement potential than any of his previous job opportunities did. At the time of his graduation ceremony for his bachelor's degree, Tom had several job offers—more than he could entertain. Tom accepted a very well paying position as a Wireline Engineer for Weatherford International, one of the premier oil and gas service companies in the world. In this “straight up engineering” position, Tom works in the field at oil sites near Casper, Wyoming to extract data from oil wells that extend tens of thousand of feet below the surface of the earth. The job pays well and offers “phenomenal bonuses.” It is clear that Tom met his goal of earning “a useful degree.”

Table 12

Narrative Outcomes: Tom W.

Definitions of Success
<ul style="list-style-type: none"> • Get a useful degree that would lead to better employment opportunities
Barriers to Success
<ol style="list-style-type: none"> 1. Math 2. Lack of engagement and instructor interaction in synchronous broadcast classes 3. Personal tragedy 4. Main campus engineering culture
Actions Taken to Overcome Barriers
<ul style="list-style-type: none"> • Started over in MATH 0990; took an extra year and concentrated on math (1) • Selected face-to-face courses when he could (2) • Took a year off school (3) • Reduced work hours to manage course load in the professional program (4) • Studied with friends from the preprofessional program in the professional program (4) • Left engineering and pursued a degree in geology- engineering track (4)

Note. Number in parenthesis matches the action taken to overcome barriers to the numbered barrier listed above.

Kay: Outside, Looking for a Path Back In

It was 2007 when Kay—estranged from her beloved husband with their three young children in tow—left Phoenix and moved back home to Brigham City to live with her mom. A civil engineer, Kay left her engineering career behind nearly a decade prior to raise a family. Now, she had every intention of reverting to her “default mode”—going back to school—in hopes of refreshing her skills and reentering the engineering workforce.

Kay was raised in Brigham City, Utah in a family of educators and Utah State University (USU) alumni. She grew up surrounded by those who loved to teach and loved to learn and, as she explained, “My education was my whole life.” Wherever she happened to be, Kay worked at improving herself through continuing education. As a full-time engineer, she took masters level courses in the evenings and learned AutoCAD in her free time. Yet, after nearly ten years, her skills were outdated— “computers had come along during those years but I hadn’t”—and her confidence was low. Kay hoped that earning a graduate degree in engineering might be her avenue back into the career wherein she once thrived.

Kay graduated from Box Elder High School, located in Brigham City, in 1978. She was an engaged and interested student who generally got good grades—except, perhaps, in English class. The subject in which Kay most excelled was math. Kay loved math and knew she wanted to make it a career except for one, seemingly small, detail—she didn’t want to *teach* math. She wanted to *use* math. The problem was “in those days

it was all about teaching.” Women who were good at math were almost exclusively offered the option to become teachers. Kay recalled,

Back in those days, all high school counselors had a form. Everybody got called to a counselor’s office so that the counselor could fill out the form. So, my counselor said to me, “Oh, gee, you did pretty good on your ACT courses. Your math was the best. You can be a teacher.” And I said, “No, I don’t want to teach math.” And the counselor didn’t know what to do. So, the next time the counselor called me in, and I said, “No, I don’t want to teach math,” she still didn’t know what to do. So she said, “I’m supposed to fill this out.” I said, “I want to do something *with* math.” And she said, “Well, you can be an engineer.” And I said, “You mean I can drive a train?” And so she wrote engineer down on my form.

The ultimate irony for Kay was that she grew up in a neighborhood in which most of the “dads” were engineers, technicians, and technical managers at nearby ATK-Thiokol³³ or Hill Air Force Base. Kay admitted, “My dad was a school teacher. It’s funny but, at that time in my life, I had no idea what an engineer was.”

Kay’s high school grades and test scores were good enough to earn her an engineering scholarship to USU. It was the fall of 1978. She enrolled at the USU Logan campus because, at that time, there were no regional campuses. Perhaps more important to her current situation, as Kay pointed out, at that time there were no personal computers at USU, either.

Early on in the USU civil engineering program, Kay struggled. She found the classes to be hard and still wasn’t convinced that engineering was for her and felt ostracized by her classmates. She took fewer classes than the recommended engineering course load suggested. Instead of piling on engineering classes each semester, she experimented by taking classes in other majors to see if she could find a better fit yet still

³³ ATK-Thiokol (now ATK Orbital) designs, builds, and supports defense, space, and aviation-related components and systems.

satisfy her desire for using math. At one point she thought she had found an alternative in accounting. One day she asked her accounting professor when they would start using calculus. He replied, “You won’t unless you go on to study accounting theory.” Kay decided to stay with engineering.

Upon finishing her third year in the civil engineering program, Kay took a leave of absence to complete missionary service for her church, The Church of Jesus Christ of Latter Day Saints, in Fresno California. When she returned home after two years, she came right back to school and finished her degree. Kay graduated in 1987 with a bachelor’s degree in civil engineering, almost nine years after she began.

After graduation, Kay went into private practice. She moved to Salt Lake City and worked for a small civil engineering firm. Unfortunately, the boom-bust seasonal nature of civil engineering work ended in her being laid off after only a year on the job. Kay was frustrated.

If I had known how few civil engineering projects come in during the winter, I would have chosen to work for a larger firm that had a better ability to maintain its employee base through the slow periods. At the time I was single, female, and disposable.

Hearing that the civil engineering “business was booming in sun-shiny Arizona,” Kay moved to Phoenix and spent the next three years at several private practice firms. There she found work she loved and got extensive experience on many road design and rehabilitation projects. Yet, after a while, Kay grew tired of big city life and “sitting at traffic lights, which is pretty much all I did.” She also experienced the demands often placed on engineers in private practice. “I got burnt out. There was no such thing as a

forty-hour week. Everybody worked more, a lot more, to meet deadlines.” Kay began to look for employment opportunities in other, smaller cities.

Using connections she made as an engineering co-op student, Kay found a civil engineering position with the U.S. Forest Service in Cedar City, Utah³⁴. The work in Cedar City, however, was disappointing. “It consisted of building roads from incomplete sets of plans. This translated into driving around in a pickup and telling the bulldozer where to go up the mountain.” Kay felt the work was “behind the times” and not nearly technical enough to hold her interest. She took AutoCAD classes just to try to stay up with the rest of the profession.

Kay took the next opportunity to transfer and headed back to Phoenix, but this time with the Forest Service. There she found her true niche. She was put in charge of the design and construction of what was, at that time, the largest campground facility in the U.S. Forest Service. The campground was constructed at Theodore Roosevelt Lake, an expansive reservoir, located about 100 miles northeast of Phoenix, formed by Theodore Roosevelt Dam on the Salt River. The project consisted of designing and building over 400 campsites, 15 toilet buildings and the accompanying water system, three boat ramps, 10 playgrounds, and a 500 unit parking lot with accompanying access roads. As the project manager, Kay advised many younger, dynamic civil engineers and did what she considers the best work of her career. She stayed at the Forest Service long enough to oversee construction and watch the project come to fruition. “Those were great days,” Kay remembered.

³⁴ Cedar City is located approximately 330 miles south southwest of Logan, Utah.

During this same time, Kay met her husband and the two married in 1993. After several years trying to conceive and/or adopt a child, they finally got the news that their adoption request had come through. Kay and her husband adopted a baby boy in 1998. After taking maternity leave and struggling to juggle the time demands of engineering work upon her return, Kay decided to stay home with their new baby. In 1999, Kay left the Forest Service to become a full-time mom and the family lived frugally on her husband's salary. Five years later, in 2003, Kay and her husband added to their family by adopting two babies, a boy and a girl, from an orphanage in Russia. "It was a great life, with the white picket fence and all."

Thirteen years of happiness all came crashing down the day Kay received a phone call from the bank saying that the mortgage bill hadn't been paid.

Kay was shocked to discover that her husband suffered from a well-hidden gambling addiction. It took Kay about a year to work through the details of a legal separation from her husband. The divorce decree came several years later, after years of unrequited waiting for professional help to cure the gambling addiction that ruined her family's financial security. Kay knew that providing a stable, consistent lifestyle for her children was paramount to their well-being; Kay stayed in Arizona and lived for about a year on no income with help from her siblings. Knowing, too, that her she needed health care insurance for her family, Kay found a job in Ogden, Utah and moved her family into her childhood home with her elderly widowed mother.

To have some family income and secure health insurance for her children, Kay found seasonal work with the Internal Revenue Service (IRS). She worked through the

grind and physical trauma of swing shift with three children for a while and then was lucky to secure daytime hours. The seasonal position was important to Kay at that time because it allowed her to be at home with the children during the summer season when there was no work. Yet, while the job provided some of the money and the health insurance benefits that Kay and her family desperately needed, it was mundane, at times very stressful, and nothing Kay felt suited to do.

What I do is in the IRS department of code and edit and in the forms department. I check and make sure there's a name on the return, a social security number, and then I go down the return and check for other specific pieces of information. I have a red pen and I mark things on a return. I also have to look for certain forms. There are about 20 different forms we look for and none of them are the same. There's no rhyme or reason to any of it. So some days it feels like I pull staples off of returns all day. It's kind of a joke; I tell my children I pull staples all day. Some days with certain forms, that's about all you do is separate forms. Other times, it is much more complicated.

Kay often referred to her IRS employment as a "sweatshop." The faster you worked, the higher up you got, and the more you got called for additional work. She explained,

Most people want to be called. I am a real rarity in that I don't want to be called as much. I still try and do my best but I don't really care if I am at the top of the sweatshop. But, now, my children are getting older. And it costs more money. Plus, my mother is to a point where she is getting older too. So I'm in a financial pinch. And I need to be called back more to keep my medical insurance.

Kay summed up her situation: "The professional part of me really needs engineering again, but I can't figure out how to make it all work to get back in."

In 2008, at the age of forty-eight, Kay mustered her confidence and made her first attempt to go back to school. She went to the USU Logan campus and inquired about enrolling in the civil engineering masters degree program. The response she received was

truly disheartening: Kay's undergraduate grade point average was too low to qualify for the masters degree program. There was nothing that could be done.

Kay talked to several professors in the civil engineering department for advice about how she might go about getting into a masters degree program. In an ironic twist of fate, a few of the civil engineering professors she talked to had been her classmates and friends in the undergraduate program. Kay felt like she could talk openly and candidly with them about her desires and her doubts. She went on a tour of the Water Research Laboratory and thought "Oh, when I grow up that's what I want to do!" But figuring out how to get to that point was difficult.

Kay began to consider going back for a second undergraduate engineering degree. So, then I thought, oh dear, I'm going to have to figure out what to do on my own. I finally figured out I can get a second undergraduate degree, and it doesn't cost as much money if you're just doing you bachelor's. And then I thought, if I get to that point, then I could go ahead and slip into a master's.

After even more inquiries, Kay found out additional unfortunate news: She couldn't qualify for scholarship funding because she had already completed an undergraduate degree. If she had left just one course unfinished, there were many avenues for her to receive financial help. But, because she had completed her bachelor's degree, she didn't qualify. This meant she'd most likely have to take evening classes in order to fit school around her increasingly busy and erratic work schedule.

Desperate to get started, Kay decided to enroll in a full load of mixed courses at the Brigham City regional campus in the fall of 2009. Her goal that first semester was to see if she "could still handle a full load." One of the courses she took was Introduction to Engineering taught as part of the Associates in Preengineering program. Although she

wasn't officially enrolled in the preengineering program, the Brigham City advisor let her take the course—something that she was barred from doing on the Logan campus.

Tragically, a few weeks into that semester, Kay noticed a lump on her eleven-year old son's neck. After multiple doctor visits, medical exams, tests, and waiting for confirmation, her son was finally diagnosed with Hodgkin's lymphoma. Kay dropped her courses, leaving full tuition on the table, to care for her son while he went through treatment and recovery.

Even though she had to drop that first engineering course, Kay felt that something extremely positive occurred during her short-lived experiences in that class. She explained, "When I was in the lab talking with a bunch of engineering students again, it made me realize that yeah, I belong back here in engineering." Kay's experiences in that course gave her the confidence to continue.

Thankfully, Kay's son fully recovered from the cancer. Still, Kay found living through the whole experience to be extremely "unnerving" and it took until the fall of 2011 before she felt things were settled enough for her to enroll in another course. This time, Kay chose to enroll in Engineering Statics because, as she stated, "I needed to know if I still had a brain left." Kay honestly wondered if she could still perform analytical engineering work after the mental and emotional trauma she'd experienced in recent years.

Kay not only completed the Engineering Statics course, but she did extremely well—earning an A and the top score in the class. The discovery that she could still do the work and do it well provided a huge boost to both her confidence and her motivation

to get back into an engineering career. Kay felt that her experience in the course was a rousing success.

Kay was also happy that she learned some basic yet still important technical skills related to computer use by taking this course. The instructor required students to go online to the course website to get assignments, check grades, and do other administrative tasks. Kay, having virtually no computer experience and no computer at home, was literally dumbfounded, at first, by these course requirements.

“I never even learned how to type. My father insisted I didn’t need to. It was the 1980s and I wasn’t going to be a secretary.”

Thankfully, the regional campus provided all day and evening access to a computer lab “where the computers were already set up!” Kay took full advantage of the lab and the tremendously helpful assistants who patiently answered her very basic computer questions without so much as a smirk. She appreciated the fact the computer assistants they never made her feel silly or dumb for the computer questions she asked.

Kay also noticed something important about her fellow engineering students while taking that Statics class. Despite being the only female student in the class—just like thirty years earlier—her male classmates this time around seemed to be both accepting of her presence and interested in what she had to say. Kay attributed some of this accepting attitude to the tone that the instructor—who was also female— set. Yet, the acceptance she felt differed so substantially from the isolation she felt in the male dominated engineering classes of the late 1970’s and early 1980’s that it empowered her. Kay got excited thinking how the engineering profession itself may be evolving.

While taking the Statics course in the preengineering program had been a hugely successful experience, Kay realized that simply retaking lower level engineering courses that she'd already had probably wasn't the best strategy for her at this point. Perhaps, if she could retake some of the upper level courses she had done poorly in and earn higher grades, she could slowly bring her grade point up to meet the qualifying cutoff for civil engineering graduate school. In order to accomplish that, since only lower level engineering courses were taught at the regional campuses, she'd somehow have to get permission to retake the engineering classes she needed in Logan without actually enrolling in a degree program. Kay went from feeling frustrated, to feeling hopeful, back to feeling frustrated.

Kay's epilogue. Currently mired deep in the quandary of reentry, Kay feels as if time is running out for her and her dream of getting back into the engineering profession. She explained,

I am fifty-five now. Are people going to hire someone at age sixty? I don't know. My reentry is a lot different than most because I've already done the hard part. I've already done the engineering part. But the system is just not set up to accommodate someone like me.

Now, the most promising path for Kay back into engineering seems to lie outside of the Engineering College. She said, "When I came back to USU, I automatically came to the engineering college. I never thought to look for options in another college." One day, while scouring through all of the degree options offered at USU, Kay happened to run across an undergraduate degree in hydrology offered in the College of Natural Resources. "I could get a second degree in hydrology. That fits in well with civil engineering and

with my experience. I'll still have my engineering degree and my skills will be up to date. I'm not entirely sure it will work, but right now it's the best hope I've got."

Table 13

Narrative Outcomes: Kay

Definitions of Success
<ul style="list-style-type: none"> • Regain professional confidence by doing well in courses • Gain computer skills necessary in the contemporary engineering workplace • Develop a sense of belonging with male engineering peers
Barriers to Success
<ol style="list-style-type: none"> 1. Personal trauma and ensuing lack of self-confidence 2. Accessing preprofessional courses without enrolling in the program 3. Balancing family and work requirements to be able to attend school 4. Lack of computer skills made learning in a distance delivery environment difficult
Actions Taken to Overcome Barriers
<ul style="list-style-type: none"> • Took night classes at the regional campus (1, 2) • Took low level classes to test abilities and gain confidence (1) • Took classes when seasonal work schedule would allow (3) • Took classes at own pace (3, 4) • Clarified online assignments with instructor (4) • Sought assistance at regional campus computer lab (4) • Took computer classes at local technology college (4)

Note. Number in parenthesis matches the action taken to overcome barriers to the numbered barrier listed above.

Narrative Outcomes of the Remaining Seven Participants

In this final section of Chapter IV, the success measures, barriers to success, and actions taken to overcome barriers to success that were reported by the seven remaining participants are summarized and presented in Tables 14-21. While the co-developed narratives for these participants are not presented in the main body of this chapter, they are provided in their full-form in Appendix J for those desiring access to them.

Joe: In It for the Long Haul

Joe recently transferred to the mechanical engineering professional program after spending six years in the preprofessional program earning his associate's degree in preengineering. Employed as a heating, ventilation and air conditioning (HVAC) technician for Orbital ATK, Joe hopes to move into a facilities engineering position once he graduates.

Table 14

Narrative Outcomes: Joe

Definitions of Success
<ul style="list-style-type: none"> • Earn a mechanical engineering degree while maintaining job performance • Learn how to think like and do the job of an engineer
Barriers to Success
<ol style="list-style-type: none"> 1. Math instruction and low expectations of math instructor 2. Balancing work, school, and family 3. Engagement and instructor interaction in synchronous broadcast classes 4. Logistics of transitioning to main campus
Actions Taken to Overcome Barriers
<ul style="list-style-type: none"> • Started at MATH 0900, focused on math first (1) • Took classes at slower pace (1) • Strategically picked math instructors (1) • Studied almost exclusively on weekends (2) • Gave up critical family time (2) • Worked extra during week so could concentrate on school on weekends (2) • Strategically picked instructors who were “good at” synchronous broadcast (3) • Moved to swing shift (4)
Note. Number in parenthesis matches the action taken to overcome barriers to the numbered barrier listed above.

Tom D.: It's all About Balance

After spending seven years in the preprofessional program, Tom began his final semester of the civil engineering professional program in the spring of 2016. Tom is employed by the Logan City Engineering Department as an engineering technician and hopes to move into a civil engineering position there after he graduates.

Table 15

Narrative Outcomes: Tom D.

Definitions of Success
<ul style="list-style-type: none"> Earning an engineering bachelor's degree while maintaining a balance between work, family and school
Barriers to Success
<ol style="list-style-type: none"> Limited time to balance work, family, and school Tendencies toward strategic learning approaches Logistics of transitioning to main campus Main campus engineering culture
Actions Taken to Overcome Barriers
<ul style="list-style-type: none"> Found curriculum online and made won schedule (1, 4) Took preprofessional classes only two nights per week (1) Used Sundays as homework/study days (1) Accepted B's and C's as good enough (2) Earned employer trust and confidence to get work flexibility in professional program (3) Took professional courses at a pace he thought he could do (4) Changed study habits; worked with friends form the preprofessional program in the professional program (4)

Note. Number in parenthesis matches the action taken to overcome barriers to the numbered barrier listed above.

Mike: A Work—School Symbiosis

Mike worked his way up from a technician job to a full time position as a mechanical engineer with TCR Composites, Inc. while simultaneously earning his bachelor's degree in mechanical engineering. The relationship that Mike and his employer shared was seen to be mutually supporting and beneficial in several ways.

Table 16

Narrative Outcomes: Mike

Definitions of Success
<ul style="list-style-type: none"> • Learning how to study in engineering courses • Earn an engineering degree as quickly as possible • Work and maintain health benefits while going to school
Barriers to Success
<ol style="list-style-type: none"> 1. Getting placed into Calculus I 2. Rigid course scheduling that is not conducive to work in professional program 3. Main campus engineering culture
Actions Taken to Overcome Barriers
<ul style="list-style-type: none"> • Took Accuplacer test four times (1) • Sought special permission from math department to place into Calculus I (1) • Worked odd night hours to take professional courses that were spread out throughout the day (2) • Took an extra semester in the professional program (2) • Studied with a friend from the preprofessional program in the professional program (over the phone) (3) • Got solutions manuals from a friend in the professional program (3)
Note. Number in parenthesis matches the action taken to overcome barriers to the numbered barrier listed above.

Jaxon: School First

Once Jaxon made the decision to pursue his engineering bachelor's degree, he remained laser-focused on his studies until he reached his goal. At first, Jaxon benefitted from the hands-on experience and mentorship he received while employed in technician roles during the preprofessional program. Later, when Jaxon stopped working to concentrate on his studies, he was able to fund himself through school using the money he saved while working since high school. Jaxon easily found employment as a mechanical engineer upon his graduation from the professional program.

Table 17

Narrative Outcomes: Jaxon

Definitions of Success
<ul style="list-style-type: none"> • Earn a bachelor's degree in mechanical engineering • Get a mechanical engineering job in Utah
Barriers to Success
<ol style="list-style-type: none"> 1. Math 2. Financing school 3. Main campus engineering culture
Actions Taken to Overcome Barriers
<ul style="list-style-type: none"> • Started at MATH 1010 (1) • Never stopped taking math (1) • Took classes in the summer (1) • Made his own course schedule (1) • Sough out advice about courses from engineering mentors at work (1) • Worked his life around earning money for school (2) • Worked full time and saved; tuition reimbursement was a job requirement (2) • Prepped for class; studied more after class (3) • Tried to attend study groups when could (3)

Note. Number in parenthesis matches the action taken to overcome barriers to the numbered barrier listed above.

Daniel: Plan Your Work—Then Work Your Plan

A homeschooled entrepreneur with three businesses under his belt prior to going to college, Daniel used his keen ability to plan to see his way through engineering education as a nontraditional student. Upon completing the preprofessional program, Daniel was awarded the prestigious Department of Defense (DOD) Science, Mathematics and Research for Transformation (SMART) Scholarship. This scholarship funded his studies for three years and incurred a work commitment as an engineer for the DOD after graduation. Daniel graduated with his Master's Degree in Electrical Engineering (with research thesis) in just 5 ½ years.

Table 18

Narrative Outcomes: Daniel

Definitions of Success
<ul style="list-style-type: none"> • Better his life through education • Earn an engineering bachelor's degree in four years (beat national average) • No/limit debt incurred while pursuing education
Barriers to Success
<ol style="list-style-type: none"> 1. Lack of confidence he could be successful in school 2. Psychological/demotivating effect of lower grades 3. Logistics of transitioning to main campus
Actions Taken to Overcome Barriers
<ul style="list-style-type: none"> • Started at MATH 1010 at another community college to test the waters (1) • Limited his credit hours, took classes at a slower pace (1) • Took classes in the summer to stay on time table (1) • Planned extensively (1) • Consciously accepted he was succeeding even if he didn't earn all A's (2) • Made major changes in family personal finances (2) • Accepted SMART scholarship (2)
Note. Number in parenthesis matches the action taken to overcome barriers to the numbered barrier listed above.

Skyler: Flexibility Was the Key to Moving Ahead

After eight years, Skyler is set to graduate with this bachelor's degree in civil engineering in spring 2016. Because his goal to pursue an engineering career came out his desire to be a solid and stable family provider, Skyler took the inevitable twists and turns of his engineering education in stride. By changing engineering majors in the professional program, he enabled himself to reach his ultimate goal.

Table 19

Narrative Outcomes: Skyler

Definitions of Success <ul style="list-style-type: none"> • Earn an engineering degree as quickly as possible while supporting his family • Find a long-term career in engineering
Barriers to Success <ol style="list-style-type: none"> 1. Finances- affording things he needed for school like high speed internet 2. Limited time to balance work, school, family, and self-care 3. Tendencies toward strategic learning 4. Logistics of transitioning to main campus 5. Main campus engineering culture
Actions Taken to Overcome Barriers <ul style="list-style-type: none"> • Used internet at parent and work (1) • Used weekend as homework days (2) • Used schedule flexibility at work (2) • Worked ahead in school to prepare for work contingencies (2) • Strategized homework preparation; used solutions manuals (2) • Accepted C's and D's as good enough (2, 3) • Found a job compatible with daytime courses (4) • Earned respect at work which led to work hour flexibility (4) • Studied with friends from the preprofessional program in the professional program (5) • Changed engineering majors (5)

Note. Number in parenthesis matches the action taken to overcome barriers to the numbered barrier listed above.

Connor: Dedicated to Doing What He Loves

Connor had a natural inclination for designing and building dynamic, mechanical systems. Despite his keen interest and innate ability, he struggled with working and going to school. Instead of changing engineering majors, Connor opted to pursue a mechanical engineering technology degree at another institution.

Table 20

Narrative Outcomes: Connor

Definitions of Success
<ul style="list-style-type: none"> • Gain experience applying engineering principles • Earn a bachelor's degree in mechanical engineering
Barriers to Success
<ol style="list-style-type: none"> 1. Poor high school preparation—especially in math 2. Financing college 3. Combined psychological stress of jobs and school 4. Main campus engineering culture
Actions Taken to Overcome Barriers
<ul style="list-style-type: none"> • Retook MATH 1050 (although had it in high school) (1) • Took classes in the summer (1) • Enrolled at regional campus instead of main campus (1) • Worked multiple jobs to save up money (2) • Learned how to machine and took machining jobs (2) • Took out student loans in professional program to concentrate on school (2) • Sought counseling (3) • Participated in an extracurricular engineering design project to improve confidence and feelings of self-worth (3) • Went to see advisors for help (4) • Petitioned expulsion from mechanical engineering program (4) • Changed majors and universities (4)

Note. Number in parenthesis matches the action taken to overcome barriers to the numbered barrier listed above.

CHAPTER V

DISCUSSION

The discussion chapter is divided into two sections. First, I present an emic essay that describes my path taken toward an emic, or insider, understanding of the stories told to me by the participants in this study. This insider awareness helped me to conceptualize the participants' experiences in terms of their own beliefs and value systems. Second, I discuss the analysis of participants' narrative outcomes and how the reported results support, extend, and contradict the literature.

Toward an Emic Understanding

A key methodological goal of this study was to co-develop chronological narratives—from an authentically emic, or insider, perspective—based on each participant's experiences negotiating an alternative engineering education pathway. The narratives were intended to serve two cross—yet complementary—purposes: a) to stand on their own as “intuitive and empathetic” (Jingfeng, 2011, p. 78) “windows” (Chase, 2011, p. 424) into the real-life experience and meaning of nontraditional engineering undergraduates (i.e., narrative presentations with an emic, or cultural insider, perspective) and b) to serve as a refined dataset for cross-case comparative analysis of the narrative outcomes across participants (i.e., a cross-cultural analysis from the etic, or cultural outsider, perspective). Fulfilling these purposes required my role to fluidly transform during the research process: first from researcher (outsider) to trusted confidant (insider), in order to understand and document the “culturally specific...beliefs, thoughts and attitudes” of

each participant, and then back from confidant (insider) to researcher (outsider) to compare and extract “culture-free features” from the detailed experiences of the participants (Jingfeng, 2011, p. 77).

As the audience for this work will, undoubtedly, be other engineering educational researchers and practitioners, it is likely that readers will approach this text with, or from, an etic perspective (Feldon, January 21, 2016). The intent of this essay, therefore, is to provide connecting bridges between the dichotomous yet complementary perspectives (etic and emic) of the participants’ experiences that are described in this work. By establishing these easily traversable connections, I hope that the potentially divergent perspectives can work to inform and refine one another.

Coming to Empathy

My path for conceptualizing the nuanced meanings that participants’ assigned to their own experiences as nontraditional students in engineering was painstakingly cut over a seven-year period. This work began in January 2009 as I was hired into the engineering transfer program. When I began teaching at the USU Brigham City regional campus, the program was in its infancy and little local knowledge existed among program faculty and administrator about the nontraditional engineering student culture.

During time spent in the classroom and “on the screen” with students in the program, I began to form my own “ethnographic sensibilities” (Gubrium & Holstein, 2009, p. vii)—or personal feelings of appreciation and responsiveness—to their local contexts, perspectives, and practices. I entered the program as a practiced adjunct instructor with experience teaching undergraduate courses within USU’s mechanical

engineering department. Personally, I felt I understood the challenges associated with instructing traditional engineering students well. I was also keenly aware of my disadvantaged status as a female engineering “instructor” who did not have the instant credibility associated with having earned a terminal degree in a discipline of engineering.

While teaching traditional engineering students had been challenging, I anticipated a tougher go teaching engineering to nontraditional students. I expected to face considerable objection, challenge, and resistance, especially from students employed in the technical trades. At the time, I questioned how seasoned technicians and tradesmen—hands-on, skilled laborers employed in male-dominated workforces—would respond to theoretical engineering instruction provided by a middle-aged female who, unlike her colleagues, was not a “real professor.”

Much to the contrary, students who expressed interest in learning, manifested personal humility, and expended considerable effort greeted me. Many students were respectful and displayed interest in my prior experiences as a military officer and professional engineer. Surprisingly, I felt comfortable as a female instructor—more comfortable than I felt teaching engineering to traditional students—and started to see my age and prior work-related experiences as positive factors in my instructional role in the program. Sensing this connection with students, I encouraged them to recount on-the-job stories—not only to draw parallels to the engineering principles we discussed in class, but also in hopes of getting to know them on a more personal level.

As conversations continued during breaks and sometimes even after class, students and I became better acquainted. I learned who worked and where they were

employed, who was married, and who had children. Over time, I became increasingly privy to the situational constraints that many faced. For example, I learned how students who were employed full-time and attended class during weekday evenings often did coursework and studied, alone, on weekends. Consideration of these learning practices, which differed markedly from the more traditional engineering student practice of working with peers in groups, caused me to rethink how I assigned and supported out-of-class assignments.

I experienced other situations, too, that pushed and prodded me toward a broader reconsideration of my instructional practices: apologetic students who rushed into class late—or missing class altogether—when employers required them, unexpectedly, to work overtime; exhausted students who struggled to stay awake after sleepless nights with young children; anxious students who asked for assignment make-ups or due-date extensions as they managed critical course requirements amid major life events such as impending marriages, anticipated births, and unanticipated funerals. These situations—that frequently played havoc with carefully outlined course schedules and policies—frustrated me. Yet, the more I experienced these encounters, the more I came to see them as reflections of underlying cultural goals and values, rather than as isolated actions of miscreant students.

At the time, this shift of thinking had been revelatory. As I moved from considering the causes of emergent teaching challenges as aberrant to seeing them as culturally foundational, I became free to reshape and expand my teaching practices in new and impactful directions. And, perhaps most importantly, this shift provided me

freedom to see myself—not me, the eighteen-year old, fresh out of high school engineering undergraduate of thirty years prior, but the current me who relentlessly struggled to concurrently fulfill roles as parent, spouse, engineering instructor, and Ph.D. student—mirrored in the lives of the nontraditional undergraduates. Catching my own adult reflection in this way turned out to be the key that unlocked my empathic consideration and understanding of the nontraditional engineering student cultural context.

Confronting Personal Bias and Deficit Thinking

While coming to empathy was a critical milestone along the path of my thinking about nontraditional student experience in engineering, it was not the final destination of my understanding. Linking my personal experiences—not only as a traditional engineering undergraduate many years ago but also as a nontraditional parent-spouse-employee-student today—to theirs, I developed an understanding of their actions, choices, and decisions while growing immensely as an instructor. Yet, to fully comprehend what it meant to be “nontraditional” for the purposes of this research, I had to face my own inner doubts and misgivings concerning the capabilities of nontraditional students to persist and ultimately succeed in engineering education.

When I embarked on this Ph.D. dissertation project in the fall of 2014, I was five years into my tenure as an engineering instructor and three years into my doctoral program in engineering education. The choice of topic for my dissertation research—nontraditional student experience in engineering—had come rather easily to me.

Professionally, my doctoral studies up to that point had clearly illustrated the potential of new knowledge in this area to strengthen current efforts to broaden access to undergraduate engineering education and create a more diverse and socially representative engineering workforce. I was eager to explore this area of educational research that targeted social justice within my chosen profession.

I had personal interests for pursuing this line of inquiry, too. Coming, myself, from deep within the dominant engineering education culture of exclusivity that works to prize academic preparation and achievement above other skills and attributes, I was (nervously) curious about how these nontraditional students made sense of their experiences as they attempted to infiltrate the engineering academic context using an unorthodox route. This long-standing cultural bias, which favors formal instruction and academic performance, supports a pervasive stereotype within engineering education. This stereotype suggests that traditional students, due to recent high school preparation, polished mathematical skill, and freedom from work or familial responsibilities to focus on academics, are the preferable, ideal engineering students. At the same time, this stereotype neglects other forms of social and cultural capital that nontraditional students in engineering are more likely to possess (e.g., professional commitment, resilience, hands-on skills, self-efficacy, organizational skill, time-management skills, social support, etc.) due to informal learning experiences they have engaged in since high school. In its extreme, this stereotype lures faculty and administrators into preferentially welcoming full-time, non-working, residential students with excellent standardized test scores and outstanding grades into engineering programs of study.

Although I taught in a program specifically aimed at providing engineering access to nontraditional students, I admit that this ingrained engineering cultural bias often led me to doubt their capacity to survive, let alone thrive in, these educational pursuits. This type of thinking, known as deficit thinking, led me to worry about the fate of students who transferred and to question whether former students would deem their experiences in the program as positive and beneficial in retrospect. It was the process of interviewing nontraditional student participants and analyzing the qualitative data through narrative co-construction that laid bare this contradiction residing among my thoughts, attitudes, and practices.

My doubts in the ability of nontraditional students to succeed in engineering were largely due to what I was trained to view as deficiencies—attributes that nontraditional students generally lacked—in comparison to what traditional engineering students typically had (e.g., financial/parental support, academic knowledge, mathematical skill, recent formal instruction, study skills, pure academic focus, etc.). This way of thinking is called deficit thinking because it places responsibility for the failure of a social or cultural group (e.g., nontraditional students in engineering) on the perceived deficiencies of that group rather than on the structures, practices, and policies that are in place to serve that group. Deficit thinking is potentially harmful because it often calls for change to occur within marginalized social groups that do not possess adequate resources and agency to affect positive and lasting change.

At first, as I sampled for volunteers and conducted the initial interviews, I sensed the deep appreciation that participants had for—what they considered to be—

opportunities provided by the program. I had many more volunteers than I needed and was heartened by former students' visible expressions of enthusiasm for the research. Several commented to me concerning their feelings of gratitude for the program and how they would not have tried to become engineers without it. These early insights spoke to me not only about the exclusion the nontraditional students felt, but also about the level of courage, commitment, and resiliency they summoned in order to go about the process of becoming engineers. These initial insights were expanded and deepened as I conversed with participants during interviews, listening to their stories of often difficult and sometimes emotionally painful experiences.

Later, as I worked with the data to chronologically order the events that the participants described in preparation for narrative co-construction, I was confronted by the non-linearity and personalized nature of each of the participants' experiences. The interwoven complexity of participants' experiences—at first as they came to pursue engineering as a career and later as they balanced employment, formal education, and family—often made the step-by-step ordering of events arduous. It was easy to see how situational and dispositional barriers—those inherent to “being nontraditional”—worked to complicate and contextualize the participants' educational pathways.

The common understanding within engineering education suggests that these sorts of complexities work against student success and that a timely, ordered, linear progression through engineering curricula is key to undergraduate degree completion. Moreover, time to graduation is another a metric often used to motivate engineering students to “stay on track”; concern is voiced that students will “forget what they learned”

in secondary education or prerequisite courses if engineering study is not begun immediately after high school and follow-on courses are not taken soon after completing pre-requisites. Imprinted by and sensitive to these arguments, I was struck when I noticed something different occurring in the data. I noticed that many “nonlinear experiences”—those that led or kept nontraditional students off the standard curricular track and pace of formal engineering education (e.g., working full-time, taking a gap year between high school and college, or being homeschooled)—actually helped to promote positive engineering educational outcomes for the participants instead of acting as deficiencies or deterrents to their becoming engineers.

Recognizing the effect of ingrained bias on my perceptions of nontraditional students capabilities, I realized that I had to break free from deficit thinking in order to adopt a truly emic perspective in this research. Therefore, I purposefully worked to change my conceptualization of the differences I saw between the nontraditional student culture I was researching on the one hand and my knowledge of traditional engineering student culture on the other. Instead of instinctively perceiving differences within the nontraditional student culture as deficiencies, I challenged myself to see differences as signposts that signal alternative forms of socio-cultural capital—capital that is uniquely possessed by nontraditional students yet overlooked and undervalued in engineering education.

Empowered with this new way of perceiving difference, I became better equipped to sense potential for success as lived and felt by those within the nontraditional student culture. It soon became easy to pick out specific examples of difference acting as capital

to support nontraditional student success. Employment or religious service after high school provided participants time and means to thoughtfully consider their choice of career. Rooted in understanding of what engineers do and not necessarily on a list of academic subjects in which they excel, an advisor's guidance, or parental influence, the participants entered engineering education with confidence in their career choice. Some began coursework with substantial engineering self-efficacy due to their technical work experience and the mentoring they received on the job from practicing engineers.

Perhaps due to their strong commitment to a career in engineering, several participants brought with them a desire to go beyond surface learning and used their previous experience to deeply explore the concepts and principles they learned in class. Mutually rewarding relationships with local industry enabled several participants to gain valuable engineering-related experience—and follow-on engineering employment—while working toward their degrees. Attending college close to home enabled many to leverage support from family members, long-time friends, and community contacts. The circumstance of being financially self-supporting starting a family provided many with extraordinary drive and focus in their studies.

Because of my experiences teaching and researching with nontraditional engineering students, my own understanding of what it means to become an engineer has evolved and grown. I have learned that formal engineering education, while a critical component to this process of becoming, is but one piece of a complex puzzle. I am now freer to envision new ways to fit the pieces together.

Comparison of Narrative Outcomes

The work of ordering and synthesizing data and co-creating chronological narratives for and with each nontraditional student participant helped to illuminate several key outcomes of this study related to the research questions:

1. Within the context of alternative engineering transfer program, how do nontraditional engineering students define success?
2. *Within the context of alternative engineering transfer program*, how do nontraditional engineering students experience success?
 - a. Sub question: What are the major barriers to success experienced by nontraditional students?
 - b. Sub question: What are the actions and base of knowledge that enable nontraditional students to overcome these barriers?

The key outcomes of this study are: a) participant views of success were contextual, relational, and reflective of long term goals that often evolved or solidified during the educational process, b) participants worked to overcome barriers to success in the alternative transfer program through highly personalized action, c) the alternative transfer program worked to promote participant success in several mutually supporting ways related to employment, academic environment, and community support, and d) pathways to engineering and engineering–related careers were pursued outside of traditional engineering degree programs. The first three outcomes were considered important because they appeared consistently across many/most of the nontraditional

student experiences represented in this study. The fourth outcome was considered noteworthy due to the insights it offers to curriculum developers and advising staff within engineering education. In the following sections, I discuss how these narrative outcomes support, contradict, and extend the literature related to nontraditional student success and student persistence in engineering education.

Success is Contextual, Relational, and Reflective of Long Term Goals (Answers Research Question 1)

Participant Success Measures Compared with Those Reported in the Engineering Education Literature. In exploring the ways in which the participants defined their own success as engineering students, the multi-faceted nature of the construct of student success (Seymour & Hewitt, 1997; van den Bogaard, 2012) was evident. (Measures of personal success reported by each participant are summarized in Tables 7-20 in Chapter IV.) Most participants listed more than one personal measure or definition of success. As shown in Table 21, many of the varied ways in which traditional student success is defined within the engineering education literature (e.g., degree attainment, grade achievement, persistence or intentions to persist in a degree major over time, and re-enrollment) (van den Bogaard, 2012) were reflected in the success measures that the participants used to judge their own experiences in engineering education.

Eleven participants considered that earning an engineering bachelor's degree was a summative or cumulative measure of their overall educational success. Several (six) participants considered grades in engineering, especially in the preprofessional program, to be formative indicators of their success. Many of these participants indicated that

Table 21

Participant Success Measures Reported in Engineering Education Literature

Success Measure	Participants	Used as Success Measure in Engineering Education Literature
Earn engineering bachelor's degree	Skyler, Tom A., Clair, Daniel, Connor, Tom, Brad, Joe, Mike, Jaxon, Tom W.	Moller-Wong and Eide (1997)
Get good grades in engineering program	Cade, Mike, Tom A., Kay, Brad, Clair	Baldwin (1993); Haemmerlie and Montgomery (2012); Suresh (2006)
Persist in engineering major	Clair, Cooper, Brad	Cech et al. (2011); Lent et al. (2013); Litzler and Young (2012); Suresh (2006)
Re-enroll in engineering program	Cooper	Haemmerlie and Montgomery (2012); Ohland et al. (2008)

Note. Kay already earned a bachelor's degree in civil engineering and is attempting to reenter the engineering workforce after an extended break in employment as an engineer.

earning good grades in the preprofessional program increased their confidence and engineering self-efficacy. Persistence in a chosen engineering disciplinary major and re-enrollment on a semester-by-semester basis were other ways that participants assessed their success. All of these success measures were previously recorded in the engineering education literature as shown in Table 21.

Contextuality of common success measures. Moreover, many of the traditional success measures found in the engineering education literature (Table 21) carried substantive contextual undertones when described by the participants. One example of the contextual nature of these success measures was seen in the participants' considerations of using grades to indicate success. Four students (Cade, Mike, Tom A., Kay) who listed grades as a measure of success had been high achieving students in high school. Based on their high school experience, they easily connected grades with success.

These students considered good grades to be “mostly A’s” (Mike), especially during the preprofessional program. Each of these students expressed the idea that getting “good” grades improved their confidence and helped them feel that they could do (or, in Kay’s case, could still do) engineering.

Yet, the meaning assigned to the word “good” in “good grades” was seen to be mutable when considering the experiences that other participants shared. Brad, who had been a hard working—but not an exceptionally high achieving—student in high school considered “good” grades to be “no D’s and no repeats.” Grades above this level would be sufficient to keep him safe from the administrative rules governing courses failures and repeats in both the preprofessional program and in the professional program in his major of mechanical engineering.

Clair, who admitted that he had not tried very hard in high school (except in automotive class), came to view grades as a measure of success only after he earned high marks during his first semester in the preprofessional program. Prior to completing his first semester in the preprofessional program, Clair considered “doing as well as he could” and “trying hard” as being successful. Cooper, who had struggled substantially while moving in and out of several high schools, likened success simply to “survival” in engineering and persistence within the major without any mention of grades. Cooper’s fierce determination to continue in engineering education led him to search for other nearby engineering programs that would allow him unfettered re-enrollment. In the event that he was unsuccessful the USU preengineering program (due to an excessive number of course failures), Cooper was determined to re-enroll at another institution. Thus,

Cooper saw dogged persistence toward his goal of becoming an engineer, rather than his grades, as a formative measure of his success.

Table 22

Participant Success Measures Attributed to Nontraditional Students in the Literature

Success Measure	Participants	Literature
Get an engineering job after college /Improve earning potential /Get a better life	Clair, Skyler, Cooper, Daniel, Tom W., Jaxon	Wirth and Padilla (2008)
Understand engineering /Learn to relate engineering to real world /Gain engineering skills /Learn how to learn engineering	Cade, Tom A., Connor, Brad, Joe, Mike, Kay	(Boswell & Passmore, 2013); Johnson and Berge (2012); Knowles et al. (2005)
Maintain job performance and/or family life during school	Tom, Joe, Mike, Brad, Kay, Tom W.	Enke and Ropers-Huilman (2010); (Johnson & Berge, 2012)

Participant Success Measures Compared with Measures Attributed to

Nontraditional Students. As shown in Table 22, participants' views also supported the wider representations of success often attributed to nontraditional students in the community college and nontraditional student literature. (Measures of personal success reported by each participant are summarized in Tables 7-20 in Chapter IV.) These nontraditional success measures include goal orientation (Wirth & Padilla, 2008), gaining career skills (Boswell & Passmore, 2013; Johnson & Berge, 2012; Knowles et al., 2005), and maintaining balance between competing life demands (Enke & Ropers-Huilman, 2010; Johnson & Berge, 2012) .

Several participants equated success in engineering education with a social mobility goal of attaining employment as an engineer. Other participants defined success in engineering education as deeply learning the material and being able to apply what they learned to real world problems. It was inferred that these participants wanted to learn engineering deeply so that they would be better prepared to practice as engineers in the field. Participants employed in engineering apprenticeship-like roles (Tom, Joe, Mike, and Brad) indicated that they considered maintaining their job performance while earning their degree to be another facet of their success. They saw their current employment as a pathway to a career as an engineer and strongly desired to maintain their level performance and supervisor/mentor relationships in order to affect employment as engineers after receiving their degree. In other words, these participants would not have considered themselves successful if they earned the engineering bachelor's degree but lost or performed poorly in their current job—their pathway to an engineering career—in the process. Four participants (Tom, Joe, Mike, and Kay) discussed how important it was to them to balance school with work and family life. Tom W. discussed the strain that going to school placed on his marriage and his need to stop-out when faced with a personal family tragedy.

Contextual interplay between degree attainment and social mobility goals. The relationship between more traditional success measures, such as degree attainment, and nontraditional success measures, such as of goal realization, as seen in this study is important to consider. In contrast to more academic majors in higher education, engineering is a professional major (i.e., engineering bachelor's degree programs prepare

students for careers in the engineering profession by emphasizing the practical skills and knowledge required of engineers; an engineering bachelor's degree is prerequisite for gaining employment as an engineer). With this understanding of the professional nature of engineering study, the traditional success marker of degree attainment was seen to be conflated with the participants' social mobility/career goal in this study. Based on the co-created narratives, it is clear that all participants desired to work as engineers. Moreover, over half of the participants who indicated that degree attainment was a marker for success also expressed that they intended to be employed as engineers. Therefore, participant use of degree attainment as a marker for success cannot be wholly separated from the social mobility career goal in the data. In other words, it was likely that the participants' use of degree attainment as a success measure was more related to their desire to gain employment as an engineer than to getting a degree. As Tom W. explained, "...In your forties, you go to school because you want a better job... not because Mom's making you go to college." This result supports the findings of Hagedorn (2005) that indicated that older community college students reported being less likely to return to college to earn a degree than younger students, but more likely than younger students to return because a degree or certification was required for work or because their employer encouraged them to go.

Stackable credentialing in engineering. The issue of offering stackable credentials as incentives to nontraditional students in engineering is also of importance. In conversations with the participants, many communicated that they did not place substantial value in earning an associates degree in preengineering. None of the

participants suggested that they had a goal of earning an associate's degree when they entered the preengineering program—initially all of the participants (except for Kay, who already had an engineer bachelor's degree) sought out an engineering bachelor's degree as a prerequisite for engineering practice. Notably, Jaxon was unaware that he had earned an associate's degree after completing the preprofessional program; Tom A. remarked that he was “embarrassed to walk at graduation” for an associate's degree. It was inferred from the narratives that the participants valued the bachelor's degree, and devalued the associate's degree, due to their perceptions of the engineering employment opportunities that each degree represented.

Some participants did see value in earning an associate's degree in preengineering for other reasons. Cade and Skyler noted that an associate's degree may help facilitate college credit transfer to another institution (other than USU) and others (Tom, Tom A.) suggested that earning the associate's degree served as a personal and professional milestone on the way to earning a bachelor's degree. Tom and Cade envisioned that the associate's degree could as potentially serve as “employment insurance” (Tom) or a “backup plan” (Cade) in the event that the engineering bachelor's degree didn't work out. (Tom saw tangible evidence—in the form of job postings— of engineering technician jobs that required associates degrees in preengineering.) Importantly, some participants (Tom, Joe, Brad, Mike, Tom W.) discussed how earning the associates degree helped them prove to their employers that that they were serious about—and capable of— completing their engineering bachelor's degree program. This phenomenon, known as

“market signaling,” was previously noted by (Boswell & Passmore, 2013, p. 14) and is discussed in more detail in a later section as an outcome of this study.

In general, it was clear that participants were skeptical that the associate’s degree in preengineering would lead to employment in the engineering profession. Overall, these findings underscore the close connection between the success measures and the social mobility goals held by the nontraditional student participants in this study. The findings also point to difficulty in designing compelling stackable credentials that are “sliced thinner” (Garcia, January/February, 2014, para. 3) than bachelor’s degrees for students pursuing engineering majors.

Participant Success Measures Not Previously Reported in the Literature. As shown in Table 23, the participants further defined success in ways not previously reported in the literature. (Measures of personal success reported by each participant are summarized in Tables 7-20 in Chapter IV.) Nine participants added qualifying conditions to the degree attainment success measure. These qualifiers included a) attaining the bachelor’s degree in the minimal time possible, b) limiting or abstaining from student loans while in school, and c) maintaining a level of employment that provided retirement and/or medical health benefits while pursuing their degree.

Table 23

Participant Success Measures Not Previously Reported in the Literature

Success Measure	Participants
Minimize time to bachelor’s degree	Daniel, Mike, Skyler
Limit / abstain from student loans	Cade, Clair, Daniel
Maintain retirement or medical benefits while attending school	Mike, Tom A., Kay

Minimize time to engineering bachelors' degree. Mullin (April 2012) discussed that time was a critical factor for low-income students who attend 2-year institutions primarily because their time is often limited due to work responsibilities. Fry (2002); Mullin (April 2012) pointed out that these students may “stop-out” of school during time of financial or personal hardship. Clearly, participants in this study experienced severe and often conflicting demands. They were required to effectively prioritize activities and manage their time in order to simultaneously progress in the program, maintain employment, and care for their families. Yet, despite these demands, three participants (Daniel, Mike, and Skyler) qualified success in terms of the time it took them to earn their bachelor’s degree. For these participants, setbacks that delayed their degree completion were particularly distressing. Daniel’s goal was to beat the national average for bachelor’s degree completion. Mike was determined to stay on track in the preengineering program, even while suffering a near-fatal rupture of his appendix. Instead of taking another setback, Skyler— who lost nearly a year when he broke his wrist in an automobile accident during the preprofessional program—chose to change majors from mechanical engineering to civil engineering in order to stay on track for graduation. For these participants, there was the sense of their urgency to get out of school and on with life—in terms of earnings and family life—as quickly as possible. This result directly contradicts the community college literature which indicates that nontraditional students often prefer to stop-out in times of personal emergency or distress and potentially points to ways in which nontraditional students in professional majors, such as engineering, view success differently.

Limit / abstain from student loans. Bailey (2005); Spellman (2007) argued for increased financial assistance for non-traditional students. Bailey (2005) claimed that the federal student loan program, which is currently based on need, is biased toward younger full-time students and against part-time working students. McKinney et al. (2015) found that, while they often considered federal loans as a last resort, community college students reported feeling that the loans had ultimately contributed to their academic success. These authors suggest that while an “aversion to borrowing” can protect students from accruing “unmanageable debt,” it can also act as a “barrier to [educational] access and persistence” (McKinney et al., 2015, Student and Familial Characteristics, para. 2).

Eleven of the 14 participants in this study were considered financially self-supporting (“financially independent” for student loan determination); all were responsible for paying for their own education. Three of the participants (Clair, Daniel, and Cade) made conscious decisions to either heavily limit or altogether abstain from taking out student loans to pay for their engineering education. These participants went as far as to consider limiting /abstaining from student loans as a condition of success: the less money they borrowed to finance their engineering degree, the more successful they judged themselves to be. This potentially unprecedented view of success may have been an artifact of upbringing within the dominant local culture (Latter-day Saints), a particular characteristic of nontraditional students who study engineering, or underpinned by the participants’ personal abilities to secure alternative funding for school (Clair and Daniel were able to fund the professional program using scholarships and Cade was able to fund his education by working and living at home with his parents). It may also be

true that nontraditional students who are employed and support spouses (Clair) or families (Daniel) have more developed financial sense and, thus, are more wary of incurring student loan debt than traditional students are. This area is ripe for further research.

This result supports recommendations provided by McKinney et al. (2015) to improve federal loan policies and student loan counseling practices in order to better prepare community college students to assess the advantages and disadvantages of using federal student loans. While these three nontraditional participants were each poised to earn an engineering degree without taking out student loans, this strategy might not be viable for other or all nontraditional engineering students. As McKinney et al. (2015) discussed, nontraditional students are at higher risk for working long hours at lower paying jobs and spending increased time away from campus while working their way through school. Therefore, while abstinence from loan-based financial aid may be seen as a noble, virtuous, or forward-looking strategy to some, it may not be the most effective course of action for every nontraditional student. I suggest that it is likely that many of the nontraditional participants in this study could have benefitted from federal loan counseling to help them understand how to use federal aid to their best advantage.

Maintain retirement or medical benefits while attending school. There were participants who indicated that maintaining medical and retirement benefits while attending school was an important or necessary part of their success. Tom A., Mike, and Kay each discussed the importance of maintaining the health and retirement benefits they were earning prior to entering the professional program while they were going to school.

The desire to maintain his current level of retirement benefits made it unattractive for Tom A., who had been receiving 401K retirement benefits since he started working at the Wal-Mart Distribution Center at 19, to look for other jobs that may have better accommodated his school schedule. Tom A. kept the same benefitted job throughout his engineering education even though it meant he was never able to do course work or study during the weekend (because he worked thirty six hours on the graveyard shift Fridays - Sundays). For Kay, the need to maintain medical benefits for her three children effectively tied her to a low skilled, seasonal job for the IRS and made it impossible to attend school on a consistent basis. Mike found the health benefits he received on the job to be invaluable when he got married after completing the preprofessional program. The desire/need for nontraditional students to receive medical and retirement benefits as part of their employment during school, which has implications for nontraditional student employment decisions, has not been previously discussed in the literature.

**Personalized Approaches for Overcoming
Barriers to Success in Engineering Education
(Answers Research Question 2)**

Identifying barriers to success. Along with defining their measures for personal success, participants also described the barriers to success that they encountered in engineering education. (The personal barriers shared by each participant are summarized in Tables 7-20 in Chapter IV.) According to Spellman (2007), educational barriers for nontraditional students can be categorized as enrollment or retention barriers. The work of Cross (1981) related to adult learners can be used to further classify the barriers to enrollment into three types: situational (i.e., pertaining to students' current life

circumstances), institutional (i.e., deriving from programmatic policies and practices), and dispositional (i.e., relating to the limits that students' place on themselves). In this study I employed a categorical framework, based on the classifications reported by Spellman (2007) and Cross (1981), to organize, synthesize, and report participant data related to barriers to success and actions taken to overcome barriers to success.

Categorized data related to participant reported barriers to success are provided in Tables 24-25.

Barriers to success in the engineering preprofessional program. A synthesized listing of participant reported barriers to success, organized as barriers to enrollment and barriers to retention, in the alternative preprofessional program is provided in Table 24.

Barriers to enrollment. Considering barriers to adult education broadly, Darkenwald and Valentine (1985) reported six factors that deterred adults in the general public from participating in formal or informal education: lack of confidence, lack of course relevance, time constraints, low personal priority, cost, and personal problems (i.e., child care requirements, family issues, health, and dis/ability) (pp. 183-185). Of these six factors, three factors (i.e., lack of confidence, cost, and personal problems) aligned with the participant discussions of barriers to enrollment in the preprofessional program as shown in Table 24. A fourth factor that was reported by Darkenwald and Valentine (1985)—the factor of time— aligned with participant reported barriers to retention in the preprofessional program as shown in Table 24.

Table 24

Barriers to Success in the Alternative Engineering Preprofessional Program

Barriers to Enrollment	
Situational	<ul style="list-style-type: none"> • break in education; rusty skills (especially in math) • financing education costs • need to maintain benefits for family members/future • lack of college cultural capital (first gen status)
Institutional	<ul style="list-style-type: none"> • lack of information about the preprofessional program • inaccurate/difficult math course placement (Accuplacer) • access to refresher courses without enrolling
Dispositional	<ul style="list-style-type: none"> • lack of confidence • fear of unknown, fear of failure
Barriers to Retention	
Academic readiness	<ul style="list-style-type: none"> • poor high school preparation, especially in math • poor study skills/habits • feeling out of place in an academic environment
Instruction	<ul style="list-style-type: none"> • math instruction • math instructors' low expectations for performance • lack of familiarity with distance education/instruction • difficult to stay engaged during night broadcast classes • difficult to ask questions in broadcast classes • technology issues or poor instructor use of technology • inadequate remote site laboratory support • delayed instructor feedback • lack of familiarity with using computers
Time factors	<ul style="list-style-type: none"> • limited access to high speed internet service off campus • finding adequate time to study • balancing work/family/school
Program factors	<ul style="list-style-type: none"> • three course failure rule

Note. Major category names (i.e., barriers to enrollment, barrier to retention) were taken from (Spellman, 2007). Subcategory names of barriers to enrollment (i.e., situational, institutional, and dispositional) were taken from (Cross, 1981). All other data were gathered from participants.

The finding that the participants in this study viewed time more as a barrier to retention rather than as a barrier to enrollment differs from the findings of Darkenwald and Valentine (1985). This result may reflect the context of this study: the participants'

intense desire to engage in engineering studies and to become engineers may have influenced them to underestimate the rigorous curricular requirements of engineering study prior to enrollment. Or perhaps the nontraditional participants, especially those who did not have rigorous high school experiences, may have been surprised by the intensive time requirements inherent in engineering studies after enrollment in the preprofessional program. It is understandable that the remaining factors (i.e., course relevance and personal priority) discussed by Darkenwald and Valentine (1985) were not reflected in the data from this study since the participants in this study were not from the general public and discussed having substantial interest in studying engineering and entering (or re-entering) the engineering profession.

The enrollment barriers reported by the participants, shown in Table 24, also reflect those reported (i.e., financial barriers, cultural barriers, and personal issues) in the literature for nontraditional community college students by Spellman (2007, p. 67). The two most frequently cited barriers to the participation of adults in education, a lack of time and money (Merriam, Caffarella, & Baumgartner, 2007, p. 65), are evident in the data and listed under situational and time factors. Additional barriers to enrollment in the preprofessional program (word-of-mouth style advertising of the program, a cumbersome math placement process, lack of refresher training for students seeking reentry into the profession) are also listed as barriers to enrollment in Table 24.

Barriers to retention. In general, reported barriers to retention in the preprofessional program (i.e., academic readiness, time factors, and program factors), as shown in Table 24, reflected those reported (i.e., academic failure and juggling other

responsibilities) by Spellman (2007, p. 69). It was common for participants to discuss how poor high school preparation in mathematics and/or a break in using mathematics was a substantial barrier to their retention in the preprofessional program. This result supports the strong correlations between academic performance in first year post-secondary mathematics courses and attainment of engineering bachelor's degrees that are reported by other researchers (Budny, LeBold, & Bjedov, 1998; Gardner, Pyke, Belcheir, & Shrader, 2007; Koch & Herin, 2006).

As they generally worked during the day and took preprofessional courses during the evening hours, the participants also struggled with constraints on their time that made it difficult to achieve academically; many completed most if not all of their studying and coursework in one or two days over the weekend. Some participants reported struggling with the mathematics instruction, itself, in the preprofessional program; the seemingly low expectations that the regional campus mathematics instructors had for their performance was also reported as a demotivating factor for some participants as shown in Table 24. One student (Joe), in particular, shared how he purposefully sought out a classes taught by an especially motivating mathematics instructor who taught on main campus.

The most numerous barriers to retention in the preprofessional program, as shown in Table 24, were reported under the category of instruction and were related to the synchronous broadcast delivery of the preengineering curriculum. This finding suggests that the preprofessional program may have been effective at eliminating or reducing common barriers in other areas. Moreover, attrition in distance education is a well

documented phenomenon and is a current area of research emphasis (Angelino et al., 2007). Barriers to retention in distance education environments reported in the literature include issues associated with physical separation, isolation, perceived lack of support, and feelings of disconnectedness (Angelino et al., 2007, p. 7). Therefore, the barriers to retention related to the distance delivered instruction reported in Table 24 are not necessarily new.

What is interesting, however, is that—despite reporting a large number of distance education-related barriers to success—most participants (not including Cooper³⁵) communicated that, if given the choice, they would choose the distance-delivered synchronous broadcast preprofessional program over attending the traditional preprofessional program on main campus. Even Tom W., who was perhaps the most vocal critic of synchronous broadcast instruction, commented, “given the choice again, I’d probably do the same thing. I can’t say that I liked them [broadcast classes] all that well but, you know, they weren’t bad.” Most participants felt that, because the preprofessional program was so attuned to their needs as nontraditional, adult learners, it made going back to school to study engineering *possible*. Considering what would have happened if there had been no alternative preprofessional program, Tom said,

I probably wouldn’t be here. I wouldn’t be in engineering, let’s say. I would have found a program that worked [for me] with the business college or something. I know they have online stuff and night classes, so I probably would have chosen something like that, which is sad.

³⁵ Cooper transitioned to main campus to receive face-to-face instruction prior to completing the alternative preprofessional program. Cooper felt that his experiences in serving in the military left him unprepared for learning in a more academic environment. He felt that the distance delivery format added to his difficulties and that he needed more traditional style (i.e., face-to-face) instruction.

This finding suggests that the attention paid to the nontraditional student context in the preprofessional program far outweighed the barriers to success presented by the synchronous broadcast distance delivery format.

Barriers to success in the engineering professional program. By far, the most numerous and potentially significant barriers to success were reported by the participants relative to their experiences in the engineering professional program. Barriers associated with transferring to and persisting in the traditional engineering professional program may be a unique contribution to the literature. Because undergraduate engineering curricula are difficult to support at the community college level (Enriquez, Dunmire, Rebold, Rentsch, & Schiorring, 2015), studies that focus on transfer students in engineering are limited. The current study breaks new ground by examining the experiences of nontraditional engineering students who transfer from an alternative, 2-year college program, designed to accommodate nontraditional students, to a traditional 4-year university environment. A synthesized listing of participant reported barriers to success in the professional program, organized as barriers to enrollment and barriers to retention, is provided in Table 25.

Barriers to transition. Barriers to success that occurred during transfer—which, for the participants, included the physical transition from the alternative preprofessional program to the professional program—are provided in Table 25. Reported barriers echoed many factors previously reported in the literature regarding 2-year to four year college transfer: improper or poor advising (Gard et al., 2012; Olson & Labov, 2012), financial issues (Gard et al., 2012), exclusive cultures that predominate in STEM

Table 25

Barriers to Success in the Engineering Professional Program

Barriers to Transfer	
Situational	<ul style="list-style-type: none"> • need to relocate or commute • need to find a new employment or re-negotiate schedule with current employer • personal finances/ ability to survive with lower income • unsupportive spouse and family concerns • demotivating advising staff <ul style="list-style-type: none"> ○ guidance that misunderstands of individual nontraditional student context
Institutional	<ul style="list-style-type: none"> • rigid conceptions of course scheduling by advising staff • courses taught at extreme times (early morning, late afternoon) that do not facilitate work schedules/shifts • required courses taught once a year, no summer courses
Dispositional	<ul style="list-style-type: none"> • fear of /resistance to change
Barriers to Retention	
Instruction	<ul style="list-style-type: none"> • uninviting main campus engineering culture <ul style="list-style-type: none"> ○ perceived change in faculty priorities (“unavailable faculty”) ○ perceptions of uncaring faculty (“students are a number not a name”) ○ perceptions of being considered different/ sub-par • teacher-centered instruction <ul style="list-style-type: none"> ○ large classes (100+) ○ use of undergraduate tutors as course help/support mechanism ○ different expectations between disciplinary majors ○ difficulty finding study partners or fitting into previously formed study groups ○ stressful test environments (e.g., fast-paced multiple choice tests) ○ student culture of strategic learning (e.g., heavy use of solutions manuals) ○ normative grading procedures and the psychological effects of low grades • need to quickly adapt to different approaches to teaching and learning (i.e., within the first semester)
Time factors	<ul style="list-style-type: none"> • difficulty accessing main campus support (e.g., physical office hours, study groups) due to work schedule and family responsibilities

Program factors	<ul style="list-style-type: none"> • inability to follow alternative course schedules • inability to “stop-out” • single course failure rule
Personal factors	<ul style="list-style-type: none"> • ongoing psychological stress of combined school/work/family responsibilities • emotional or physical reaction to stress

Note. One major category name (i.e., barrier to retention) was taken from (Spellman, 2007). Barriers to enrollment were changed to barriers to transfer. Subcategory names of barriers to enrollment (i.e., situational, institutional, and dispositional) were taken from (Cross, 1981). All other data were gathered from participants.

disciplines (Olson & Labov, 2012), and psychosocial factors such as a lack of familial support (Gard et al., 2012).

Yet, these seemingly common barriers took on new meanings for nontraditional students who transitioned to a traditional engineering education context from the regional campus. Participants who transitioned faced a choice of finding new employment and physically relocating themselves (and most likely their families) to the “main” campus location in Logan, Utah, or assuming a long daily commute that incurred substantial costs in terms of transportation monies (McKinney et al., 2015) and time. Relocation was left up to the participants; the institution did not provide transition assistance or guidance. Moreover, participants who were able and chose to commute were faced with negotiating new work schedules with their employers in order to accommodate a daytime course schedule in the professional program. For some participants, the need to accommodate a daytime course schedule necessitated a job change even if they did not relocate.

The reported institutional barriers to the transition included advising practices and curricular constraints that were not attuned to the nontraditional student context. Participants reported being subtly (and not so subtly) admonished by engineering advising staff for maintaining, or attempting to maintain, employment during the

professional program or for requesting to take a lighter than standard course load during the professional program. Tom, remembered how “[an engineering advisor] put it very bluntly to me: ‘You will not be able to do this unless you quit your job.’” Tom explained that, “That’s not an option for me.” Cooper discussed how he heard stories of Logan campus engineering advisors labeling any request by traditional engineering students to take a lighter than standard course load as a “never, never plan to graduate,” suggesting that students would “never, never” graduate from the professional program without taking a full course load each semester. He stated, “It’s them [the administration] trying to make sure that everyone stays on task and finishes the program in the right amount of time and not slack off.” Cooper surmised that a different plan would “never, never” be offered to non-traditional students. These findings support participants’ descriptions of rigid curricular structures and an unaccommodating administrative climate toward student nontraditionality within the engineering college.

Barriers to retention. Reported barriers to retention closely paralleled those reported by Seymour and Hewitt (1997) (i.e., inadequate teaching practices, inadequate support mechanisms, weed-out campus culture, and an overwhelming curricular pace). During the professional program, the participants reported a) difficulties accessing course support (Seymour & Hewitt, 1997) or “help worth having” (Tom W.), b) seemingly uncaring faculty that didn’t try to get to know them, c) stressful learning and testing environments (e.g. fast multiple choice style tests), d) a culture underpinned by strategic learning practices (e.g., use of solution manuals), e) support mechanisms that were not

aligned with nontraditional student needs, and f) ongoing psychological stress (Gard et al., 2012) that occurred at higher levels than in the preprofessional program.

It was common for participants to describe struggling in the professional program—especially within their first semester classes— and, simultaneously, having difficulty finding adequate help. Surviving the first semester was often described as the major hurdle to earning a bachelor's degree. Participants indicated that professional program faculty seemed generally unavailable and that, when available, their help was highly structured with respect to time. Moreover, two students (Clair and Daniel) each reported talking to a faculty member who was critical of alternative preprofessional program itself. These faculty members suggested that students who graduated from the alternative preprofessional program were not trained to the same standard as students who completed the preprofessional curriculum on main campus.

Participants' time constraints often conflicted with scheduled support hours (e.g., office hours, study group hours) and substantially reduced their ability to obtain adequate support. Several participants suggested that the undergraduate engineering tutors were not adequately skilled or knowledgeable in the subjects they tutored and did not instill confidence in their help. Commonly, by the time the participants arrived on the main campus at the start of 3rd year, student study groups had been formed and were difficult to join. All of these findings support participant descriptions of the professional program being unresponsive and unsupportive to their needs as nontraditional students.

The cumulative effect of the stress felt by the participants within the professional program was particularly evident in narratives of Tom A. (excessive weight loss and

sickness), Tom W. (anger and emotion), and Connor (psychological counseling). While some of this stress was undoubtedly attributable to inherent characteristics associated with being a nontraditional student (Coley, 2000; Horn, 1996; Spellman, 2007), increased stress was attributed to rigid programmatic rules (e.g., one course failure rule³⁶) and to semester course loads that exceeded participant capacity. Additionally, it was seen that having to make critical adaptations to changes in employment and school environments within the time span of a single semester was a considerable source of stress for the participants. While some participants had prior experience navigating the main campus, others were inexperienced, yet were not provided campus orientation from either the college or institution. Seemingly small issues, such as finding food and knowing where to find parking when arriving on campus at midday, added to the overall stress that some participants felt.

Overcoming barriers to success. In addition to describing the barriers to success encountered during their engineering education, the participants recounted actions they took to overcome, or attempt to overcome, these barriers. (The specific actions taken by participants to overcome barriers to success are summarized in Tables 7-20 in Chapter IV.) In the following sections, synthesized listings of the actions that participants took to overcome barriers to success in the preprofessional and professional programs are provided in Tables 26-27 and discussed.

³⁶ In some disciplinary engineering professional programs such as mechanical engineering, students are allowed only one course repeat. If students fail more than one course, they are expelled from the professional program

Overcoming barriers in the engineering preprofessional program. Actions taken by the participants to overcome barriers to success in the preprofessional program were synthesized across all participants and are shown in Table 26. The sizeable number of actions taken by participants to overcome barriers during the preprofessional program suggested that participants exercised a substantial amount of agency and felt empowered as they made their way through the program. Moreover, the varied, personalized ways participants used to overcome barriers, which included substantial personal sacrifice, highlighted their strong underlying commitment to studying engineering.

Actions to overcome barriers to enrollment. Many discussed how choosing the alternative preprofessional program was one way they overcame substantial situational and dispositional barriers to enrollment. Additionally, participants experimented by taking low-level math and general education courses at other community colleges in order to adapt themselves to the academic environment or to judge their ability to overcome specific situational barriers. To overcome institutional barriers, participants shared how they talked to friends and extended family members, as well as researched online, to find out about the alternative preprofessional program. They also reported talking with personal mentors and the regional campus engineering advisor about important curricular choices and concerns.

Actions to overcome barriers to retention. To overcome barriers to retention in the alternative preprofessional program, participants tended to take classes slowly, especially at first. Many participants concentrated on remedial or review math courses in order to adjust their expectations and gain confidence. Some participants

Table 26

Participant Actions to Overcome Barriers to Success in the Engineering Preprofessional Program

Actions Participants Took to Overcome Barriers to Enrollment	
Situational	<ul style="list-style-type: none"> took low level classes (math and general education courses) prior to enrollment to test abilities chose the alternative preengineering program sought information about college from friends, relatives
Institutional	<ul style="list-style-type: none"> sought program, course information online sought out curricular advice from engineering mentors met frequently with regional campus advisor
Dispositional	<ul style="list-style-type: none"> sought support from friends, relatives, mentors
Actions Participants Took to Overcome Barriers to Retention	
Academic readiness	<ul style="list-style-type: none"> took extra semester never took more than three classes a semester / took classes at a slower pace than master schedule took remedial math/concentrated on math during first year retook Calculus I even though had AP credit never stopped taking math took classes over summer to stay on track at slower pace retook classes to get better grades and learn material better participated in extracurricular activities to gain experience served as a calculus tutor to gain confidence
Instruction	<ul style="list-style-type: none"> studied more on own to make up for lack of engagement chose instructors considered as good at distance delivery learned how to trouble-shoot lab equipment transitioned to main campus for face-to-face instruction clarified online assignments with instructor took computer classes at technology college accessed Internet at parents', in-laws', and work carefully chose math instructors took math classes on main campus with a particularly motivating instructor
Time factors	<ul style="list-style-type: none"> carefully constructed course schedule based on other responsibilities studied on weekends gave up family time worked ahead to prepare for mandatory overtime strategically completed assignments
Program factors	<ul style="list-style-type: none"> researched course failure policies at other universities

Note. Major category names (i.e., barriers to enrollment, barrier to retention) were taken from (Spellman, 2007). Subcategory names of barriers to enrollment (i.e., situational, institutional, and dispositional) were taken from (Cross, 1981). All other data was gathered from participants.

(Cooper, Connor, Tom A.) engaged in extracurricular activities (NASA sponsored design competition, regional campus math tutor) to gain skills and experience. When participants faced instructional barriers to retention, some responded by carefully choosing instructors, taking a course with a highly regarded instructor on the main campus, or concentrating on doing more on their own (studying or troubleshooting lab equipment). Some worked through time factors with careful course planning, studying on the weekends, and attempting to work ahead or strategically completing assignments in order to be more be able to flexibly adapt to changes in work or family requirements.

Overcoming barriers in the engineering professional program. The actions taken to overcome barriers to success during the transfer to and within the professional program were synthesized across all participants and are shown in Table 27.

Actions to overcome barriers to transition. In comparison to the actions taken against barriers in the preprofessional program, the actions taken against barriers in the professional program were less numerous and decidedly more severe and consequential in the lives of the participants. This finding suggests that participants were able to exercise less personal agency during the professional program. During transition to the professional program, students took decisive actions to overcome situational barriers including re-negotiating work hours; finding new employment; applying for large scholarships, using savings, taking out loans, or charging tuition to credit cards. Some of these actions, such as taking out loans or using credit cards had long-term financial

Table 27

Participant Actions of Overcome Barriers to Success in the Engineering Professional Program

Actions Participants Took to Overcome Barriers to Transfer	
Situational	<ul style="list-style-type: none"> • changed shifts or found new jobs • applied for academic scholarships • made substantial changes to personal finances to survive on minimal income • quit job and used savings to pay for school • used savings and credit cards to pay for school • used savings and student loans to pay for school
Institutional	<ul style="list-style-type: none"> • firmly told advisors restrictions on course load
Dispositional	N/A
Actions Participants Took to Overcome Barriers to Retention	
Instruction	<ul style="list-style-type: none"> • worked with friends from preprofessional program • built study group with new friends from scratch • prepped before class • attended study/review sessions • got solutions manuals from friends • took classes at a slower pace
Time factors	<ul style="list-style-type: none"> • moved closer to campus to have more time on campus • negotiated schedule flexibility with employer • reduced work hours
Program factors	<ul style="list-style-type: none"> • repeated junior year after failing a course • petitioned expulsion from engineering major • changed engineering majors • changed majors (out of engineering college) • changed universities
Personal factors	<ul style="list-style-type: none"> • engaged in senior design class to regain desire to be an engineer • divorced/remarried • sought counseling

Note. One major category name (i.e., barrier to retention) was taken from (Spellman, 2007). Barriers to enrollment were changed to barriers to transfer. Subcategory names of barriers to enrollment (i.e., situational, institutional, and dispositional) were taken from (Cross, 1981). All other data were gathered from participants.

repercussions. A few students were able to negotiate lighter courses loads with engineering advisors in order to overcome institutional barriers.

Actions to overcome barriers to retention. Barriers associated with instruction required students to cultivate peer interaction and outside support mechanisms based upon more limited opportunities for student-instructor interaction on main campus. In order to be present on campus at appropriate times to generate an adequate level of peer interaction, participants took varied actions including moving closer to campus and re-negotiating or reducing works hours. Moreover, the participants often needed to initiate social contact on the main campus in order to join existing student-based study groups or to make new ones. To overcome program factors, students took drastic actions like petitioning expulsion, changing majors within the college of engineering, changing to majors located outside the college of engineering, and changing institutions. Participants tended to look outside the college and university context to friends, work mentors, spouses, and professional counseling for sources of personal support.

Alternative Transfer Program Promoted Success in Engineering Education

The purpose of the alternative engineering transfer program, that served as the context for this study, was to provide access to undergraduate engineering education to Utah residents historically underrepresented—if not altogether absent— within its engineering programs. Perhaps because the program sprung out of grand vision (Barta, Foley, & Brown, 2010) and encompassed—what many considered to be—a lofty purpose, concerns related to the ability of nontraditional students to complete the alternative preprofessional program locally and then transition to and complete the traditional professional program in Logan were frequently voiced—by administrators and faculty—

throughout the tenure of the program. Indeed, in the minds of many, there was substantial uncertainty as to whether the alternative transfer program was able to promote nontraditional student success in engineering.

This study helps shed light on this important question. The work of co-developing participant narratives and synthesizing participants' data uncovered three predominant and mutually supporting ways in which the alternative engineering transfer program promoted nontraditional student success in engineering. These three programmatic mechanisms for promoting student success include: a) enabling sustained engineering and technology sector employment that worked to promote career goals through job market signaling, b) providing opportunity for academic bootstrapping in an adult learning environment, and c) facilitating on-going participation in established familial and community-based support networks. These mechanisms are discussed in the following sections.

Sustained engineering and technology sector employment promoted engineering career goals through job market signaling. One way in which the alternative transfer program promoted engineering student success was by enabling participants to build and sustain mutually beneficial, ongoing relationships with regional engineering employers while completing their engineering education. As the narratives showed, several participants (Brad, Joe, Mike, and Tom) maintained employment with one key engineering employer throughout their engineering education. Generally speaking, they worked full-time, technician level jobs with moderate to large size engineering companies (e.g. Orbital ATK in Promontory, Utah; TCR Composites in

Ogden Utah; and the City of Logan Engineering Department in Logan, Utah) prior to entering college. In addition to gaining practical work experience in engineering specialties in which they were interested, they earned tuition reimbursement once they started taking remedial and refresher classes.

As they enrolled and progressed in the preprofessional engineering program, the participants gained increasing visibility among their supervisors and became potential engineering hires. It was seen that supervisors took special interest in the participants who were productive, full-time, technical employees simultaneously pursuing accredited engineering degrees on their own time. Managers kept tabs on participants' headway through post semester debriefings that also served as decision points for continued tuition reimbursement. The attention and feedback the participants received from their supervisors gave them added motivation to continue working toward their degree. Some employers even became a source of moral support and career guidance for the participants.

Seeing the participants' commitment and progress during the professional program, supervisors provided participants increasing amounts of flexibility in terms of work hours, overtime, and shift placement. These benefits helped the participants manage their time when they had important assignments due or imminent exams. As participants earned associates degree transitioned into the daytime professional program, managerial support became critical to their continued progress. Employer support during the professional program included highly flexible work hours including late nights and weekends, shift changes, and even options for telecommuting. Brad explained how

working his way through the alternative preprofessional program had proven his commitment to his employer. He stated,

Other people [at work]... have asked them for help [with going to school]... they've even used my name, like 'How come Brad gets to go to college?' But they [employer] know I'm serious because I went to night school for, like, five years.

Furthermore, not having the additional stress of finding a new job or moving was also a big benefit to the participants during the transition. Participants who benefitted from these ongoing employer relationships commuted to Logan for the professional program.

Upon earning their 2-year preengineering degree, it became fully clear to the participants that they were being groomed by their employers to fill future engineering positions. Participants were offered internships in an engineering department within the company (Joe), told that the plan was to move them to an engineering position after graduation (Mike), and even moved into an engineering role prior to completing their engineering degree (Tom, Brad). This phenomenon, whereby “2-year degree completion acts as signal to employers of desirable human capital” is known as market signaling (Boswell & Passmore, 2013, p. 14; Spence, 1973; Stiglitz, 1975). In sum, the combined “signals” of being a productive technical employee and completing an accredited associate’s degree in preengineering degree on personal time led directly to opportunities for long-term employment as engineers. Job market signaling was perhaps the most impactful way that the associate’s degree in preengineering was used as a stacked credential in engineering by participants working toward becoming engineers.

Other participants benefitted from the relationships they developed with engineering and technology employers to a lesser extent. Jaxon, for example, worked for

a civil engineering firm during the latter part of his time in the preprofessional program. As he began to transition to the mechanical engineering professional program, it happened that Jaxon's employer would not continue to fund his tuition reimbursement if he pursued a mechanical engineering degree. Wanting to study mechanical engineering, Jaxon decided to quit his job and use his savings to fund himself through the professional program. Undoubtedly, Jaxon benefitted from technical work experience, good pay, and tuition reimbursement he received during the preprofessional program. However, Jaxon's engineering-related employment did not directly result in an engineering position after graduation.

Cade, likewise, benefitted from the technical skills he gained and the schedule flexibility he enjoyed while working at a web-hosting company during his engineering education. While Cade, as he becomes an electrical engineer, will benefit from the extensive software coding experience he gained on the job, his current employment will not lead directly to employment as an engineer (since it is not an engineering company). Interestingly, those who did not work (Cooper) or did not work in the technical sector (Connor, Kay) during the preprofessional program experienced, perhaps, the highest levels of stress, disappointment, and doubt about their ability to succeed in engineering. Despite having a busy course schedule, Connor and Cooper participated in an extracurricular engineering design activity (i.e., NASA robotics competition) to gain engineering and technical skills, find support, and reduce the stress they felt during the preprofessional program. This finding suggests that engineering-related employment and relationships with engineering workplace mentors may be one way that nontraditional

students gain a sense of belonging and self-efficacy in engineering education environments.

Academic bootstrapping in an adult learning environment. The second way in which the alternative preprofessional program promoted student success was by providing participants opportunities to bootstrap themselves academically in an environment attuned to their needs as adult learners. All participants had a substantial break in schooling and many began their studies by concentrating on remedial mathematics courses, retaking courses they had had in high school (i.e., Calculus I), or taking a mix of a few courses (i.e., mathematics and general education courses) at a slower pace. Participants discussed wanting to refresh their mathematics skills after a long break from formal education and to judge their readiness for engineering studies. Brad, who started over in remedial math (MATH 0900) shared his academic plan saying,

I went to school and I said “I’m going to do all the math first, ” and then I did generals while I did math. And I figured if I can pass the math, then I can keep going but I’m not going to do anything else if I can’t pass the math. That was kind of my plan.

Participants re-entered the formal academic environment with feelings of fear, low self-confidence and engineering self-efficacy, and substantial doubt regarding their own abilities to “do engineering”. Clair explained these feelings when he stated,

I remember being so scared. Four and a half years—I haven’t been in school. I haven’t done math in four and a half years. Granted, I could do it back then [in high school]....I’m embarrassed to say this.... I couldn’t test out of trigonometry because I couldn’t remember it.... All these kids going into the engineering program skipped out of calculus. And I was starting in algebra.

Ultimately, classroom experiences during this period were pivotal to participants' decisions to enroll in an engineering program of study.

Adult learning theory. Theory related to adult learning is useful for understanding how the environment of the preprofessional program promoted the participants' academic bootstrapping. Knowles et al. (2005) argued that the U.S. system of education, including higher education, rests on a pedagogical model. The pedagogical model of education is characterized as being instructor-centered, wherein the learner plays a dependent role. The pedagogical model places little value on the experiences of the learner and assumes that learners are motivated purely by external factors (grades, instructor approval, parental cues, etc.) (Knowles et al., 2005, pp. 61-63). Knowles et al. (2005) suggested that the pedagogical model is increasingly inappropriate as learners age and that it becomes detrimental when applied in higher education where learners have naturally developed toward independency and self-determination. In fact, Knowles et al. (2005) argued that implementation of a pedagogical model for adult learners "... produces tension, resistance, resentment, and often rebellion in the individual [learners]" (p. 62).

The distinction that the participants made between themselves and the "kids" (Clair) who entered the engineering program directly from high school is telling. Attending a regional campus, the participants were surrounded by others like themselves—working students with spouses, families, and major life responsibilities (e.g., mortgages). Feeling like others students helped to ease the participants' initial fears concerning belonging in college and improved their abilities to make the important peer and social contacts that they relied on throughout their engineering education. Moreover,

instructors at the regional campus were part of a larger USU regional campus teaching community that emphasized consideration of students' needs as adult learners in regional campus teaching. Thus, regional campus instructors worked to “incorporate[s] contextual analysis as a step in the development of [instructional] programs” (Knowles et al., 2005, p. 148). Evening courses offered at the regional campuses were small; it was easy for instructors to get to know students and provide opportunities to share experiences during class. Moreover, it was commonplace for instructors and administrative staff to know students by name as well as to know their “story.” Many participants commented that this feature of the regional campus motivated them to progress and excel. Since many of the preprofessional engineers had previous experience practicing engineering, they were able to organize their teaching in ways that related back to engineering practice. These efforts helped satisfy their “need to know why they need to learn something before undertaking to learn it” (Knowles et al., 2005, p. 64).

Lindeman (1926), another “pioneering theorist” (Knowles et al., 2005, p. 39) of adult learning, argued that because individual differences increase as people age, adult education programs need to provide maximum flexibility in relation to the “style, time, place, and pace of learning” they provide (Knowles et al., 2005, p. 40). The structure of courses and programs provided at the regional campus, including local and evening classes, meeting only once or twice per week but for longer time periods, online course material availability, responsive instructor support, and administrative policies adapted to common constraints of adult, nontraditional students all helped to create a more flexible and supportive learning environment for the participants. This added freedom and support

was likely important as the participants negotiated the transition to academic life from other life experiences including work, military service, and religious missions. The regional campus environment can be contrasted to the more rigid, formalistic environment of the main university campus where participants struggled with being “a number not a name” (Skyler), asking questions in large classes, finding help they considered adequate, and developing course schedules adapted to their work constraints. In the contrast, the benefits of the alternative transfer program to the participants become evident.

Maintaining connection to community through place. The third way in which the alternative transfer program, delivered at a regional campus located within the rural community of Brigham City, Utah, was seen to promote participant success was by helping the participants’ maintain connection to their personal and local support communities as they embarked on their college education. The participants in this study did not all come from one highly particular region or specific geographic location; each had small town upbringings in the rural, American West (i.e., Utah, Idaho, California, and west Texas). While a theory of place is frequently used to account for and “acknowledge the importance of ‘place’ in the lives of rural students,” a substantial body of literature that makes use of theories of place focuses on specific geographic regions, such as the American South (Chesbro, 2013, pp. 3-4). Malpas (1999), in telling us that “while it is not an exclusively European or Western notion, that human identity is somehow inseparably bound up with human location is nevertheless an idea that has been

especially taken up in Western culture” (p. 4), perhaps legitimized the use of place-related theory within other regions and among other rural “places.”

As Chesbro (2013) and Byun, Meece, and Irvin (2012) explained, “there are numerous definitions of rurality” (Byun, Meece, et al., 2012, p. 414). Donehower, Hogg, and Schell (2012) told us that “it is important to define rural not only demographically and geographically, but culturally as well” (p. 7). What struck me as most important to understanding the effect of place on the experiences of the participants was the cultural nature of their connections to local, tightly knit, and self-sustaining communities of family, friends, and mentors. I used the term “rural” in this sense of local community to examine ways in which the participants in this study are connected to place.

As Byun, Meece, et al. (2012) discussed, there is a substantial body of research related to the use of precollege factors, such as socioeconomic status (SES), parental education levels and experiences, and academic preparation, to predict the enrollment trends, persistence, and completion rates of college students. Generally speaking, it is widely considered that “rural youth tend to face serious challenges [relative to these precollege factors] that may limit their postsecondary educational attainment” (Byun, Meece, et al., 2012, p. 415). These challenges are used to substantiate the “rural disadvantage perspective,” which argues that “rural parents and schools invest fewer resources in their child’s education” (Byun, Meece, et al., 2012, p. 429). This common perspective is often invoked to explain why rural students are shown to have lower levels of performance when compared to nonrural students (Byun, Meece, et al., 2012, p. 413).

Yet, as Byun, Meece, et al. (2012) pointed out, there is limited research that seeks to understand the precise mechanisms by which precollege factors affect postsecondary enrollment and degree attainment for rural college go-ers and, perhaps more importantly, “the features of rural communities that may be conducive to youth’s educational attainment” (Byun, Meece, et al., 2012, p. 415). New attention is being paid to the characteristics of “rural families, schools, and communities” that may promote college enrollment and achievement; these characteristics of rurality include the “high social resources or capital [of rural communities] due to their small size and strong connections among families, schools, and religious organizations (Coleman, 1988; Crockett et al., 2000; Elder & Conger, 2000)” (Byun, Meece, et al., 2012, pp. 413-414).

Recent investigations have pointed to ways in which rural backgrounds may positively contribute to college enrollment and achievement. Byun, Irvin, and Meece (2012) suggested that “impoverished but academically talented youth may especially value college education as pathway toward economic prosperity” (p. 479). Byun, Meece, et al. (2012) reported that rural students had a higher level of community resources, shared among the parents of friends or attendees of a particular church, and that rural students were more likely to attain bachelor’s degrees due to access to these community resources. The authors surmised that a high level of community resources reflected the “strong kinship bonds and close social ties among families and religious institutions in rural communities” (Byun, Meece, et al., 2012, p. 431). The idea that strong community resources can offset economic hardship and other resource constraints is known as

“community social capital” (Byun, Meece, et al., 2012; Israel, Beaulieu, & Hartless, 2001).

Using a theory of place to understand that a “sense of place” (Malpas, 2009, p. 19) suggests not only physical location but also relationships to location and others who reside there helped me to examine more deeply how the locally offered alternative transfer program may have worked to promote the participants’ enrollment and success in engineering education. In talking with the participants, I was initially struck and confused by their seeming worldliness on the one hand, and current desire to settle down and go to school within their local communities on the other. Many served extended religious missions in other parts of the U.S. and abroad; several grew up in or worked in other states; some had experiences living in or near the “big city” of Salt Lake. A few participants, those who had experiences growing up in larger metropolitan areas, even mildly complained about the pedestrian aspects of their local town and how they had felt bored and constrained growing up there. Yet, when I asked the participants if they had considered going elsewhere—out of the region—to school, the answer was always “No, I’m from here,” or “No, I want to stay by family,” or “No, I never thought about it.”

It was not until I considered how being from a place brings with it more than an appreciation of seasonal change, skills on the ski slopes, or a good sense of direction that I began to understand the participants’ viewpoint on the matter of staying in place. By enabling participants to remain connected to their places—in terms of location and, through location, community—I saw how the professional program empowered them to make use of their support structures while transitioning to their pivotal first years of

college and simultaneously living messy and complex adult lives. By cultivating these support networks and structures, which included the participants' relationships with their spouses, parents, friends, employers, and formal and informal mentors, the participants were better equipped to weather financially burdensome times, care for themselves in times of physical or emotional injury or illness, care for their own families and extended families, find and maintain affirming employment with benefits and potential for future career paths in engineering, and remain committed to completing their degree in the face of adversity. It is somehow ironic to consider that the alternative engineer transfer program, having as its purpose to make the engineering education independent of place—or, perhaps, placeless—through technology and distance-delivery, may have produced some of its most positive effects in the lives of the participants by enabling them to participate in engineering education from, within, and among their own rural place(s).

Finally, it should be noted that the preprofessional program enabled participants to form a new sense of place within the boundaries of engineering education. This new place—this engineering education community— was forged from participants' relationships with other nontraditional engineering students in the preprofessional program. Membership in this new community among others with similar backgrounds, barriers, and goals, provided participants with belonging, acceptance, and peer support. Often, membership within this community was pivotal to the participants' success as they migrated away from local community support structures and the learning environment of the preprofessional program and entered into the professional program. There, they counted on each other in study groups and as friends.

Alternative Pathways to Engineering-related Careers Sought Outside of Traditional Engineering Education

Lastly, it is important to consider the conditions under which a few participants in this study sought (or are currently seeking) engineering and engineering-related career pathways outside of traditional engineering education. Three participants, (Tom W., Connor, and Kay) left either the preprofessional or professional engineering program short of completion. Two of these participants (Tom W. and Connor) pursued (or are pursuing) engineering-related degrees in other USU colleges or institutions as career pathways. Kay has yet to find her pathway back to an engineering career.

Tom W. and Connor both left engineering education on poor terms during or at the end of their first semester in the mechanical engineering professional program. Tom W. struggled in his classes and was angry about the teaching and learning environment provided in the professional program. He had substantial life and work experience in construction and technology and also prior experience in college. On a particularly bad day in his solid mechanics class, Tom W. “wandered down to the geology department,” where he had had an enjoyable class as a young engineering freshman more than two decades prior. There, while talking with a geology departmental advisor, he discovered his pathway forward. Tom W. finished his bachelor’s degree in geology in the engineering track in less than two years from that point.

Connor was overwhelmed with coursework during the professional program and felt for a long time as if things “weren’t right.” He never connected the way he needed to with the college of engineering advisors or university support systems. He tried too late

to withdraw from classes and was expelled from the professional program due to multiple course failures during first semester. He tried, unsuccessfully, to appeal the decision. He considered switching to a civil engineering major but decided it did not sufficiently interest him. Connor eventually left USU and enrolled in the mechanical engineering technology program at Weber State University.

Kay, a degreed civil engineer who has substantial engineering work experience but has been out of the engineering profession for an extended period of time, realized that continuing to take classes in the preprofessional program was not her best option for gaining reentry into the engineering workforce. She is still searching for a means to get refresher training and the computer tools-related skillset needed to land an engineering position today. She is currently looking into the option of earning a second bachelor's degree in hydrology in the College of Natural Resources with the hope of getting that training while studying for her second bachelor's degree.

Examining the narrative trajectories of these participants, a few key points became clear. First, in order to help these participants advance toward their intended careers, more targeted advising, personalized course scheduling, and ongoing support was needed in order to more easily transition between the preprofessional and professional programs. It is clear that not all of the participants, though similarly trained, were able to handle a full course load while negotiating the transition to a new campus, a new teaching and learning environment, and potentially a new work environment. Additionally, it appeared as though the administrative checks in place were insufficient to affect positive outcomes for all the participants.

Second, this evidence suggests that there may be little known—or yet undiscovered—pathways into engineering and engineering-related careers quietly residing in academic disciplines or fields that are not housed within traditional colleges of engineering. That participants who left the preprofessional and professional engineering programs earned bachelor's degrees in other disciplinary fields supports the findings of Meyer and Marx (2014) who reported that students who left engineering programs went on to attain bachelor's degrees in other fields (e.g., business and communication studies). Yet, what is different about the findings in this study is that participants who left engineering programs completed/found degree programs offered in other colleges that kept them in or may lead them back into engineering careers. Both Tom W., who left the mechanical engineering professional program, and Kay, who decided that taking more classes in the preprofessional program would not get her back into her engineering career, found alternative bachelor's degree programs in other colleges that promoted their engineering career goals.

Participants who left the College of Engineering were not alerted to these cross-disciplinary degree options by their engineering advisors. It is understandable if the engineering advisors were unaware of these options available in other colleges. Tom W. discovered the geology degree option by personally venturing over to the department advisor and asking. Kay found about the hydrology degree option by pouring over degree requirement information while trying to find a path forward to re-enter engineering. Kay shared how difficult the hydrology degree had been to find in the USU degree information materials. These findings, however, suggest that there is value in advising

staff becoming aware of cross-disciplinary pathways to engineering careers and providing this information to students who are struggling in an engineering curriculum. Knowledge of alternative degree options may be especially important when advising nontraditional engineering students who may be less concerned about the specific degree designation they receive.

Upon closely examining the effects that the alternative transfer program had on nontraditional student success in engineering, I admit to being excited, surprised, and even a bit relieved to understand the ways in which the alternative transfer program positively affected the outcomes of many of the participants in this study. I am deeply happy that, in many ways, this study represented a "...narrative inquiry into environments where something is working" (Chase, 2011, p. 431). Yet, the findings also suggest that more can be done to improve this alternative engineering pathway by more tightly integrating the alternative and traditional sections of the path.

It is clear that, by enrolling in the alternative preprofessional program, the participants effectively submitted themselves to two distinct transitions: first, from adult life as employees, spouses, and parents into the community college context; second, from the community college context into a traditional university context. In their stories, participants recounted that, while the preprofessional program was tough, the professional program was wrenchingly difficult in comparison. In fact, it was during the first semester of the professional program that participants changed engineering majors, failed out, left for an engineering-related major within another college, got divorced, and fell extremely ill. Clearly, more can be done to support nontraditional engineering

students, who have run “the gauntlet” (Cooper) by completing the preprofessional program, as they continue on in the professional program.

As this study shows, completion of a 2-year, accredited preengineering program and technical work experience in industry, together, served as a signal of “desirable human capital” (Boswell & Passmore, 2013, p. 14) to prominent engineering employers within the state. I suggest that these same accomplishments should also portend desirable human capital within state sponsored postsecondary programs having responsibility to train engineers. Anything less widens a divide which separates the needs of the engineering profession on the one hand from the goals, policies, and processes of engineering education on the other. Recommendations for actions that can be taken to unite this divide within engineering programs targeting nontraditional students are presented in the final chapter.

CHAPTER VI

CONCLUSIONS, LESSONS LEARNED, RECOMMENDATIONS, AND SIGNIFICANCE

The final chapter of this dissertation is divided into five sections. In the first section, the conclusions and their significance to nontraditional student experience in engineering education are presented. In the second section, lessons learned while implementing a narrative research methodology to explore nontraditional student experience in engineering education are shared. In the third section, recommendations for designing impactful alternative engineering pathways, as suggested by the study's findings, are presented. In the fourth, recommendations for future research in the area of alternative engineering pathways are discussed. Last, in the fifth and final section, the significance of the study is discussed.

Conclusions

Using a robust, dialogic narrative research process, this study captured the experiences of 14 nontraditional students who each participated in a distance-delivered engineering transfer program as an alternative engineering pathway. The following conclusions offer important insights regarding the ways in which nontraditional students experience success in engineering education.

Nontraditional Student Context Clashes with Engineering Education Culture

The fact that participants viewed their own educational success contextually, relationally, and in terms of their long-term goals for social mobility is important for those who have responsibility for instructing and advising nontraditional students to understand and consider. The data showed that traditional measures of student success such as academic or educational achievement (i.e., grade achievement, degree attainment) did not neatly map onto the measures of success held by the nontraditional student participants. Participants discussed wanting to do well and that they often experienced improved confidence and feelings of self-efficacy by getting good grades. Yet, in the end, their views of their own success in engineering education were complicated by a) needs to work and/or maintain benefits while going to school, b) desire to maintain a high level of job performance, c) desires to abstain from student loans, and d) personal aspirations to balance family responsibilities with work and school.

Importantly, many participants equated success with maintaining balance between work, family, and school. For most, working was something they had to do, rather than simply something wanted or chose to do. While participants frequently looked to their local community networks for support, oftentimes, family responsibilities could not be negotiated or put off until a later date. Frequently, actions taken to fulfill work and family responsibilities took a toll on participants' performance in school. As Joe, who recently started the mechanical engineering professional program, explained,

I know I have put myself in this situation, as far as being a nontraditional student, but it sure is tough trying to hang in there with the traditional students.... I keep feeling like the instructors/advisors [on main campus] must think I am a terrible

student, and that engineering may not necessarily be what I should be pursuing. If I had a chance to explain my situation, that school is really my third (major) priority, maybe they would better understand my seemingly lackadaisical effort, when sometimes that effort is truly all I can give.

Joe's concern that instructors and advisors compared him, as a nontraditional engineering student, unfavorably to traditional engineering students serves as weighty insight into the culture of mainstream engineering education. In order to expand engineering pathways to nontraditional students, the data from this study suggests that engineering academia must seek out and adopt a more empathetic, accepting, and inclusive stance toward nontraditional students.

Alternative Programming Can Promote Broader Participation in Engineering Education

Most participants considered the alternative engineering transfer program as being essential to their ability to participate in undergraduate engineering education as a nontraditional student. The regionally-delivered, evening program was seen to promote nontraditional student success by a) acting in concert with technical employment as a mechanism for job market signaling, b) promoting academic bootstrapping in a small, intimate learning environment that catered to adult learners, and c) enabling students to maintain connections to local communities of support through place.

At the start of their engineering studies, participants perceived tremendous risk and often doubted their abilities to participate in an engineering program. Access to a locally-delivered, evening program enabled participants to attend school with minimal disruption to their families, at their own pace, and within an environment that understood and

accommodated the educational barriers they faced. Only after gaining confidence and self-efficacy in the preprofessional program were participants able to envision a path forward in the professional program.

Importantly, the ability of the alternative engineering transfer program to provide these important benefits was largely derived from its distance-delivery instructional model. It is true that the most of the barriers to success faced by participants within the preprofessional program were related to the synchronous broadcast method of instruction. Yet, while the participants voiced several grievances concerning the distance-delivered instruction, they generally agreed that—if forced to do it over—they would again choose the alternative transfer program. This conclusion suggests that distance-delivered instruction may be an important mechanism for broadening nontraditional student participation in engineering education.

Nontraditional Students' Commitment to Careers Goals Help to Overcome Barriers in Engineering Education

As reported in this study, the nontraditional student participants experienced many, varied barriers to success during their engineering education. Specifically, the participants experienced the most difficult barriers to overcome during the first year—and, more precisely, during the first semester— of the professional program. The decisions made and actions taken by participants to overcome barriers during the professional program held substantially more long-term consequences than those taken during the preprofessional program. Moreover, during the professional program, singular barriers to success were made more difficult to overcome given the quickness with which

the participants had to adapt to the Logan campus environment. These conclusion suggests that, in order to effect more traversable engineering education transfer pathways, engineering program administrators should seek to provide especially strong levels of advising support and mentoring during transition points between alternative and traditional programs.

As indicated in the narratives, one of the most common reasons that participants pursued engineering education was to access an interesting and stable career that enabled a good standard of living. Social mobility and attainment of better lives for themselves and their families were strong motivators for the participants to go to college and study engineering. These motivations buoyed the participants, enabling them to remain resilient and steadfastly focused on their long-term goals when faced with seemingly insurmountable barriers.

Participants' determination to achieve their social mobility goals was seen in the decisive actions taken during the professional program: retaking classes, changing engineering majors, finding alternative majors outside of engineering, and enrolling at a new institution. Though some participants left engineering education, none gave up on their goal of engineering-related employment. Perhaps Joe, upon completing the preprofessional program, summed it up by saying, "It's taken me so long to get here; it would be a glorious waste of time to quit." Thus, it was seen that the long view that the nontraditional participants took toward their education enabled their resiliency and ability to persist in their engineering. It is interesting to consider if focus on long-term goals and future outcomes is a common factor that distinguishes nontraditional from traditional

students in engineering and, if so, how can taking a longer view of engineering education be encouraged among traditional student.

Lessons Learned

As engineering education research continues to mature as a scholarly field, several researchers (Borrego et al., 2009; Case & Light, 2011; Koro-Ljungberg & Douglas, 2008) suggest that methodology is “a crucial area which researchers need to grapple with in order for the quality and scope of research to continue to develop” (Case & Light, 2011, p. 186). By distinguishing narrative methodology as an “emerging” or “promising but as yet not well represented” methodology in engineering education, Case and Light (2011, p. 190) indicate that there is more to learn about applying narrative methodology within engineering education research. In this section, I discuss the lessons learned while employing narrative inquiry in this project.

Narrative Interviewing is Different

Chase (2011, p. 423) explain how narrative interviewing “requires a shift” from a more conventional style of interviewing that asks participants to generalize across experiences. Narrative interviewing is different in that it invites detail, reflection, and even emotion as specific events are recalled and put into words. Chase (2011) discusses that “Amia Lieblich (in Clandinin & Murphy, 2007) suggests that narrative interviewing requires emotional maturity, sensitivity, and life experience, all of which may take years to develop (p.642)” (p. 423).

In my own project, I saw firsthand how participants recalled intense details of

their experiences and reacted emotionally. I found that having my own experiential insights and ethnographic sensibilities concerning the research context helped me to “be a witness to a wide range of emotions” (Chase, 2011, p. 424) and respond appropriately with empathy and patience during the interview sessions. Had I not had a deep prior knowledge of the research context, the process of interviewing and dialogic narrative development—which required substantial of trust between the researcher and participant—would have taken considerably longer to accomplish. Time requirements, participant privacy, and interviewer empathy should be all be considerations in narrative research planning.

Narrative Research Has Unique Ethical Considerations

Chase (2011, p. 424) suggests that participants in narrative research are more likely to feel “vulnerable or exposed” since longer stories—rather than short excerpts— are commonly included in narrative research documents. Chase (2011) also discusses how narrative researchers should ask for participant permission to use stories after the researchers know the form in which the narratives will be made public.

Participants may feel less vulnerable releasing their stories in some forms over others.

In this project, I used narrative co-development as a technique to help to diminish feelings of vulnerability or exposure experienced by the participants in this study.

Engaging with the researcher and the data throughout the narrative development process, each participant helped to shape the final product to be made public. Areas that made participants feel vulnerable or exposed were worked on until participants felt comfortable

with what was to be presented. As Chase (2011) advised, if the co-developed texts are changed for publication after the dissertation, it is my responsibility as researcher to share the revised narratives with the participants and request permission anew to share the revised stories in a different form or for a different audience.

Narrative Research Can Help Satisfy the Needs of Marginalized Groups to Speak and Be Heard

My purpose for employing a narrative co-development technique in this project was to improve the chances that the participants, after being closely involved in development of their stories, would be willing to share their stories through publication in my dissertation. As the narrative development period came to a close, I was surprised to find that all of the participants were willing to share their stories and all but two preferred to be represented using their own name.

While the participants' willingness to share may be due—at least in part—to the their active engagement in the narrative co-development process, I surmise from comments during interviews and their reactions to their written stories that there are other reasons that also played into their willingness to be visible protagonists. These additional reasons are best described by Chase (2011, p. 427) as a “sense of urgency of the need for personal or social change.” Chase (2011, p. 427) suggests that there are an “urgency of speaking” and an “urgency of being heard” that exist for those with stories to tell. Those who possess an urgency of speaking use stories to “lead to personal emancipation—to ‘better’ stories of life difficulties or trauma” (Chase, 2011, p. 427). Those having an urgency of being heard need to voice their tales of marginalization or repression to others.

For some participants, I noticed that the act of simply reading their own stories helped them to see and appreciate, from a wider perspective, the enormity of their accomplishments. For others who still struggle along their educational path, the acts of verbally expressing and chronologically ordering their experiences helped them reconnect to their goals and plan their next steps. Those participants who felt unjustly marginalized within the professional program wanted their stories told in the hope that the engineering pathway could be improved— and even expanded into a full four year program—for future nontraditional students. It seems clear to me as the researcher that these urgencies also played an important role in the participants’ decisions to share their stories.

Researchers in engineering education (Borrego et al., 2009; Case & Light, 2011) point out that a wider range of methodologies must be used to address the increasingly complex research questions that are coming to the fore within the developing field. As Clandinin and Connelly (1998) suggest, “When one asks what it means to study education, the answer is to study experience” (p. 154). Although narrative inquiry has been used infrequently in engineering education research in the past, it represents substantial potential for engineering education researchers who wish to dive “beneath the surface” (Case & Light, 2011, p. 205) and more deeply understand student experience. The deep and detailed approach that narrative inquiry represents may be well equipped for describing and understanding the complexities of marginalized student experience. This study provides one example of how a narrative methodology can be employed to study nontraditional student experience in engineering education.

Recommendations for Promoting Alternative Engineering Pathways

The following recommendations are derived from the narrative interviews with the participants, narrative outcomes portrayed in the participants' stories, and the researcher's experience instructing in the alternative engineering transfer program for over seven years. Recommendations are provided at three programmatic levels: preprofessional program, professional program, and the level of the overall or combined (preprofessional and professional programs) engineering education pathway.

Preprofessional Program

The major areas for improvement within the alternative transfer program, as suggested by the data, were in the areas of math instruction and student engagement in the synchronous broadcast environment.

Math instruction. Calculus is widely considered to be a gatekeeper course sequence for engineering undergraduates (Budny et al., 1998; Gardner et al., 2007; Koch & Herin, 2006). For incoming engineering students who are not calculus-ready, becoming calculus-ready and completing the first-year calculus sequence act as two substantial barriers to engineering study. Data from this study supported previous findings in reporting the nontraditional student participants viewed that math as a critical barrier to success. Most of the participants discussed how concentrating on their math skills was their first step in going to college to study engineering. As Brad said, "I figured if I can pass the math, then I can keep going but I'm not going to do anything else if I can't pass the math."

Preprofessional engineering programs that wish to serve nontraditional students should consider these findings carefully. Generally speaking, success in calculus is dependent on precalculus mathematics fluency. Therefore, incoming nontraditional students should be strongly advised to refresh their precalculus mathematics skills. Nontraditional students entering postsecondary study with poor math preparation in high school or long breaks between secondary and postsecondary education should be particularly encouraged to take additional time concentrate on precalculus mathematics before entering calculus and the preprofessional engineering program. As Tom W. said, “Take a few extra math classes. I mean, I wish somebody had told me that...unless you’re really good at math you’re gonna struggle.”

Comprehensive and easily accessible support must also be provided (and monitored) for all mathematics courses to insure that nontraditional engineering students are getting the out of class support they require. Interestingly, Tom A.’s story provided an example of how a nontraditional student substantially benefitted from, in terms of confidence and understanding, working as a precalculus math tutor. Working as a tutor in lower level math courses for other nontraditional students, Tom A. gained added experience doing math. This additional experience helped to dissipate his fear surrounding about his abilities to do math. Since moony nontraditional engineering students will enter college with concerns about math, opportunities for them to serve in these sorts of math-related roles should be made available and encouraged by regional campus faculty and advising staff whenever possible.

Student engagement during synchronous broadcast classes. The data indicate that participants had difficulty engaging in synchronous broadcast courses and that they felt that certain instructors were better at engaging students at a distance than others. As Rutz and Hajek (1998) report, instructors in synchronous broadcast environments face additional, nontrivial responsibilities when using classroom technology. These authors suggest that the effective use of technology in a synchronous broadcast classroom requires a greater degree of preparation and changes in teaching style in order to effectively motivate students to engage. Moreover, Bernard et al. (2004) and others (Cavanaugh, 2001; Moore, 1994) report that no significant differences exist between in the effectiveness of distance education (including synchronous broadcast-style instruction) and face-to-face instruction. Therefore, prior research suggests that participants' complaints concerning synchronous broadcast instruction may be more related to instructor training and experience in distance instruction than to a failure of the synchronous broadcast instructional approach.

With this understanding, it is recommended that administrators and faculty who consider employing synchronous broadcast instruction as a mean to reach geographically dispersed nontraditional students be aware of the instructional challenges faced in this teaching environment and actively work to mitigate their effects. The participants' discussion of the barriers associated with the synchronous broadcast method of instruction provides insights into specific areas for attention and/or improvement when employing distance-delivery for nontraditional engineering students. Several approaches

to improve synchronous broadcast instruction— based upon the researcher’s experience teaching in alternative engineering transfer program— are offered.

New instructors should be carefully trained in techniques for synchronous broadcast engagement. Shadow teaching could be employed during the first semester(s) a new instructor teaches. Additionally, teaching mentors could be assigned so that instructors skilled in distance delivery regularly share their knowledge and talents with new or less experienced instructors. All instructors should engage in periodic distance teaching trainings and workshops refresh their skills and learn new techniques and technologies. Distributed team-teaching of broadcast courses could be encouraged to improve student engagement and cross-pollinate teaching techniques (Minichiello, Blake, Goodridge, & Sam, 2011, 2015). Finally, administrators could periodically monitor synchronous broadcast classes and identify, through direct observation, instructors who might benefit from additional training.

Professional Program

The data show that the major areas for improvement within the professional program suggested were in the areas of advising and course scheduling, the Logan campus engineering culture and predominant use of teacher-centered instruction, and course support.

Advising in the professional program. Data from this study suggests that the nontraditional student participants needed academic advising that was contextualized, frequently occurring, and ongoing. This data echoes findings of other researchers (Gard et al., 2012; Olson & Labov, 2012) who report that improper advising contributes to poor

transfer rates between two and four year colleges. Taken together, these findings suggest that advising that works for traditional students in 4-year colleges may not be adequate or appropriate for nontraditional students transferring from a 2-year university. It was also inferred from the actions of the professional program advising staff that they did not have the resources or knowledge base to provide all of the advising that was required or desired by the participants.

Therefore, it is recommended that a dedicated engineering advisor be put in place for nontraditional students who transfer to a professional program on the Logan campus. While this advisor may oversee a much smaller number of students, student meetings would occur more frequently and cover a wider range of topics. The nontraditional student advisor should be knowledgeable and empathetic to the nontraditional student context and carefully assist nontraditional students in arranging for alternative curricular schedules. S/he should keep in close contact with nontraditional transfer students, especially during their critical first year in the professional program. The nontraditional student advisor should also be responsible for such things as arranging financial aide and loan counseling, campus orientations, assistance accessing course support, and social opportunities for nontraditional students to meet other students in the professional program.

Course scheduling. Data show that participants, who often worked full—time while going to school, struggled because a) required courses were often scheduled in a way that precluded shift work (required courses scheduled early in the morning and late in the afternoon on the same day— incidentally with no classes scheduled in between—

precluded nontraditional students from working either the 1st or 2nd shifts) and b) required courses were not offered in the summer. Taking a reduced load each semester while taking courses year round was one strategy employed by participants in the preprofessional program to maintain balance while steadily progressing way toward their degree. It is recommended that the professional programs consider a) work shifts when scheduling required courses and b) offering required courses during the summer semester. It is also recommended that advisors provide options for alternative course scheduling that allow nontraditional students more overall time to complete the professional program.

Professional program engineering culture, teacher-centered instruction, and course support. As participants transferred from the preprofessional to the professional engineering program, one of the most significant changes they had to make was adjusting their expectations for instructor-based interaction and support. Course support mechanisms on main campus were clearly centered on peer support (e.g. study groups, undergraduate tutors) and, to a lesser extent, graduate student support (teaching assistants were available in some courses). University engineering faculty provided only a minimum level of support (scheduled office hours) outside of class. Many participants reacted negatively to this reality after having known their preprofessional instructors well. In addition, the large lecture style courses—that seem almost common in the professional program—and associated teacher-centered instructional practices employed by the faculty reinforced the perception among the participants that the engineering college was uninviting and uncaring.

Participants, who often had few student contacts on main campus and work schedules that precluded them from attending office hours and study group meetings (if they were able to join a study group at all), generally felt unsupported in their courses in the professional program. The college of engineering tutors, who held in person support hours on weekdays and Saturday mornings, provided perhaps the best option for supporting the participants in their courses. However, the participants often voiced that the undergraduate tutors were ill prepared to help them at anything other than a cursory level.

Therefore, in order to better support nontraditional engineering students in the professional program, it is recommended that the process for selecting college of engineering tutors be critically examined and that the possibility for employing graduate students as college of engineering tutors be considered. Graduate students who are assigned to tutor undergraduate courses in their disciplinary sub-area should be able to provide a deeper level of support compared to undergraduate students tutoring across the range of disparate undergraduate courses. It is further recommended that tutor hours be expanded to include evening and weekend hours to adequately support nontraditional students who often work full time during the weekdays. Additionally, options for online/remote tutoring to support nontraditional students when off campus should be considered. Online tutor access may be a viable option for weekend or evening course support.

The Engineering Education Transfer Pathway

Inter-programmatic trust. The data suggested that a major obstacle to realizing a widely traversable engineering pathway that links the alternative transfer program to the professional program might well be a lack of trust. In order to best support preprofessional students as they transfer into the professional program, staff and faculty at all levels of the institution must trust that the nontraditional transfer students are, indeed, desirable and worthwhile human capital in engineering education. For trust to occur, the perceptions among professional program faculty that the nontraditional transfer students are somehow ill prepared or less than the traditional students must be changed.

In order to change this perception, closer interaction is required among personnel at all levels of both programs. Faculty interaction, however, may be most important. It is recommended that faculty from both programs be brought together regularly to discuss specific curricular issues and decisions related to the courses they teach. Program administrators should insure these meeting occur and are documented. Faculty from both programs who teach the same courses should collaborate and interact frequently, sharing insights and lessons learned from their classrooms. Faculty partners could attend each other's classes on an occasional basis to insure teaching emphases are consistent across campuses. Close interaction at all levels will do much to insure that program requirements, processes, and procedures are equivalent across main and regional campuses. Over time, this type of interaction will infuse trust between the personnel of both programs. Trust will naturally lead to the best possible outcomes for the transferring nontraditional students.

Connecting work and school. The participants who enjoyed, perhaps, the most desirable outcomes in terms of their social mobility goals were those who were employed by prominent regional engineering companies throughout their engineering education. For many of these participants, earning an associate's degree in preengineering degree while gaining technical skills on the job served to signal their worth as future engineering employees. As a result of job market signaling, employers supported the participants and enabled them to maintain their level of employment while attending the professional program. Several of these participants went on to be hired as engineers by these companies.

These results suggest that one way to increase nontraditional student participation in engineering is for academia and industry to work together, in partnership, to create more engineering and technology-related employment opportunities for nontraditional students. By teaming with industry, academic institutions and industry together may find new ways to ease the burden that nontraditional students face in securing decent, flexible, and perhaps long-term, benefitted employment while pursuing an engineering education. With these partnerships in place, academic institutions could help match incoming nontraditional students with established school-friendly employment option. Such efforts toward creating partnerships between schools and industries located within the same region may be very effective in making the engineering education pathways more widely traversable by nontraditional students.

Recommendations for Future Research

Nontraditional student success in engineering education is a rich area for continuing research. There are two important areas for further study that are suggested by findings of this project. The first is the use of distance education to create alternative pathways for those currently underrepresented in engineering education. This study suggested the distance-delivered instruction is a viable means for providing access to preengineering curricula by moderately to highly nontraditional students. More research is needed to understand which distance instructional options (i.e., synchronous broadcast, hybrid, fully asynchronous) may provide the most impactful strategies in engineering education. Moreover, distance-delivered instruction may offer potential for providing nontraditional undergraduates unprecedented access to engineering education throughout the entire 4-year curriculum. Funded research examining how distance education can be integrated with traditional education programmatically to serve underrepresented students in engineering is growing (Enriquez et al., 2015) and further signals the importance of this area for on-going inquiry.

The second area for research that is suggested by this work is understanding how joint efforts between academia and industry can be initiated and leveraged to envision and develop work-study options for nontraditional students who require employment during their engineering education. The results of this study showed that sustained engineering-technology sector employment with employers who shared in the goal of engineering degree attainment benefitted several nontraditional student participants. Working toward a better understanding how this synergy develops and how these

arrangements can be purposefully created and maintained on a programmatic scale is also a rich area for inquiry.

Significance

This study attempts to understand the ways in which the nontraditional student participants defined and experienced success while participating in an alternative undergraduate engineering pathway. The focus on nontraditional students is timely because, as (Choy, 2002) notes, “The traditional student...is [now] the exception rather than the rule” (p. 1). The aim of this study is go “beneath the surface” (Case & Light, 2011, p. 205) to find deeper meaning in ways in which nontraditional students negotiate engineering education. It is hoped that this newfound meaning will be used to envision contemporary educational pathways that are responsive to and supportive of the needs nontraditional students as future engineers.

The narrative data collected and analyzed in this study suggest that, while nontraditional students face substantial barriers to access and participation in engineering education, their long-range, contextualized views of educational success often enable them to persist despite stressful and potentially overwhelming circumstances. The nontraditional participants in this study showed tremendous dedication, drive, and creativity in negotiating barriers to achieve educational success as they came to define it. Perhaps most importantly, their stories stand as proof that nontraditional students have tremendous potential for making significant and lasting contributions to the engineering profession.

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APPENDICES

Appendix A

IRB Letter of Approval

Institutional Review Board

USU Assurance: FWA#00003308



Exemption #2

**Certificate of Exemption**

FROM:

Melanie Domenech Rodriguez, IRB Chair

Nicole Vouvalis, IRB Administrator

To: Oenardi Lawanto, Sherry Marx, Angela Minichiello
 Date: May 11, 2015
 Protocol #: 6625
 Title: Nontraditional Student Success In A Distance-Delivered Engineering Transfer Program

The Institutional Review Board has determined that the above-referenced study is exempt from review under federal guidelines 45 CFR Part 46.101(b) category #2:

Research involving the use of educational tests (cognitive, diagnostic, aptitude, achievement), survey procedures, interview procedures or observation of public behavior, unless: (a) information obtained is recorded in such a manner that human subjects can be identified, directly or through the identifiers linked to the subjects; and (b) any disclosure of human subjects' responses outside the research could reasonably place the subjects at risk of criminal or civil liability or be damaging to the subjects' financial standing, employability, or reputation.

This exemption is valid for three years from the date of this correspondence, after which the study will be closed. If the research will extend beyond three years, it is your responsibility as the Principal Investigator to notify the IRB before the study's expiration date and submit a new application to continue the research. Research activities that continue beyond the expiration date without new certification of exempt status will be in violation of those federal guidelines which permit the exempt status.

As part of the IRB's quality assurance procedures, this research may be randomly selected for continuing review during the three year period of exemption. If so, you will receive a request for completion of a Protocol Status Report during the month of the anniversary date of this certification.

In all cases, it is your responsibility to notify the IRB prior to making any changes to the study by submitting an Amendment/Modification request. This will document whether or not the study still meets the requirements for exempt status under federal regulations.

Upon receipt of this memo, you may begin your research. If you have questions, please call the IRB office at (435) 797-1821 or email to irb@usu.edu.

The IRB wishes you success with your research.

Appendix B

Screening Survey Protocol

Did you delay enrollment into college?

Delayed enrollment indicates that there was a gap in time between the date of your high school graduation (or attainment of a high school completion certificate) and your enrollment into the associates in pre-engineering program (APE).

If you graduated high school in May/June and then started the APE program in the following August/September, do not consider this a delay.

- Yes
 No

How many months passed between the date of your high school graduation (or attainment of high school completion certification) and your enrollment into associates in pre-engineering program (APE)?

Do/did you attend college part-time for at least part of any academic year during the associates in pre-engineering program (APE)?

- Yes
 No

Do/did you work while enrolled in the associates in pre-engineering program (APE)?

- Yes
 No

Was this work considered full time?

- Yes
 No

On average, how many hours per week did you work while enrolled in the associates in pre-engineering program (APE)?

Are/were you considered financially independent for the purposes of obtaining financial aid for college while enrolled in the associates in pre-engineering program (APE)?

- Yes
 No

Do/did you have dependents other than a spouse while enrolled in the associates in pre-engineering program (APE)?

- Yes
 No

Are/were you a single parent while enrolled in the associates in pre-engineering program (APE)?

- Yes
 No

Do you have a high school diploma?

- Yes
 No

What high school certification do you have?

Powered by Qualtrics

Appendix C

Email to Potential Student Volunteers

Hello!

I am emailing you to request your participation in a research study entitled “Nontraditional Student Success in an Distance-delivered Engineering Transfer Program.” This study seeks to gain a better understanding of how nontraditional students experience success within alternative undergraduate engineering programs. You have been asked to take part because you are or have been enrolled in the Associates in Preengineering Program at Utah State University Regional campuses.

Please read the attached letter that explains how I will select participants for the study. If—after reading the attached letter—you are interested in participating in the study, please reply to this email letting me know you’d like to volunteer. I will respond to your email with a link to a short (5 minute) online survey and a unique study identifier (for you to use in accessing the survey). You must complete the online survey to be considered for participation. I will let you know whether or not you have been selected via email by early August.

Thank you for your interest in helping improve nontraditional student success in engineering education! I hope you will consider volunteering to be a part of this research.

Sincerely,

Angie

P.S. If you have any questions you’d like answered before volunteering, feel free to email me at angie.minichiello@usu.edu. I will be happy to answer your questions and look forward to working with you!

Angela Minichiello, P.E.

Principal Lecturer

Ph.D. Candidate

Department of Engineering Education

Utah State University

Appendix D

Letter of Information for Screening Survey



Page 1 of 2
USU IRB Approval: 5/11/2015
Approval Terminates: 5/10/2016
Protocol #6625
IRB Password Protected per IRB Coordinator

LETTER OF INFORMATION**Nontraditional Student Success in an Distance-delivered Engineering Transfer Program-
REQUEST FOR VOLUNTEERS**

Introduction/ Purpose Dr. Oenardi Lawanto and Ph.D. Candidate and faculty member Angela Minichiello in the College of Engineering and Dr. Sherry Marx in the Emma Eccles Jones College of Education and Human Services at Utah State University (USU) are conducting a research study to understand how nontraditional students experience success within alternative undergraduate engineering programs. You have been asked to participate because you have been enrolled as a student in the USU Associates in Pre-engineering Program.

Procedures To volunteer to participate in this research study, you will be asked to complete an online survey related to nontraditional student characteristics that you may or may not possess. Completion of the survey is required in order for you to be selected to participate in the study. Your participation in the survey is expected to take approximately 10 minutes.

Risks The risks to you are considered minimal. There may be questions about activities that may make you feel uncomfortable. However, they are considered ordinary experiences encountered in daily life or during the performance of routine testing. The survey will be administered confidentially through the use of a non-descriptive ID that will be assigned if you decide to volunteer for this study. There is a small risk of loss of confidentiality but we will take steps to reduce this risk.

Benefits There are no direct benefits to you expected as a result of your participation in this study. Research data may help researchers better understand how to promote nontraditional student success in alternative engineering programs.

Explanation & offer to answer questions Angela Minichiello has explained this research study to you and answered your questions. If you have other questions or research-related problems, you may reach the investigator at 435-797-8699.

Voluntary nature of participation and right to withdraw without consequence Participation in the screening survey is entirely voluntary. You may refuse to participate or withdraw at any time without consequence. You may be withdrawn from this study without your consent by the investigators if they have reason to suspect your responses are fabricated in any way.

Confidentiality Research data and records will be kept confidential, consistent with federal and state regulations. Only the investigators will have access to the data. All data will be digitized and kept on a USU Box.com account. The ID/name table will kept in a locked file cabinet in a locked office and separate from the electronic data. Screening survey data for volunteers who are not selected to participate in the study will be destroyed immediately. Screening survey data for selected participants will be destroyed three years after completing the research.



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USU IRB Approval: 5/11/2015
Approval Terminates: 5/10/2016
Protocol #6625
IRB Password Protected per IRB Coordinator


LETTER OF INFORMATION
Nontraditional Student Success in an Distance-delivered Engineering Transfer Program-
REQUEST FOR VOLUNTEERS

IRB Approval Statement The Institutional Review Board for the protection of human participants at USU has approved this research study. If you have any pertinent questions or concerns about your rights or a research-related injury, you may contact the IRB Administrator at (435) 797-0567 or email irb@usu.edu. If you have a concern or complaint about the research and you would like to contact someone other than the research team, you may contact the IRB Administrator to obtain information or to offer input.

Investigator Statement "I certify that the research study has been explained to the individual, by me or my research staff, and that the individual understands the nature and purpose, the possible risks and benefits associated with taking part in this research study. Any questions that have been raised have been answered."

Signature of Researcher(s)

Oenardi Lawanto, PhD
Principal Investigator
(435-797-8699)
(olawanto@usu.edu)



Angela Minichiello, P.E.
Student Researcher
(435-919-1284)
(angie.minichiello@usu.edu)

Signature: 
Sherry Marx (Jun 15, 2015)
Email: sherry.marx@usu.edu

Sherry Marx, PhD
Co-Investigator
(435-797-1441)
(sherry.marx@usu.edu)

Signature: 
Oenardi Lawanto (Jun 15, 2015)
Email: olawanto@usu.edu

v7 2/3/2010

Appendix E

Email to Screening Survey Participants

Hello and thank you for volunteering to take the participant screening survey! This screening survey will ask you questions concerning common nontraditional student characteristics that you may or may not possess. Please answer all questions considering your situation when you were enrolled in the USU Associates in Preengineering Program.

The data from your screening survey will be kept confidential. This data will be destroyed immediately if you are not selected to participate in the study. It will be destroyed after the study is complete if you are selected to participate.

Below you will find a unique link to the screening survey created just for you. **Please do not share this link with anyone. This is your personal survey link matched with your name.**

Once I receive screening surveys back from all of the volunteers, I will select several participants for the study. Expect to hear back from me by early August at the latest. If at any time you decide you are no longer interested in volunteering for the study, please send me an email at angie.minichiello@usu.edu and I will take you off of the volunteer list.

Thanks again! Angie

Follow this link to the Survey:

Or copy and paste the URL below into your Internet browser:

Follow the link to opt out of future emails:

Appendix F

Letter of Information for Interview Phase



Department of Engineering Education
4160 Old Main Hill
Logan UT 84322-4160
Telephone: (435) 797-7020



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USU IRB Approval: 5/11/2015
Approval Terminates: 5/10/2016
Protocol #6625
IRB Password Protected per IRB Coordinator

LETTER OF INFORMATION**Nontraditional Student Success in an Distance-delivered Engineering Transfer Program**

Introduction/ Purpose Dr. Oenardi Lawanto and Ph.D. Candidate and faculty member Angela Minichiello in the College of Engineering and Dr. Sherry Marx in the Emma Eccles Jones College of Education and Human Services at Utah State University (USU) are conducting a research study to understand how nontraditional students experience success within alternative undergraduate engineering programs. You have been asked to take part because you are either currently enrolled as a student in, or have graduated from, the USU Associates in Pre-engineering Program. There will be approximately 10 participants in this study.

Procedures If you agree to participate in this research study, you will be asked to take part in a series of interviews with the researcher in order to document your experiences within the Associates in Pre-engineering program. Your participation is expected to take approximately 4 hours over the course of 4-5 interviews sessions.

Risks The risks to you are considered minimal. There may be questions about activities that may make you feel uncomfortable. However, they are considered ordinary experiences encountered in daily life or during the performance of routine testing. There is a small risk of loss of confidentiality but we will take steps to reduce this risk.

Benefits There are no direct benefits to you expected as a result of your participation in this study. Interview data may help researchers better understand how to promote nontraditional student success in alternative engineering programs.

Explanation & offer to answer questions Angela Minichiello has explained this research study to you and answered your questions. If you have other questions or research-related problems, you may reach the investigator at 435-797-8699.

Payment You will receive a \$30 gift card for your participation in this study. **If you will receive payments, gift cards or similar items of value for participating in this research**, the Internal Revenue Service (IRS) has determined that if the amount you get from this study, plus any prior amounts you have received from participating in research studies at USU since January of this year, total \$600 or more, USU must report this income to the federal government. If you are a USU employee, any payment you receive from this study will be included in your regular payroll.

Voluntary nature of participation and right to withdraw without consequence Participation in research is entirely voluntary. You may refuse to participate or withdraw at any time without consequence. You may be withdrawn from this study without your consent by the investigators if they have reason to suspect your responses are fabricated in any way.



Department of Engineering Education
4160 Old Main Hill
Logan UT 84322-4160
Telephone: (435) 797-7020



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USU IRB Approval: 5/11/2015
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LETTER OF INFORMATION

Nontraditional Student Success in an Distance-delivered Engineering Transfer Program

Confidentiality Research data and records will be kept confidential, consistent with federal and state regulations. Only the investigators will have access to the data. All data will be digitized and kept on a USU Box.com account. Audio (only) interview recordings will be captured digitally and thus will also be kept on the USU Box.com account. The ID/name table will kept in a locked file cabinet in a locked office and separate from the electronic data. Interview recordings will be destroyed when the study is completed. All other data will be destroyed three years after completing the research. Pseudonyms will be used to protect participant confidentiality during reporting of research findings.

IRB Approval Statement The Institutional Review Board for the protection of human participants at USU has approved this research study. If you have any pertinent questions or concerns about your rights or a research-related injury, you may contact the IRB Administrator at (435) 797-0567 or email irb@usu.edu. If you have a concern or complaint about the research and you would like to contact someone other than the research team, you may contact the IRB Administrator to obtain information or to offer input.

Investigator Statement "I certify that the research study has been explained to the individual, by me or my research staff, and that the individual understands the nature and purpose, the possible risks and benefits associated with taking part in this research study. Any questions that have been raised have been answered."

Signature of Researcher(s)

Oenardi Lawanto, PhD
Principal Investigator
(435-797-8699)
(olawanto@usu.edu)

Angela Minichiello, P.E.
Student Researcher
(435-919-1284)
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 IRB Password Protected per IRB Coordinator

LETTER OF INFORMATION

Nontraditional Student Success in an Distance-delivered Engineering Transfer Program

Statement of Consent: I have read the above information, and have received answers to any questions I asked. I consent to take part in the study.

Your Signature _____ Date _____

This consent form will be kept by the researcher for at least three years beyond the end of the study and was approved by the IRB on [date]

Appendix G

Interview One Protocol

1. Where are you in your life (job, education, personal life) now?
 - a. Describe your current situation (work, family, living situation)
 - b. How did you get to be where you are?
 - c. Are you where you thought or planned you would be?
 - d. Are you where you want to be?
2. Describe your background and how you came to participate in to the USU APE program.
 - a. Why did you choose the USU APE program?
 - b. What were your goals in relation to the APE program?
 - i. How did you choose these goals?
 - c. What obstacles did you face?
 - i. How did you overcome these obstacles?
 - ii. How did prior experiences affect your ability to overcome obstacles?
 - d. What successes did you achieve?
3. Additional prompts to use as needed
 - a. Tell me about yourself.
 - b. Tell me about your family.
 - c. Tell me about your education.
 - d. Tell me how you got to college.
 - e. What about APE Program helped? What about the APE Program made things difficult?

- f. What are your plans for the future?
 - g. Anything else you'd like to tell me?
4. Probes on institutional structures- financial, early education, later education, city/community services, religious institutions, student support, transportation, rules and regulations inside the university/college like transfer rules, admission rules, graduation rules...
5. Generic prompts
- a. Let's talk about that for a minute
 - b. Tell me more about that.
 - c. So, just to clarify...
 - d. How did you learn this?
 - e. What about this was important to you?
 - f. Any regrets? Anything you wish had been different?
 - g. Tell me about a time when...

Appendix H

Post Interview Reflection Memo

Miles and Huberman (1994, p. 53)

1. What were the main issues that struck you in this interview?
2. Summarize the information you got (or failed to get) on each of the target interview areas you had.
3. Was there anything else that struck you as salient, interesting, illuminating, or important in this interview? Any patterns?
4. What new (or remaining) questions do you have in considering the next interview with the subject? With another subject?

Appendix I

Journey Map Instructions for Participants

Please complete and bring with you to our next meeting

Take a few minutes to think about your journey as an engineering student in the USU APE program, on your way to your personal and professional goals. How would describe your experience? You may want to capture “your APE story” either visually or with words- whichever is helpful for you.

Appendix J

Participant Narratives Not Highlighted in the Main Dissertation Text

Joe: In It for the Long Haul

“It’s taken me so long to get here, it would be a glorious waste of time to quit.”

At thirty-five and married with a five-year old son, Joe works as a heating, ventilation, and air conditioning (HVAC) technician at ATK Launch Systems Group (formerly Thiokol, then ATK, now Orbital-ATK) in Promontory, Utah. Hired as a temporary worker in 2007, Joe was promoted to full-time status after only four months on the job. At the time, the technician job at ATK was a good fit for Joe. It provided steady work during the lean times of the housing downturn of 2007-2008, paid a decent salary, and provided generous health care benefits and tuition reimbursement when he went to full-time status.

Joe was well prepared for HVAC work. When he was sixteen, his dad got laid off from his job as a computer programmer for the Southern California Edison power company. Joe’s dad quickly found employment at Thiokol located in Promontory, Utah and moved the family from the ocean side town of Vista, California to Tremonton, Utah. Tremonton is located about halfway between the city of Logan and Promontory—the location of the golden spike where the first transcontinental railroad in the United States was completed.

The move was tough for Joe who felt as if his family was moving to “the boonies.” As Joe explained, “It seemed like my high school in Southern California was bigger than the entire city of Tremonton.” New to the mountain west and the more rural lifestyle,

Joe's family started out renting a house. One day, the house's well went out. When the landlord came by to put in a new one, Joe offered to help. It wasn't that Joe knew anything about putting in wells— he was just trying to be helpful and to keep from getting too bored. After putting in the new well together, the landlord offered Joe a job at his heating, ventilation, and air conditioning (HVAC) company.

Joe worked at the HVAC company for the last year and a half of high school, learning how to install, operate, and maintain HVAC equipment while working occasionally with several mechanical engineers. In 1998, Joe graduated from Bear River High, which was located just up the road from Tremonton in nearby Garland, Utah. Joe considered himself a good student except, perhaps, during his senior year when he “got lazy.” Joe admitted that the move to Utah sapped his interest in school. He explained, “I knew a lot of people at school in California. When we moved, I knew nobody. I went from loving high school in California to hating it in Tremonton. I couldn't wait to get out.”

Joe spent most of the summer after graduation with his maternal grandparents in Portugal, and then enrolled at Utah State University (USU) for the fall semester of 1998. While Joe's mother—a native of Portugal—never attended college, his father graduated with a bachelor's degree in computer science from the University of California at Berkeley. Joe had two older siblings who were in college at the time he graduated from Bear River High. While Joe's parents considered going to college to be “a good idea” and offered him financial support, they never pushed Joe or told him that he had to go.

Due to his experience in the HVAC industry, Joe anticipated majoring in mechanical engineering at USU and took a “logical course load,” including chemistry

and college algebra (MATH 1050). Since Joe lived at home and his parents paid for his school that semester, Joe was considered a “traditional” college student. Despite his parents’ support, Joe put in “little effort” and “got bad grades”—a B, two C’s, and a D. At the end of the semester, Joe decided that going to college wasn’t what he really wanted.

Joe attributed some of his ambivalence toward college at the time to the knowledge that he would soon be getting a mission call from his church, The Church of Jesus Christ of Latter Day Saints. The call came early the following year. Joe left college and spent the next two years as a missionary in Connecticut and Rhode Island. During his mission, Joe considered his plans for the future. He decided that what he really wanted to do was to train to become a commercial airline pilot. For a short while, Joe considered joining the Air Force as a way to eventually work into a commercial flying position. Coincidentally, the World Trade Center attacks of September 11, 2001 occurred one week prior to Joe returning home. Even though Joe’s paternal grandfather had been career Army and his father—who had grown up as an “Army Brat”—was very patriotic, Joe knew that joining the military would be extremely hard on his parents. At the time, armed conflict— if not all out war—seemed likely and Joe was concerned that his parents would worry to the extreme about him.

After Joe returned home, he spent the summer of 2001 readjusting and then began to pursue his goal of becoming a commercial pilot. He made a tentative plan to move to Phoenix to live with his sister and attend commercial flight training at the Pan American Flight Academy. He soon found, however, that the cost of commercial flight school was

prohibitive. Joe also began dating seriously and slowly, over time, the idea of becoming a commercial airline pilot—who was away from home much of time—seemed less attractive.

Joe switched gears back to what he knew. He started to work for his family's former landlord as an HVAC technician again, hoping that he could "be successful there" and eventually work his way into a management position. Over time, however, Joe began to see that "that wasn't going to happen." Joe eventually felt that "no craftsmen would ever be promoted into management." When Joe was married in 2005 at the age of twenty-five, the momentous life event made him even more attuned to the path his career was—or was not—taking. Joe explained, "My employer and I had these discussions about where I could be in the next several years and nothing ever really happened." Joe began to see that the "sole possibility of an annual raise" was his future as a technician.

So Joe made the decision to leave the HVAC company. In 2007, Joe and his wife moved to Idaho and Joe started to work with a long-time friend from California whose brother owned a mechanical contracting business. Joe explained,

They just did plumbing and I was going to be the guy that started up HVAC for the company. At that time I decided to leave for Idaho, the housing and the construction market was really good and it seemed like it was the right thing to do. But right when we left Utah, everything backfired.

By the time Joe and his wife reached Idaho, the 2007-2008 housing market downturn made HVAC work hard to come by. The company started taking jobs in California; Joe hated all of the travel that was required. Finally, when the company asked Joe to relocate to central California, he decided it was time to do something else. In 2008, Joe and his wife moved back to Utah, only a year after they'd left. Joe explained,

My wife and I just moved back to Utah - to Riverside³⁷ - where her parents live. I didn't really know what I was going to do. I ended up getting hired on as a temp for ATK doing HVAC work. That quickly turned into a full-time position as an HVAC technician.

Back from Idaho with yet another technician job, Joe began to think hard about going back to school. While he “liked the work,” he was “getting tired of doing this” and “wanted something to fall back on, better job opportunities, and better pay.” So he set his sights on going back to school to earn his mechanical engineering degree.

In the fall of 2009, Joe enrolled in the pre-engineering program at the USU Brigham City campus. He explained why he chose USU:

When I was hired at ATK full-time, I kind of hinted to them that I wanted to go back to school. Geographically speaking, USU made more sense for me than the University of Utah or even Weber State University. One of the stipulations for tuition reimbursement at ATK was that the degree program had to be accredited and I knew that USU’s engineering programs were accredited. Also, people have always said good things about the USU engineering programs. It was supposed to be a good program and it was the most convenient so that was what I did.

Joe discussed what it was like starting school with full time employment and why chose the USU regional campus program:

I don't know if I really had a conscious decision to go to the regional campus instead of the main campus. I mostly had a fear of the long commute to Logan. For me, the commute from home to work and then to the Brigham City campus is a triangle. It’s twenty-five miles from home to work and then about thirty miles from work to the Brigham City campus and another thirty miles home. I would go to Brigham City right after work most of the time if I had classes. After a while, USU opened up the education center in Tremonton and I could take classes there, only a few miles from home. That was the best.

The other big part of that was the class times—being able to take classes at night. I don't even know if I would have tried to go back to school if there hadn't been that option. I felt like at the beginning, when I was fairly new to ATK, for me to just say “Hey, I'm going to school, I'm not showing up until 2:00pm, take it or leave it” wasn’t going to work. There were so many layoffs happening and I

³⁷ The town of Riverside, Utah is approximately seven miles north of Tremonton, Utah.

thought, “If I’m *that guy*, they’re going to get rid of me.” I was trying to minimize the impact to my work schedule. That’s probably the biggest reason why I chose the regional campus program.

Perhaps one downside of participating in the regional campus program for Joe was having to take classes via synchronous broadcast delivery. Inevitably, Joe had some classes where the instructor was not physically present in his classroom. This method of instruction initially worried Joe; he wondered if he would be able to get the help he needed quickly enough. Because he preferred to raise questions one-on-one with the instructor after class, Joe usually liked classes where he was in the same room as the instructor better than those where the instructor was at a different site. Yet, Joe also enjoyed the flexibility of being able to take classes at the Tremonton center, just down the road from home, even though it was never an origination site. In the end, Joe concluded that whether or not the synchronous broadcast instruction was an obstacle for him depended on the instructor and how well the instructor provided timely feedback and support.

Joe found his math courses to offer some of the biggest challenges he faced in the program. When Joe started back to school in 2009, it had been ten years since he been in college. Certain that he had forgotten most of what he had ever learned about college level math, Joe started at the beginning: MATH 0900 (Basic Math). While Joe never regretted retaking math, he regretted some of the experiences he had in his math courses. He felt that there were limiting expectations placed upon the regional campus students by some math instructors—as if the instructors’ only expectations for their students included

passing or failing—never that a student might be able to or want to earn a good grade. Joe remembered one experience in particular in calculus:

The first day of class the instructor told us, “All right, this is how many points you need to get a C minus. This is how many points you need to pass the class”— and that was it and then he moved on. I was like, “You’re not going to talk about what it takes to get a B or an A?” But that was the expectation—we were all just trying to pass and could not really do well in the course. It made the biggest difference when the teacher just expected you to fail. That’s what I felt like in some of those classes.

Joe sensed a “my way or the highway” attitude among a few of his math instructors and felt that they may have been out of touch with the regional campus student experience.

Joe readily admitted that his personal circumstances, attempting to balance full-time employment, family, and school, presented many challenges. The birth of his son in December of 2010 added another dimension to Joe’s struggle for an appropriate balance.

There have been days where I didn't see my son at all. I'd get up before he's up and he would be in bed before I got home because I would have an 8:00pm class in Brigham City. I hated that because I felt like I was missing his childhood. But, at the same time, I feel like I am doing this for the well being of our family in the future. I'm sure my wife feels like that too. And even when I am home, especially on the weekends, I'm doing homework. That's part of me trying to be a good employee. I would try to kind of cram all my homework into the weekends just so that I could work longer hours during the week. So even when I am home on the weekends it was like, enter my room at your own risk! Most of my Sundays were spent going to church and then doing homework for the rest of the day— that routine gets old quick. I guess time management for me was the biggest obstacle. Trying to keep my wife happy, spend enough time with my son, and be a good employee. That has always been the struggle.

Joe hoped that, ultimately, the ends would justify the means: his overarching goal was to improve his job situation and earning potential by completing an engineering degree. Joe emphasized, “ I viewed getting a degree as a way to get out of sweat work and more into smart work.” Joe felt that an engineering degree

would allow him to achieve long-term job stability while staying close to family in northern Utah, which he now considered to be home.

Yet Joe never underemphasized the importance of his employment within this balance. He explained how his performance at work ultimately took priority over his performance at school:

Obviously I wanted to do well in school, but I would probably say that work—because of the financial implications— was a higher priority for me than school. It gets more complicated as life goes on as far as the financial impact of employment. If it was a decision between going to school and maintaining my job, I would have to choose my job for now. I don't want to but that's probably what I would have to choose.

This important and perhaps unrecognized truth, that the balance point between work, family, and school may not lie equidistant between the three, provides important insight into the barriers faced by nontraditional students in college and, perhaps, the mis/perceptions of the academics who instruct them.

Fortunately, Joe has not been forced to choose between work and school. In fact, in 2013 Joe was given an opportunity that seemed to be aimed at further interweaving his work at ATK with his efforts at school. Joe's management offered him a chance to do a four-month long engineering internship at ATK. While the offer came suddenly and rather surprisingly to Joe, he decided to do it even though he didn't know exactly what it would entail.

I was given the opportunity and asked whether I wanted to do the internship or not. They said, "You'll be doing HVAC, you know, BTUs in and BTUs out, that kind of thing." So I decided to do it even though I was very busy with school.

That's not what it was. It was all sorts of different things. I was like "Holy crap, I don't know how to do any of this stuff!" I was really nervous and felt very inadequate at first. But it turned out that I liked the challenge. There was a lot of

stuff to get used to. Like CAD, I'd never really done a lot of CAD work. So I had to learn CAD pretty quick to be able to modify drawings—which is one of the things I had to do. And I had to learn all of the other computer programs that ATK engineers deal with on a regular basis that I'd never used before. That was the first month. I was like “Why am I doing this? I hate this.” But later on I kind of enjoyed it.

Joe ended up considering the engineering internship to have been a great experience and perhaps a sign that his management is looking to place him in an engineering position once he gets his degree.

He graduated in May of 2015 with his associates' degree in pre-engineering, six years after he began taking classes at Brigham City. While Joe didn't “see this 2-year degree as any benefit financially,” he did see it as a milestone toward his goal of attaining his four year degree – as if it's the official halfway point,

...Or just over halfway for me because I had to retake all of those math courses. At the beginning, I looked at all those math classes and I was like, man, I'm never going to get through all this. I hated the beginning of every semester but I felt so good at the end of every semester, being that much closer. I had papers that list all the classes I had to take. When I get to cross off one of those, it felt so good.

Along with the progress that the associate's degree tangibly represented, Joe saw success in the ways he was able apply what he learned in the pre-engineering program to do his current job better. He thought it was “cool to be able to run calculations for HVAC systems as well as fix them” and did a lot of work with and for the facilities engineers that other technicians can't. Joe felt he was able offer a unique combination of hands-on skill and technical knowledge to his employer and the larger HVAC industry after earning his associate's degree. For example, Joe explained that, “Taking thermodynamics has really helped me understand refrigeration at a level where I just get it and can readily explain things about it to other technicians and engineers. I couldn't do

this before going back to school.” Joe felt he understood and related better to the engineers he worked for and gained an engineering related mindset that helped him spot potential problems in the field sooner. All of this, he hopes, will allow him to transition to a facilities engineering position at ATK once he earns his engineering degree.

Joe’s Epilogue

Joe applied for and was provisionally³⁸ accepted into the mechanical engineering professional program after graduating from the pre-engineering program. Joe transitioned to the USU Logan campus in the Fall of 2015. His plans to take three courses per semester and graduate with his bachelor’s degree in mechanical engineering in three to four years. At ATK, Joe will transition to swing shift to accommodate his daytime course schedule. Joe’s management appears supportive of his efforts. Joe is most concerned with maintaining his job performance, dealing with the increased commute and unusual work hours, and transitioning to completing homework throughout the week.

³⁸ For Associate’s in Pre-Engineering students who were not able to take the MAE 2165 Materials Laboratory at their respective campus, the preprofessional degree is “provisionally” awarded until completion of the MAE 2165 Laboratory when the students attend classes in Logan. After completing the laboratory, students are then officially eligible for acceptance into the Professional Program.

Tom D.: It's all About Balance

Perhaps the worst financial crisis to hit the U.S. economy since the Great Depression, the Global Financial Crisis of 2007-2008 permanently altered the lives and livelihoods of tens of thousands of people throughout the United States and the world. While the crisis jeopardized the solvency of many iconic financial institutions, its after-effects nearly collapsed the entire U.S housing market. By the fall of 2008, U.S housing prices had fallen over 20% from their peak values reached in 2006, and just under 10% of all U.S. mortgages were either delinquent or in foreclosure. It was during these economic times that Tom, at 41 years old, steeled himself to begin his undergraduate engineering studies.

With short yet styled jet-black hair that is only tinged with flecks of grey, Tom was an articulate and athletic-looking 48 year-old who didn't immediately strike one as a former Marine. Yet, when he turned 18 halfway through his senior year at Granada high school in Livermore, California, Tom immediately enlisted in the Marine Corps. An average B-/C+ high school student who was good at math even though he "didn't work at it much," Tom he served on active duty for a year and then continued to serve in the Marine Corps Reserves for an additional five years. His enlistment didn't come as a surprise; Tom's family had a long, rich history of military service. Tom's grandfather had been a Lieutenant Colonel in the Marines; his Uncle was a Navy Commander; his brother and sister served in the Army and Air Force, respectively. To Tom, military service seemed like the natural follow-on to high school.

The ease with which Tom entered military service immediately after high school was also a result of the attitude his parents had taken toward higher education. While Tom's parents each had earned professional qualifications through education at community colleges, neither had earned bachelor's degrees: Tom's mother worked as a nursing assistant and his father worked—for over 40 forty years—as a railroad engineer driving trains for the Southern Pacific, Western Pacific and Union Pacific Railroads. Tom remembered clearly how rarely his parents discussed money, retirement, or college while he was growing up. Looking back, he got upset thinking about the approach his parents took³⁹.

Sometime during the year he spent on active duty, Tom started to think about his own education and decided that what he really wanted to do was to go to college. He made a mental plan to start school after his active duty service was over. He also began to regret that he did not to sign up for the GI Bill. Perhaps it was bad timing but, in 1985 when Tom enlisted, the GI Bill program had changed in two important ways. The total benefits paid out to each service member were substantially reduced and, perhaps even more bothersome to many, the program now required a monthly \$200 deduction from each enrolled service person's paycheck. The idea of the paycheck deduction irked Tom so much that he declined the option to enter into the program.

³⁹ With his own kids, Tom took for a totally different approach—one that is squarely focused on higher education. As he explained it, "I don't want my kids being 50 years old and going to college."

In 1986, within a week of being discharged from active duty and returning home to California, a friend called and offered Tom a construction job paying \$8/hr. “If you can get here in an hour, it’s yours,” his friend had said. For a 19-year-old at that time, \$8/hr. was good money. Tom hurried out to the jobsite, set on making some of that good money while he worked on lining things up for school.

From the outset, Tom excelled at the construction trades. He had a natural ability for structures and seeing how things fit together. He excelled so much, in fact, that his received regular raises and his pay increased at a steady rate. Yet, while Tom found construction to be lucrative, he also found it to be very demanding of his time. Up at 5am and home after 6pm each evening, Tom was exhausted at day’s end, not only from the physical labor but also from the long commutes to and from jobsites. Soon, Tom found himself putting his education on the back burner, so to speak. A more opportune time to pursue his education, however, became more and more elusive as he continued to excel at construction. After only four years on the job, Tom was promoted to foreman and began running his own construction crews. At that point, Tom found it nearly impossible to break free of the “death grip” of construction work.

While construction offered him good money, Tom also began to see that construction work “was really for young people.” In fact, it was physical injury that eventually put Tom back on the path toward an undergraduate education. Between 1990 and 1996, Tom injured his back on construction sites and underwent two separate surgeries to correct the injuries. After the second surgery, Tom’s boss insisted that he retrain under the company’s Worker’s Compensation insurance. Tom gratefully accepted

the offer and chose to retrain as a building inspector because, as he said, “construction was all I’d ever known.”

In 1996, there were only two community colleges in California that offered a certificate program in building inspection. Tom chose the nearest one, which was in the Bay area and roughly a two-hour drive from his home. He completed the two-semester, full-time program that year and earned 50 community college credits and a building inspection certificate. The certificate turned out to be a real boon for Tom because it made him marketable in the building inspection industry.

In 1997, shortly after earning his building inspector license, Tom applied for a position as a building inspector for the City of Logan, Utah. When he got the job, he willingly uprooted himself from California and moved to Utah to begin what became a very successful career as a building inspector. Always looking toward the next step, Tom continued to train for code certifications in the broad areas of building safety and construction. By 2006, he earned enough stacked credentials to reach the level of Plans Examiner— widely considered the “glass ceiling” of the building inspection industry.

While Tom was proud of his accomplishment, he grew more and more uncomfortable as he considered that he had reached the zenith of his career in building inspection prior to celebrating his fortieth birthday. Hoping to find new opportunities for advancement, Tom kept training to earn more code certifications. His ultimate objective at that time was to earn with the highly coveted Master Code Professional (MCP)

certification⁴⁰. The MCP is the highest and most prestigious of all certifications offered by the International Code Council. In 2007, while serving his tenth year as a building inspector, Tom was just two code certifications shy of earning the MPC.

At about the same time, the Global Financial Crisis began hit the United States. News of worsening economic conditions, stateside and abroad, was on every television channel, in every newspaper, and on everyone's lips. As the number of building inspections jobs dwindled statewide and elsewhere, Tom started to get a little scared, concerned for his future marketability. What could he do for a livelihood if the housing market collapsed? Kicking himself for not following up on his education earlier, he decided to tag along with a colleague who was using his lunch break to visit an academic advisor at the main university campus. His friend was finishing up the last six courses required for his bachelor's degree in Business after an extended break.

Halfway expecting an uproarious guffaw in reply, Tom casually posed a question to the advisor: "What would it take for me to get a bachelor's degree in civil engineering?" Instead of laughing, the advisor neatly mapped out the three classes Tom would have to take in order to gain admission to the university. Finally, Tom could see how to begin his education.

Tom came home that very same evening and casually told his spouse, "Honey, I'm going to school." And that, as they say, was that. Tom took the required entrance

⁴⁰ Currently, there are only about 800 professionals nationwide who have earned this certification. Typical MCPs hold a minimum of seventeen individual code certifications. Tom went on to earn his MCP in October, 2011.

courses online and/or in the evening that semester and gained acceptance into the university the following semester. Once accepted, Tom told his supervisor at Logan City of his plan to start school to become an engineer. His boss responded with words of encouragement and told Tom that Logan City would support his educational efforts as long as they didn't interfere with work. Logan City offered to pay for his tuition for one semester.

Excited by his employer's supportive attitude, Tom emailed the College of Engineering academic advising office, asking for help on how to set up his schedule for structural engineering, an emphasis area within the civil engineering program, given that he was a full-time working student. The response he received from the engineering advising office took him aback. In a nutshell it said: "Don't try engineering without quitting your job first. You'll never make it if you don't." Needless to say, quitting his career was not an option for Tom. And, while Tom later looked back and appreciated where the engineering advisor might have been coming from, at the time the response just plain ticked him off.

Nevertheless, he remained undeterred. Empowered by having watched the Business College advisor look up course requirements online, Tom went to the university's website and found the civil engineering program curriculum. Over the next several years, Tom registered and took the classes listed in the pre-professional course list. Purposefully, he inched his way through the pre-professional civil engineering curriculum: Each semester, he registered for one to two courses that he thought he could

do given his other responsibilities at work as a building inspector and at home as a husband and father of two teenage boys.

While Tom took as many courses online as he could initially, eventually he had to commute to the regional campus to take engineering and engineering pre-requisite courses such as math and science. When Tom started taking engineering courses, he chose them precisely so that he'd only have classes two nights a week, either Monday/Wednesday or Tuesday/Thursday. For these two days, he came to work about an hour early in the morning—"to get his hours in"—and then left an hour early in the evening in order to get to class on time. On those nights, Tom was in class from 5:15pm until 10:30pm and didn't get home until after his sons were in bed. On Sundays, he spent the entire day—and night if necessary—doing homework and studying.

Tom tried his best to leave the other four days of the week untouched by his educational pursuits. He worked to achieve and maintain balance between being engaged as a husband and father (family), providing for his family (work), and completing his engineering bachelor's degree (education). Maintaining the delicate three-point balance was Tom's primary goal throughout his college experience. If he earned his bachelor's degree without maintaining the balance, he would not have considered himself wholly successful.

Looking back, Tom saw his collegiate experience as serendipitous in some very important ways. As it turned out, the first few engineering courses he took at the regional campus were course offerings that, in 2009, officially became part of the Associates in Pre-Engineering program. Tom was able to "fly under the advising radar" for awhile but,

as the program solidified and was officially rolled out in 2009, he was required to declare the program and civil engineering as his major. Later, he worked with the regional campus engineering advisor who seemed to understand his situation as a full-time working student.

In fact, Tom stated that he considered the Associates in Pre-Engineering program as key to his success. During the first years, he needed a way to get courses “under his belt” while he continued to work a normal daytime shift. He needed to work not only to support his family but also to pay for his education. “I actually paid for the first couple of years in cash. And it started draining. I put a couple of years on a credit card—which was a huge mistake. Then I found FAFSA⁴¹. That really helped. I even started getting scholarships.”

As time went on and Tom progressed in the program, his employer took note. In 2011, Tom transferred out of Building Inspection and into Storm water Inspection. Storm water Inspection is housed in the engineering department. His new supervisor was enthusiastic about Tom working toward his engineering degree.

“I’m not much for ceremonies.” Even though Tom did not attend the regional campus graduation ceremony, held one evening in early spring 2014⁴², he feels strongly that the Associates in Pre-Engineering degree he received that day in abstention was

⁴¹ FAFSA stand for Free Application for Federal Student Aid.

⁴² Tom underwent a third back surgery while taking courses in the Associates of Pre-engineering program. This surgery forced him to take a semester off from his studies and extended his Associates degree graduation date by approximately one year.

extremely worthwhile: as formal documentation of his engineering college credits⁴³, as “employment insurance⁴⁴,” and as a milestone indicating his employer his capability and resolve to become an engineer. As a direct result of earning his Associate’s Degree in Pre-Engineering, Tom was promoted to an engineering technician at Logan City. His schedule flexibility allowed him to take classes during the day— needed because the remainder of this bachelor’s program was only offered at the main campus during the day. He was given a laptop to be able work from campus instead of commuting in between classes. He was also permitted to work on Saturdays if needed. In essence, his employer made it possible for Tom to continue on and complete his engineering bachelor’s degree.

If there had been no Associates in Pre-Engineering program, I probably wouldn't be here— I wouldn't be in engineering. I would probably have ended up in the Business College where I know they have night and online classes. I would have chosen something like that—which is sad since I wanted to be an engineer.

Tom D.’s Epilogue

Since graduating in spring 2014 with his Associates in Pre-Engineering degree, Tom was accepted into the civil engineering professional program on the main campus. Tom has been taking classes on main campus since Fall 2014, enrolled as a part- time student while he continues to work full-time at Logan City as an Engineering Technician. Tom anticipates attending his graduation ceremony for his Bachelor’s Degree of Civil Engineering in Spring 2016 with his wife who will also be receiving her Master’s Degree.

⁴³ Tom was dismayed when the credits for the certifications earned leading up to his MCP qualification were not transferrable into the USU system because they were not part of the degree program.

⁴⁴ Tom received weekly online updates from the American Public Works Association that regularly advertise job openings for Engineering Technicians. Typically applicants for these positions are required to have an Associates Degrees in Pre-Engineering.

Once Tom receives his degree, he hopes to move into an EIT civil engineer position at Logan City and eventually become professional civil engineer.

Mike: A Work—School Symbiosis

Entering college, Mike was more than just book-smart. An ‘A’ student in high school who earned an academic scholarship to Utah State University (USU), Mike also seemed to have an innate ability to solve hands-on, mechanical problems. Mike attributes his mechanical talent mainly to his upbringing on the family “farm” in Perry, Utah⁴⁵. He explained,

Well, I guess I should preface my use of the word “farm” by saying that it's not a full-blown, giant farm. It is just twenty acres, a barren spot of land actually, that my parents bought so that their kids could learn how to work with their hands and how to work hard—that kind of thing.

I have always been mechanically minded because I grew up on a farm and it seemed like I always had to help fix the farm equipment. I had a basic idea of what different components did very early on—like gears and sprockets and all that stuff—from fixing farm equipment. We’d fix all sorts of equipment like tractors, swathers, and balers. My dad would hand us parts and say, “Here are the parts. Go figure it out.” So I’d go through and change the tines our swather that catch the hay and pull it back. I’d pull old parts off and then put new ones in there and put them all back together.

Mike’s parents had other employment; the “farm” was not their primary source of income. Mike’s mom was a published author who wrote at home and also taught piano. Mike’s dad was a maintenance technician at Autoliv⁴⁶ manufacturing and test facility in Brigham City, Utah. Both of his parents earned associate degrees from Brigham Young University-Idaho earlier in their lives.

In addition to being adept at and trained in mechanical systems maintenance, Mike’s dad was also interested in business and business management. These interests

⁴⁵ The city of Perry, Utah is located three miles south of Brigham City, Utah.

⁴⁶ Autoliv, Inc. develops, manufactures and markets safety equipment for automobiles. Autoliv has eighty manufacturing facilities in twenty-eight countries.

were reflected in the activities that Mike's dad asked Mike and siblings to do. For example, Mike's dad encouraged the kids— that is Mike, his brother and sister—to make their own money by raising and selling cows at auction. Mike explained,

Ever since I was little, we—the kids—raised cows. We never had video games. Instead, my dad had us doing our own little business where he'd buy us the cow and the milk replacer and the equipment for it and provide us with the hay from the field. What usually happened is my dad would buy Holsteins, or milk cows, and we'd get the bull calves. Then we had to do all of the work—like haul the hay— to raise them. We'd keep them for about a year. Then we'd sell them at auction for whatever price we could get that year and get to keep the money.

Right before I left for my mission—which was right after I graduated from high school— I had twelve cows. I had more before that, you know, but I sold them to pay for my mission. I had like a little herd running around. I knew them all by their spots and their names.

Mike's dad started back to college well after Mike did. After working on his own bachelor's for quite some time, Mike's dad graduated with a bachelor's degree in business management.

Along with fixing large farm equipment and running a small cow business, Mike also learned much about the building trades while growing up because his family, led by his dad, built their own home on the “farm.” Mike remembered that his dad had never built a house before, but that “he got a book—like ‘How to Build a House For Dummies’—and just went with it.” Mike explained,

Dad learned how to do it all himself. He talked a lot with the building inspector about what things you need to make sure you do. And I did a lot of that stuff— framing, electrical, roofing, sheet rocking, sanding, and painting— I even helped dig the hole for the basement. Dad had some stuff that he hired out like the insulation and digging the hole for the main house. But mostly we did it ourselves.

We started the basement first. We lived in the garage for the first five years until dad saved up enough money to start building the main house. I think I

was in eighth grade when we started to build the main house. I worked on that all through high school. It's still not completely done.

Mike felt like his experiences growing up gave him a lot of hands-on mechanical knowledge.

When he wasn't working on the house, fixing farm equipment, or raising and selling cows, Mike was a good student who earned mostly "A's," along with a few "A-'s," during his high school career. He played soccer all four years at Box Elder High and took as many Advanced Placement (AP) and concurrent classes as he could fit in. Mike passed the end of year test in AP Calculus I, earning college credit for that course. Mike graduated from Box Elder High School in Brigham City in 2007.

While Mike had a lot of hands-on experience, he wasn't interested in pursuing anything less than a 4-year degree. He wanted something that was "hands-on" but that was also a "real degree" that was "accredited." He just wasn't sure exactly what he wanted to study. Mike batted around ideas like professional pilot training and architecture but couldn't decide.

At this point, however, Mike didn't feel much pressure to decide since he knew he was soon leaving to serve a mission for his church, The Church of Jesus Christ of Latter-day Saints, before he went to school. Not knowing when his mission call would come, Mike decided to forgo trying to take any college classes before he left. Instead, he got a job at the Autoliv facility in Brigham City—the same facility where his dad worked as a maintenance technician—on the production line. He also took two general education

classes from USU via the independent study option⁴⁷. He explained, “I wanted to do some easier classes and save the harder classes for after my mission where I would have a better chance to remember the stuff.”

Throughout that summer and fall of 2007 Mike continued working at Autoliv, earning more money for his mission and progressing on his correspondence courses. He finally got his mission call and left to serve for two years in Brazil in January of 2008. It was during his mission that Mike decided he wanted to become an engineer. His decision was in large part the result of getting to know his mission companion who was a Brazilian civil engineer.

My mission companion had a personality that was really similar to mine. We talked a lot about what he did as an engineer. Then he told me, “You know, you would probably like doing engineering.” I thought about it and said, “Okay, maybe I will do that.” Prior to those discussions, I didn’t really have a strong preference about what I wanted to do.

When Mike returned home from his mission in January of 2010, he had in mind that he would start school the following fall to become an engineer. Eager to get on with his life, Mike gave himself only three weeks from the time he got home to figure out what he was going to do about school and to find a job. He explained, “I thought that if I’m going to do this, I’m going to pick it right now and stick it out. I’m going to make sure that I get it done.” Mike described how he “did not want to be one of those people that went to school forever.”

Mike came home from Brazil with the idea that he was going to study to become an engineer. Now the questions became, what kind of engineer did he want to become

⁴⁷ These classes were mail-in correspondence courses, not online courses.

and where should he go to study? Mike began looking at the different types of engineering degrees in order to decide exactly what major to study:

I got home and just kind of decided. I thought that civil engineering is mainly bridges and stuff and that sounded kind of boring to me. Mechanical engineering sounded pretty cool. I didn't want to do electrical engineering because that kind of scared me- mainly because I had no idea what it was. So I decided that I would stick with mechanical. It was kind of a lame way to get to a conclusion but that's how I got there.

Once Mike made the decision to study mechanical engineering, he started thinking about where to go to school. Giving some careful consideration to his situation, Mike decided to “stick around here”:

I had thought about where to go. I didn't really think about out of state a whole lot because I kind of wanted to stick around here. Part of the reason why I wanted to stick around here is because neither of my parents had really done much college stuff. My mom got her Associate's and my dad got his Associate's from BYU Idaho. Neither of them finished four year degrees and they weren't super helpful at telling me what I should be doing. I'm the oldest, so I couldn't look to my siblings for help either. My parents didn't really know how to get things rolling. I was asking questions to counselors, trying to figure out how in the heck I do this college stuff.

As the first one in his family to pursue a bachelor's degree, Mike wanted to stay close to home. USU seemed like a good choice because it offered a convenient, local option for him to get an accredited mechanical engineering degree:

I chose USU because, first of all, Logan is close to where I live. Also, I did USU concurrent enrollment classes in high school and I already had credits and I was already enrolled. That meant I was already in the USU system so I didn't have to go through the application process and do transcripts and all that stuff. And I had a 1/2 tuition scholarship to USU for two years. So I pretty much knew I was going to USU.

Then I found out that USU had awesome, accredited engineering programs—that made it even better. Then, when I found out from the Brigham City engineering advisor about the brand new pre-engineering program in

Brigham City, I was even happier because all along I thought I would have to go to Logan. I thought, “Boom, this is totally what I want to do.”

Mike began to make plans to attend USU Brigham City and continue to live with his parents in Perry, which is about two miles from the USU Brigham City campus.

Mike’s next challenge was to find a job that would support him while he went to college. Mike explained that his parents told him and his siblings early on growing up that they would not pay for the kids to go to college. That meant that working through college was a must. Mike agreed with his parents’ choice and remarked that he planned to “do the same thing with his kids.”

Mike’s job search turned out to be pretty straightforward—he simply slid into the position of Quality Technician at TCR Composites that his brother vacated to go on his own mission. Before Mike returned from Brazil, his younger brother was preparing for his own mission. Just as Mike did, Mike’s younger brother got a job on the Autoliv production line while he waited for his mission call. Mike’s brother, however, was laid off as a result of the national economic downturn before he got his call. Mike’s dad helped Mike’s brother find a Quality Technician position at an upstart company, TCR Composites, in Ogden, Utah⁴⁸. The timing worked out perfectly; when Mike’s brother left for his mission, Mike stepped in.

The job at TCR turned out to be an extraordinary opportunity for Mike. It offered good pay and excellent benefits that included tuition reimbursement. Tuition coverage turned out to be very important to Mike; Mike had been surprised to find out that, due to

⁴⁸ Ogden, Utah is located twenty-five miles south of Brigham City, Utah.

USU policy⁴⁹ at that time, the USU scholarship he deferred due to his mission, which was award by the Logan campus, would not be honored if he attended a regional campus. Receiving tuition reimbursement from TCR meant Mike didn't have to worry about the financial impact of "losing" his scholarship.

Good pay and excellent benefits were not the full extent of TCR's impact on Mike's plans, however. As early as his first interview with the company, Mike found out that TCR had big plans for him and his future there:

When I interviewed at TCR, I told them that I was going to school and they asked me for what and where. I told them mechanical engineering at USU Brigham City. They got excited about that because their engineering department was kind of small and inexperienced at that time. They wanted somebody to learn and to grow up through the company as an engineer. So, when they hired me they told me they were hiring me for the quality technician position to help me get through school. Me getting through school was their number one priority. Then, once I was through school, they told me up front that their plan was to put me into an engineering position.

Mike was excited that his plans were working out so smoothly. He started with TCR in February and spent a year as a quality technician.

Mike began the pre-engineering program at USU Brigham City in August of 2010. He was twenty-one years old. As Mike began the pre-engineering program, his goal was to get his mechanical engineering bachelor's degree as quickly as possible. Mike became concerned about the possibility of languishing in school after watching his dad become stuck in a job he didn't enjoy while trying to finish his bachelor's degree

⁴⁹ USU changed this policy starting fall semester 2015. Awarded scholarships are no longer tied to specific campuses and are able to be used at any campus in the USU system (Opsahl, October 4, 2015).

over the period of several years. Mike's long-term goals were to get married and to provide a good life for his family while working as an engineer.

Mike found his entrance into the pre-engineering program to be a little rough. Due to his break in schooling, enrolling in the pre-engineering program required that he qualify to enroll in Calculus I— a course that he had already earned AP credit for in high school. In fact, Mike wanted to retake Calculus I as a refresher because it had been so long. He figured that placing into Calculus I, after he had already taken it and passed the AP exam, shouldn't be difficult.

Mike turned out to be wrong. He took the “Accuplacer” test four times (with special permission since students are technically allowed only three attempts) and on his best attempt scored only into MATH 1100 Business Calculus. Mike remarked that “the Accuplacer test is rigged. Everybody will tell you that. It places you much lower than it should.” Luckily, with the engineering advisor's help, Mike got special permission from the Math Department Head during the first week of classes to enroll in Calculus I since he technically placed into a calculus course (MATH 1100) and he had credit for the calculus I course already. Mike was relieved that he could stay on track with his degree; he didn't want to waste what would turn out to be a full year of the pre-engineering program having to retake a lower math class.

Mike progressed through the pre-engineering program on schedule. Although he had been an ‘A’ student in high school, he found that the engineering courses “pushed him to learn how to study.” He tried not to get too caught up in his grades. As the courses

got harder and he became exposed to different teaching styles, Mike concentrated more on getting through than on getting 'A's.'

Overall, Mike was very pleased with his decision to attend USU at the Brigham City campus. He worked an early morning day shift Mondays-Fridays between 7:30am – 4:30pm and then went to class Mondays-Thursdays from 5:15-10:30pm. He did homework mainly on the weekends. As things worked out, Mike was actually saving money while going to school. Since he lived at home with his parents and had tuition reimbursement from TCR, his only expenses were car expenses, gas money, his cell phone bill, and dating expenses. Mike met his future wife at the beginning of the pre-engineering program and found dating to be a substantial—but not unwelcome—“detractor from his studies.”

Mike didn't find the broadcast nature of the courses at the regional campus to be much of an obstacle for him. Mike commented that it was more “the instructor that I would see as the barrier and not the broadcast system.” Mike also commented that, because he was taking classes in Brigham City, most of the time he ended up being in the room with an instructor who was broadcasting out to other sites. That didn't pose any problems for him. He appreciated the longer, two-hour class times and smaller classes he had in Brigham and figured that that made up for any technical issues he might have had with the broadcast system.

After his first year at TCR, Mike was moved into a mechanical test technician position where he got involved in testing the composites that TCR manufactured. Mike found the testing he did on the job to coincide nicely with the 2nd year engineering

curriculum. At that time, the hands-on work he was doing on the job helped him better understand the theory he was learning in class.

Perhaps the biggest challenge that Mike faced in the pre-engineering program was recovering from an emergency appendectomy performed two months before he was supposed to graduate with his associates in pre-engineering degree. In early March of 2011, Mike began having severe pains in his stomach. Thinking he was just “developing an ulcer from school,” Mike tried his best to ignore the intense pain and keep working and studying. Finally, after three days of not eating or drinking much, Mike went with his mom to the doctor. The doctor performed a blood test and sent Mike immediately to the hospital. Within the hour Mike, was on the operating table having an emergency appendectomy: his appendix had burst. The surgeon later told Mike that his case was one of the worst three he had seen out of more than the 20,000 appendectomies he had performed in his career.

Although his grades that semester took a bit of a beating, Mike was able to finish out the semester and graduate with his associates in pre-engineering in the spring of 2012—on schedule. Mike and his fiancé were married that June. After taking a short honeymoon, the couple moved out and enjoyed the summer.

In August of 2012, Mike became an engineering intern at TCR. In this position, he was given the responsibilities of an engineer and “moved upstairs with the other engineers.” That month he also began the mechanical engineering professional program in Logan. Because Mike was moving to a daytime class schedule with a significant commute time—over one hundred miles round trip between work and school, TCR

allowed Mike to make his own work schedule. Mike started out the semester with the intent to continue working forty hours per week.

When Mike started classes in Logan he felt a “whole different dynamic.” He was married; he and his wife were living on their own. They “had to make sure life happened” on a daily basis—“no more bumming” off his parents. The professional courses seemed “10x harder,” the classes were much larger, the instructors seemed less supportive, he didn't know anyone, and the study groups were set. Mike felt “out of the loop” and had to “learn how to learn in a new environment.” Even the exams in Logan were different; many of his exams were fifty-minute multiple-choice exams with specially devised “detractor answers.” He didn't have experience studying for these kinds of tests. Mike commented that he felt the most stress of his life during that first semester in Logan—especially while he was taking exams.

The other thing that made the transition especially rough was that Mike needed to keep his full time status at TCR in order to retain benefits and tuition reimbursement. He went down to thirty-two hours per week, the minimum he could and still retain full time benefits. Still, at thirty-two hours per week, Mike went up to Logan for classes and had to leave right after to go to work. As he explained, “I was only there the minimum amount of time I had to be. I was either at school or at work and then anytime in between I was doing homework.” Ideally he would come to take classes in the morning and then to go to work in the late morning or very early afternoon. Unfortunately, some labs were scheduled in the mid-to-late afternoon, which meant that Mike had to hang around campus and then work late into the night to get his required hours.

That first semester of his junior year was by far Mike's low point. He was taking seventeen credit hours and working thirty-two hours per week. Mike felt he really missed out by not being in a study group. Not on campus except during class, Mike mainly studied with a friend from the pre-engineering program over the phone. Mike was ecstatic when someone he met in Logan shared his "whole arsenal" of solutions manuals with them, since it seemed like every other junior on Logan campus had copies except for them.

Things hit rock bottom mid-way through that first semester during the fall of 2012. Mike remembered scoring a 31 on his first Fluids exam and "freaking out" because he "never had such bad grades" in his life. He commented, "I thought I did pretty well until I got my exam back and it's all these little thing that killed me." Stressed about Fluids, Mike had to withdraw from his Advanced Dynamics class midway through the semester because he had "no idea what was going on" in that class. He remembered. "I needed to just cut back and breathe."

Mike finished that semester with a 'D' in Fluids and a 'W' in Advanced Dynamics. He did fine in his other courses. The withdrawal insured that Mike would have to take an extra semester to complete his degree. He ended up retaking Fluids, too, just because he "didn't want a 'D'" on his transcript. After that first semester, things seemed to go better for Mike. While his second junior year semester was still "crazy," it seemed a bit more doable than his first.

At work, Mike continued to work as an engineering intern. Unfortunately, due to his nonstandard work schedule, he rarely got to work with the other engineers; usually he

was coming to work only a few hours before they left to go home. Mike was given a project to design a proprietary machine for TCR using ladder logic, automation, and controls. Mike successfully designed, built, programmed, and tested the machine during his last year of school. He even presented the completed machine to management.

Mike graduated with his bachelor's degree in mechanical engineering in December of 2014, completing the professional program in five semesters. Using the extra semester, he was also able to complete a minor in Portuguese. He was twenty-six when he graduated. He views his major success as completing his degree while maintaining full time employment with benefits while incurring minimal debt; because his tuition reimbursement did not pay for books and fees, Mike took out a small number of student loans to pay for his books and his wife's dental hygiene school.

Mike's Epilogue

In December of 2014, right after his graduation from USU, Mike was promoted to associate mechanical engineer at TCR. In January of 2015, the couple's first son was born. Later that year in May, Mike and his wife bought their first home and Mike started working toward his Masters of Business Administration Degree at Western Governor's University.

Jaxon: School First

Today, at 32 years old, Jaxon is “really happy” with how things have turned out. He works, as he has for nearly two years now, full-time as a mechanical engineer for S&S Worldwide Inc., an engineering company located in Logan, Utah that specializes in the design and manufacture of vertical and family thrill rides. Jaxon and his wife, who works part-time as a dental hygienist, own a home in nearby Wellsville, Utah, where they live with their two young daughters, ages three and one. Jaxon, in fact, admits that his current situation is even a “little bit better” than he had hoped for when he started the pre-engineering program back in 2007. As he explained, “I thought I’d more likely end up doing something related to aerospace engineering with less hands-on opportunities than I have as a mechanical engineer.”

It is likely that Jaxon’s interests and experiences after high school led him to consider aerospace engineering to be his eventuality. Growing up in Brigham City, Utah, 18-year-old Jaxon graduated from Box Elder High school in 2002 with his sights set on becoming a commercial pilot. While he had always earned high marks in school, by the time he was a junior Jaxon figured out that he was doing “well enough and didn’t need to try too much harder to graduate.” He “started having a little more fun, spending less time at school.” He “did the bare minimum to graduate,” purposefully staying away from the “extra” advanced placement and calculus courses. Jaxon easily graduated with a 3.8 grade point average.

After his high school graduation, Jaxon moved to Salt Lake City, Utah and took a job at the Salt Lake City International Airport as an airplane refueler. Jaxon had “always

loved to fly” and considered airports to be “interesting places.” He also had family and friends that worked at the airport. Jaxon explained that, even though both of his parents went back to school and earned bachelors degrees by the time he was twelve or thirteen years old, going to college was not something that was expected of him or pushed onto him. And, while it was far from glamorous, Jaxon considered his job at the airport to be a “good first step out of the house—especially at eighteen.” The refueler position consisted of a lot of manual labor, such as equipment inspection and maintenance, measuring and dispensing fuel, and checking fuel quality. Yet, it also required Jaxon to learn and understand Federal Aviation Administration (FAA) operating ground rules and airplane/airport safety regulations, providing him with a solid knowledge base for pursuing pilot training.

After working at the airport for about a year, Jaxon began pilot training. He completed aviation ground school at nearby Salt Lake Community College (SLCC). SLCC also had a flight department and Jaxon started logging flight hours toward his private pilot’s license. During this time, Jaxon was “just scraping by on the money, trying to keep the flight hours coming in.” He desperately tried to minimize his expenses for everything else and took as many hours as he could get at the airport.

Then, in August of 2005, disaster struck when Hurricane Katrina made three separate landfalls across the states of Florida, Louisiana, and Mississippi. In the aftermath of Katrina, which included the total destruction of thirty oilrig platforms and precipitated

the closure of nine oil refineries⁵⁰, the price of aviation fuel skyrocketed. As a result, Jaxon's cost per flight hour essentially doubled. As he struggled increasingly to make enough money for flight training, he saw friends and acquaintances—some as many as six or seven years ahead of him in training—still doing what he was doing: scraping by trying to pay for flight time in hopes of “maybe getting a mail route after two to three hundred hours of multi-engine time.” By the time Katrina struck, Jaxon had logged only about thirty hours out of the 300-400 total hours needed to go through private pilot licensure, instrument training, and multi-engine licensure and training. At that point, Jaxon decided to make a change.

Talking with his future father-in-law—who at that time was his girlfriend's father—one day, Jaxon mentioned he was interested in changing jobs and potentially moving back to Brigham City. His father-in-law had worked his entire life at ATK-Thiokol (now Orbital ATK), a major developer and supplier of aerospace and defense related technologies located in nearby Promontory, Utah. Surprisingly, Jaxon's father-in-law told Jaxon about a job fair happening at ATK the following week.

My father-in-law was in a position he could have hired me. That was, I think, his intent. So I went through the whole job fair process. They sat me down and I interviewed with two or three different people and they kind of kept a little rap sheet as to what my skills were. And then it was the next day I got a call from the quality guy who says, “Hey, I got a position if you want it.”

My skills at the time were basically just labor—hauling the fuel truck up to an airplane to pump the fuel. But there was also a safety aspect where I had learned how to follow certain procedures on certain airplanes. And I also learned how to inspect the equipment, measure the fuel, and check the fuel quality. So I

⁵⁰ Hurricane Katrina Service Assessment Report. *National Weather Service (Report)* (Silver Spring, Maryland: National Oceanic and Atmospheric Administration). June 2006. Retrieved January 3, 2016.

had gained a background in keeping and maintaining equipment according to FAA rules. That's probably why I got the job in quality because that was very similar.

That fall, at twenty years old, Jaxon started what he considers to be "his first real world job" as a Quality Inspector at ATK. While the title "Quality Inspector" sounded auspicious, Jaxon explained that it was really an entry-level job that consisted of "making sure that the people making the rockets followed the directions and watching that they did." He considered it to be a "real world job" because in it he learned a lot about work and what he did not enjoy: production and quality control.

After approximately nine months as a Quality Inspector, Jaxon moved into a different position as a technician in the hazardous testing laboratory. In the lab, Jaxon worked to manufacture igniters used to test rocket propellants and explosives. Jaxon also helped with testing and characterizing the behavior of the explosives. He explained, "I worked with four or five different groups within our department. That's where I really got to meet engineers who were actually developing propellants and hardware for explosives." Jaxon really enjoyed the exposure he got to engineering and other engineers while working as a hazardous testing lab. Jaxon continued, "I met maybe over one hundred engineers and they all did something different. It was interesting."

Around this same time, Jaxon started carpooling to work with a few ATK engineers. During the half-hour one-way commute along thirty-five miles of Highway 83 connected Brigham City and Promontory, Jaxon was able to get to know the other carpoolers and learn about their work experiences. These conversations, along with his experiences working with engineers in the hazardous testing lab, got Jaxon thinking

about going to college to become an engineer himself. As he explained, “My motivation for going to school was getting to know engineers and deciding that engineering was what I wanted to do.” Jaxon reflected that he might be different from some of the other pre-engineering students saying, “other than being around engineers at work and being paid to go to school through the company I worked for, I was one of my own biggest pushes.”

In the fall of 2006, Jaxon started taking evening classes part-time at the USU Brigham City campus. While he had engineering in the back of his mind, he focused on completing the courses needed to get into the pre-engineering program. As he explained, “I had to start at day one in math.” Because it had been over four years since high school, Jaxon “didn't even bother taking the math placement test” and just enrolled in MATH 1010 Intermediate Algebra, the entry course for calculus pre-requisites. Along with math, Jaxon also took a few general education courses in history and sociology to get them out of the way.

Jaxon progressed relatively smoothly through Math 1010. He followed that initial success up with MATH 1050 College Algebra and MATH 1060 Trigonometry, the pre-requisites for Calculus I. These classes gave him a much needed math refresher as well as the confidence to continue on into engineering. As he explained, “Once I hit calculus I told myself that I can do engineering.” In the fall of 2007, Jaxon enrolled in the pre-engineering program at the Brigham City campus. He was 23 years old.

Jaxon continued to work during the day at ATK and take classes in the pre-engineering program evenings. This combination turned out to be a good financial

arrangement since ATK reimbursed his tuition for every class in which he earned a B or better. Knowing that he would have to transfer to the Logan campus for his junior and senior years year, Jaxon planned to save up as much money as he could working during the pre-engineering program. He explained,

I didn't want to work over here in Promontory every day and then have to go to school in Logan. I had heard that it's best going into junior year if you don't have to work. I'd been saving money and I already set my head on making whatever sacrifices I needed to now before I'm married, before I have kids, before I have any assets or liabilities. I would just do whatever I needed to on the cheap just to make sure I had the money to get through school.

Earning and saving enough money, in fact, was the biggest challenge that Jaxon faced going to school. Jaxon continued, "I think the thing I worked around the most was just trying to get it paid for. I was working and trying to use whatever tuition reimbursement I could." Jaxon mentioned that he and his girlfriend decided that they would wait to get married and start a family until after school was completed in order to help meet this challenge.

Jaxon found the pre-engineering program to be challenging in other ways, too, especially at first since calculus was brand new to him. Jaxon described how "he knew it was going to be hard, but gave himself no excuses." He remembered how one of the most difficult things about the program was just getting "into a routine of spending days at work, nights at school, and free time and weekends studying." Jaxon found that his studies became easier once he started taking the actual engineering classes. He explained, "It was the same type of schedule but it was just more enjoyable to be at school." One he got into those classes, even "the math made a lot of sense." Jaxon was also motivated because a few of engineers he worked with at ATK were engineering instructors in the

program during that first year. It was a great experience for him taking classes from people he knew. As he described, “They were supportive and helpful and they gave me pretty good insight as to what to expect.”

In 2008, Jaxon left his job at ATK and started working at Nucor Building Systems in Brigham City. By this time, Jaxon had progressed far enough in the pre-engineering curriculum that he had completed required courses in drafting and Computer Aided Design (CAD). These new skills enabled him to get a job as a draftsman at Nucor. Nucor offered Jaxon a better situation than he currently had working at ATK— including higher pay, a much shorter commute between home and work, a new skill set to learn, and an office environment. While Jaxon still worked with engineers, they were now civil structural engineers. Jaxon explained that his job at Nucor “was a step up for pretty much every reason I was working and I still had tuition reimbursement.”

Jaxon completed the pre-engineering program in the spring of 2009. Interestingly, at the time of his graduation from the program, Jaxon wasn’t aware that he had earned an associates degree in pre-engineering. His goal from day one was to earn an engineering bachelor’s degree and to become a mechanical engineer working in Utah. Earning an associate’s degree was in no way a goal or motivator for him.

Jaxon’s experiences in the pre-engineering program were such that he didn't find the engineering advising at the Brigham City campus to be all that helpful. As Jaxon recalled, “The engineering advisor was brand new and I found most of what I needed online.” He developed his own course schedules, what he thought he could handle each semester, and didn't necessarily follow the formal 2-year pre-engineering curricular plan.

He took classes in the summer too, just to keep his schedule reasonable and to keep going on the math. He explained,

The advice from people I'd been around was if you have to start all the way over math, it's easier to just knock 'em out one after another, one after another and then it all is fresh. Doing that kept me going. Once I started taking the math courses I didn't stop until linear algebra.

Jaxon admitted that he felt like the entire engineering curriculum, as it was laid out to be completed in four years, was “super unreasonable, especially if you had so much as a part-time job.”

While Jaxon considered the standard engineering curricular schedule difficult to maintain, he found that taking courses in the pre-engineering program via distance delivery was, for him, really no problem at all. Although Jaxon didn't have many pre-engineering courses in which the instructor was physically located at another campus, Jaxon did remember taking MATH 1050 from an instructor that taught from the Uintah Basin campus located in Vernal, Utah⁵¹. All in all, Jaxon didn't find many disadvantages to the synchronous broadcast method of teaching in that course.

When Jaxon met with his supervisor at Nucor in the summer of 2009 and told him that he was planning to enter into the mechanical engineering professional program in the fall, he received a shock.

I never focused on just quitting work right when I became a junior. I always thought that if I could keep a part-time job, I might as well. But when it came down to it— it was that summer before I started the professional program— Nucor told me they weren't going to do the tuition reimbursement anymore because I was studying mechanical engineering and not civil engineering. My supervisor said that he didn't have a use for that and wasn't going to push my

⁵¹ Jaxon participated in the pre-engineering program very early on, before engineering instructors were hired at several of the regional campuses.

reimbursement. And I said that that's a big part of me working here and, if that's the case then, yeah, I just left.

Jaxon explained that, by the end of the pre-engineering program "I had saved up enough money that I could quit. During my junior year in Logan, I was just a student for the first time in my adult life."

Despite not having to work at this point, Jaxon found the transition to Logan and junior year to be "super difficult." Getting through junior year was a "huge relief" and a major success in Jaxon's mind. Part of the difficulty was just getting used to the new environment in Logan—"more people and less help from the instructors." Jaxon felt technically well prepared from his pre-engineering courses; "it was just a matter of figuring out the best way to learn in the Logan classes compared to small classes at the regional campus."

Jaxon also felt a bit isolated being a non-residential student at the Logan campus. While he had participated in study groups in the pre-engineering program, Jaxon mostly studied on his own during his years at the Logan campus. Not many of the students he studied with at the Brigham City campus ended up coming over to Logan at the same time. He felt as if he missed out on many of the late night study groups and help sessions that occurred after he left campus to go home to Brigham City. After he realized how helpful they could be, he stayed late on campus to participate when he could. Jaxon was able to meet some people through group projects and a short stint as an undergraduate researcher, but he never really became a part of a pre-existing study group.

During the summer between his junior and senior years, Jaxon did a full-time paid internship at Western Zirconium, Inc., a subsidiary of Westinghouse Electric Company,

LLC., located in Ogden, Utah⁵². As Jaxon pointed out, that summer was his “first summer off” of classes— since starting college. Jaxon’s internship turned into a part-time job after the summer was over. Jaxon kept the job until he graduated in May of 2012. At the time he received his engineering bachelor’s degree, Jaxon was twenty-seven years old.

Reflecting on his experiences studying engineering as a nontraditional student, Jaxon commented:

What probably contributed the most to earning my bachelor’s degree was being prepared—not going into it because I was forced to but because I wanted to and had the assets to do it and a good plan. Looking back, that was probably it—just making up my mind and rearranging my lifestyle at the moment was the most important thing to do it. Then being a little bit more mature, too. Having some extra money. Probably those two things and not doing it straight out of school—getting out and learning to work before I went.

Definitely the regional campus pre-engineering program made it even more convenient. I would have done it regardless and come up Logan for everything, but being able to take classes in Brigham and work at ATK and Nucor made it much easier— I mean they were all within a half hour of each other. Meeting instructors from ATK and having small classes in the beginning helped everything click better or quicker than it probably would have in the big lecture style classes they have in Logan. All of that definitely helped.

For Jaxon, interest, drive, and maturity combined with a solid plan to help him to meet his long-term goals.

Jaxon’s Epilogue

After graduation, Jaxon moved to Salt Lake City to be with his long-time girlfriend, now wife, who was preparing to attend dental hygienist school. She and Jaxon

⁵² Western Zirconium, Inc. primarily produces zirconium for commercial nuclear power applications such as fuel rods and fuel assemblies.

were married in October of 2010, during the fall semester of Jaxon's senior year. Jaxon took a few three-month contract engineering opportunity in Salt Lake City to get some experience and also to enjoy some time not having to drive a lot. By the end of 2011, before he had graduated with his engineering bachelor's degree, Jaxon landed his first full time job as a mechanical engineer doing heavy equipment design for DJH Engineering, a subcontractor for John Deere. During this time, Jaxon managed a design and manufacturing team physically located in Slovakia.

A year later, Jaxon changed jobs to work at El Dorado Engineering, Inc., also located in Salt Lake City. El Dorado is an engineering consulting firm that specializes in demilitarization projects, such as cleaning up munitions and explosives, and environmental remediation. Jaxon moved mainly because he and his wife had just had their first child and the work schedule was better at El Dorado. Jaxon considered it a "neat job with a lot of governmental hoops." He worked there for two years.

In his most recent move to S&S Worldwide, Inc., Jaxon and his wife took the opportunity to move back near Brigham City where they had both grown up. Today, Jaxon feels like his future at S&S Worldwide, Inc. is stable for perhaps the next four to five years. He has room to advance and the work remains interesting and challenging. Seeing big potential for the application of advanced composites in the thrill ride industry, Jaxon anticipates going back to school within the next one to two years for a master's degree in composites, after he gives his wife "her turn" to position herself within her career field. Jaxon plans to go back to Utah State University (USU) because, as he explained, both he and his wife are "just too invested in the local area to go anywhere

else.” He envisions maintaining his hours at S&S at a full-time level and going back to USU for his master’s degree part time.

Daniel: An Entrepreneur With Big Plans

By the time his thirty-fourth birthday rolled around, Daniel accomplished more than many people do in a lifetime. The fourth of twelve children and oldest son, Daniel—along with the rest of his siblings— was home-schooled and never participated in the Utah public education system. Growing up, Daniel’s family lived in a home that sat in the middle of an acre and a half in Lehi, Utah⁵³. The front half of the lot was a lawn that, Daniel remembered, “took over three hours to mow.” The “backyard” was a three-quarter acre garden, where Daniel spent much of his time during the summers growing up. Both of Daniel’s parents earned high school diplomas. Daniel’s father was a general contractor and entrepreneur who had taken three semesters of college. Daniel’s mother was a stay-at-home mom and homeschool teacher who went to college later in life— after Daniel turned nineteen— and earned a nursing degree.

Daniel learned to read at a young age and, from the outset, was encouraged to read for understanding. In fact, Daniel’s mother designed her approach to homeschooling as guided self-study. Daniel recalled,

My mom was a teacher. I have memories of her teaching me to read at five-years-old. Once I learned how to read well, the way that my parents taught home school was very fundamental. My siblings and I were each given different books to study. We did a lot of reading on our own and worked through problems. If we ran into something that we didn’t really understand, we’d ask for help.

The curriculum that Daniel and his siblings followed was robust.

We probably didn’t have some subjects that they might have in public school— I don’t really remember social studies. But we did do spelling, English, math,

⁵³ Lehi, Utah is located approximately 110 miles south of Logan, Utah and thirty miles south of Salt Lake City, Utah.

reading. We did biology, chemistry, physics, religious studies, and music. So we pretty much touched on all of the core subjects that would be taught. We did a lot.

As Daniel got older, he began to rely more on himself to figure things out. While he went through algebra and trigonometry with his mother's help, Daniel recalled that,

Mom didn't have a really strong background in math so I would have questions that she wouldn't always be able to answer. For the most part, I hated not understanding problems through and through. I would work over something till I felt like I really understood it.

Later, using his older sister's college textbook, he tackled pre-calculus pretty much all on his own. Daniel finished homeschooling in 1994 at the age of seventeen.

Despite his evident talent in mathematics, Daniel considered his strongest suits to be in reading comprehension and writing. While his reading skills developed well during his homeschooling experiences, his writing ability bloomed while working in several family business ventures. Daniel got a lot of practice writing by developing business plans and composing patent applications while working for these startup companies.

Daniel began his entrepreneurial training at fifteen working at his father's drafting business. His duties included drawing up house plans as well as preparing drawings for commercial buildings. Daniel learned how to draft using AutoCAD, a computer-aided drafting software program used for creating structural blueprints, from a set of self-study manuals his dad gave him and "ended up learning AutoCAD better than my dad did."

In 1996 at the age of nineteen, Daniel decided he wanted to go to college and become an engineer. However, he didn't pursue college at that point; he didn't think the time was right. Daniel recounted,

I thought about going to college at the time quite heavily. I have three older sisters and two of them had gone to college by the time I was nineteen. My sister just older than me was getting ready to start college. I wanted to go, but I was

working with my dad in his drafting business. I felt a little guilty starting school because he depended on me heavily at that point. If he had given me a little bit of a shove, I probably would have gone. But after that things just got busy with working and businesses.

The idea for the second startup came at about the same time and grew out of experiences that Daniel and his father shared working in the drafting business.

My dad and I had a bunch of people coming to us for plans who wanted houses and commercial buildings drawn to use Insulated Concrete Forms (ICF)—which was supposed to be like the big next wave in energy efficient structures at that time. ICF are made of polystyrene and are typically a stay in place form that you cast concrete into. When we started looking into how to draw plans for ICF, we decided we should make our own form because everyone else's had a lot of limitations. There were some that wouldn't work in the earthquake zones that we have in Utah.

We wanted to develop our own product. We decided we were going to use a polyurethane foam that is a little bit harder to work with and takes some specialized manufacturing processes. We took that on and developed a manufacturing process. We started a company and during that time I designed and built a bunch of proprietary machines for our ICF process. It was like doing engineering without really knowing how to do engineering.

Daniel spent most of his twenties and early thirties developing a proprietary ICF manufacturing process. Unfortunately, the growing popularity of ICF didn't last through the economic downturn of 2007-2008. Daniel explained,

We did get our process running, but there was a huge learning curve. Some of things we did were essentially reinventing the wheel. We had to figure out how to do plastic extrusions for some of the components—and that's been done for like the last 150 years, really. Figuring that out was kind of a waste of time and money, thinking back on it. We manufactured enough ICF to supply several different jobs. I think we had put out about twenty different jobs by the time we shut things down. There was just no longer any demand for this product at that point.

Once the ICF work ended, Daniel started his third business venture: his own construction company. Since his father was a general contractor, Daniel had substantial experience in the building trades. He explained,

My dad did contracting from when I was as young as nine or ten until I was about seventeen. He had my brothers and me come help clean up his job sites. We'd also get to help in the summertime on some of the projects he had going on. When he didn't want to actively contract anymore, he started his drafting business.

Now ready to start his own business venture, Daniel and fiancé were married and moved to Brigham City to work on his construction business.

Daniel ran the construction company for a few years, all the while contemplating going to college to become an engineer.

I told myself that five years down the road if I didn't go to school I would regret it. That was a huge motivator for me. I looked at a lot of statistics about how long it takes to go to school for engineering. It wasn't something I went into blindly. I was used to planning in my business ventures. I did a lot of management and knew that, in order to make things run successfully, you have to put a lot of thought into things, you have to plan it out. So going to school was thoroughly, thoroughly planned before I started. I wasn't jumping into it blind.

Daniel was considered moving toward Salt Lake City to have better job opportunities to during his education. He decided to get his feet wet at Salt Lake Community College (SLCC) by taking a math course. He explained, "I decided to take one math class just to help me get started on the road because I hadn't been to college before and it had been a long gap since I had been in school." At the time Daniel was thirty-three years old Nearly seventeen years had passed since Daniel completed homeschooling.

Daniels' first priority was to be admitted to SLCC. To do that, Daniel had to earn his General Education Development (GED) certification. He explained,

The requirements for enrollment into SLCC at the time were either a high school diploma or a GED and a placement test. I did the GED test over the summer of 2009. When I took the GED, I was working full time in my construction business. I wanted to study for it because I wanted to get a good score. However, I found it really difficult to study at that point. I didn't like some of the study materials. It ended up that I just didn't study for it. I went in and took it and I scored really

high in everything. I didn't have any problems. It was kind of interesting that my highest scores were actually in reading comprehension.

On the placement test, Daniel made it into Math 1010, Intermediate Algebra. Daniel described his first semester in college at SLCC:

I was still working full time. My wife and I had one child and one on the way. We ended up not moving to Salt Lake City and stayed in the Brigham City area. I drove down to SLCC twice a week to take my class. Actually, my wife would drive and I would do my homework while she was driving. I didn't really study for that class because most of it was pretty familiar math to me. I think my lowest score was a 94% on any given test. Yeah, I didn't really study for that class at all. But I was glad I took it at SLCC. It helped build my confidence.

After his initial success at SLCC, Daniel committed himself to getting his engineering bachelor's degree—both he and his wife agreed that it would be a good thing for him to do. While Daniel and his wife did not want to go into a “huge amount of student loan debt,” they didn't have “any savings at that point” either. Daniel knew that he'd have to find a full time job that could support his family and also accommodate a school schedule that changed semester to semester.

As Daniel began to shut down his construction business, he looked for work within commuting distance of Brigham City. He explained how “really, really happy” he was when he “found out that Utah State University (USU) had an engineering program down at the Brigham City campus that offered engineering courses in the evenings.” At the time, attending the main USU campus and taking classes during the day wasn't something he could do. The regional campus program made his job search much easier; without it he'd “have to find a full-time job with a very flexible, variable schedule.”

Daniel got a much sought-after, full-time, benefitted position as the district carpenter for the Logan City School District in Logan, Utah. In this position Daniel

helped with building updates, repairs, and maintenance. Daniel was well qualified for the job due to his previous construction experience. He explained that it was a “good job while I was in school. The schedule was 7:00 am until 3:30 p.m. I got off early enough to take afternoon/evening classes and they didn’t allow overtime. So my class time was always free.”

Daniel enrolled at the Brigham City campus the following semester. He described what it was like for him during his first semester at USU:

During my first semester at Brigham City, I was pretty nervous because I had a lot of experience in other areas but I didn’t have experience in this area to give me confidence that I would be successful. I was pretty scared. And that first semester was absolutely brutal as far as the working full time and taking classes full time. I had 14 credit hours that included Math 1050, chemistry in the chemistry lab, and history and Fundamentals of Music as breadth courses. Between all of them, it was a lot of work. The math class again wasn’t very hard for me but Fundamentals of Music and history courses together were a lot of work. There was a lot of memorization needed for those two. I did come out of that semester with all A’s and feeling better. Because I got all A’s, I felt more confident in my abilities.

Daniel’s second child was born just before he started at the Brigham City campus. A bit chagrined, Daniel remembered how “with our first child, my wife and I both agreed that we would split the time getting up at night—half and half. That didn’t happen with our second child when I worked full-time and had fourteen credits.”

Daniel was officially enrolled in the associates of pre-engineering program in the fall of 2010. He was thirty –four years old. His experiences during that first semester at the USU regional campus helped him to develop a game plan for going forward. His goal was to graduate with his bachelor’s degree in four years. This meant he needed to get his associate’s degree in two years. Instead of following planned curriculum—which

assumes that students take very few, if any, courses during the summer semester, Daniel limited the number of credits he took during any semester to twelve or thirteen⁵⁴— a level he thought he could handle while working full time—and then took a commensurate number of credits during the summer semesters to stay on track with his 4-year plan.

Despite the countless demands on his time, Daniel progressed steadily through the associates in pre-engineering program. He maintained a 4.0 grade point average until he hit calculus. He described how he felt when his GPA fell below 4.0 saying,

I wanted all A's. Even in the beginning I kept thinking it would be awesome if I could have a 4.0 GPA when I graduated. So I was a little devastated the first time I didn't get an A. I went I think it was three semesters with a 4.0 and then I got a B. I got a B in Calculus I and Calculus II— both of which were supremely disappointing to me. And then I got a B+ in Calculus III. Those were my lowest scores.

Despite this disappointment, Daniel completed the associate's degree in pre-engineering program in exactly two years. He graduated as its valedictorian in the spring of 2012.

Daniel applied was accepted into the electrical engineering professional program on Logan campus. Daniel transitioned to the USU Logan campus in the fall of 2014.

Daniel's Epilogue

Daniel anticipated a tough transition to the Logan campus. He and his wife “saved money like crazy” to prepare for the financial hardship.

When I first started school, we owned a house. Additionally, I had built a four-unit townhouse and I was trying to sell two units and keep two units to rent. When I got ready to move to Logan, we sold the house and all four townhouse units and paid off the majority of debt that we had at that time. We started renting the basement of my parents' house. We cut our cost of living down dramatically to

⁵⁴ The official credit hour load for a pre-engineering major can be as high as 17-21 credit hours per semester.

where I knew that it would be manageable if I had to work a variable job while I went to school in Logan.

A big change coming to the Logan campus is that the classes are when the classes are and you have to work everything around that. I watched course schedules and could see that at the regional campuses, you might have three or four different options for a given class. In Logan, with some of the more advanced courses, there's only one opportunity to take a lot of the classes. So I was expecting that. That's one reason why I applied for the SMART Scholarship⁵⁵.

It goes without saying what a great day it was for Daniel and his family when he won the SMART Scholarship.

Winning the SMART Scholarship allowed school to become Daniels' full-time job and took a tremendous financial burden from his shoulders. Ultimately, the scholarship enabled Daniel to meet his goal of attaining his engineering bachelor/s degree in four years from the time he started his engineering studies—well “below the national average of 5.7 years.” More than that, the scholarship funded Daniel for an extra year while he went on to earn his Masters degree in electrical engineering in USU's concurrent bachelors/masters degree program. When it was all said and done, Daniel defended his master's thesis in April of 2015, completing his master's degree in five years—an incredible feat for anyone.

Daniel received two offers of support for Ph.D. research by two USU engineering professors. He declined them both. With a three-year commitment to the federal government to work at Hill Air Force Base in Ogden, Utah as a software engineer, Daniel

⁵⁵ The Science, Mathematics And Research for Transformation (SMART) Scholarship for Service Program is a highly competitive, federally funded program that provides full scholarships and follow-on employment to students pursuing undergraduate or graduate degrees in Science, Technology, Engineering, and Mathematics (STEM) disciplines. The SMART Scholarship for Service Program is part of the National Defense and Education Program. (www.smart.asee.org)

was hesitant to commit to more. He decided he will consider going back to school for his doctorate after his SMART commitment is fulfilled and he has “given his family a break.”

While winning the SMART Scholarship substantially reduced the financial hardships associated with the transition to Logan, Daniel still experienced frustrations and obstacles during his transition to the Logan campus. Being older than most and the only electrical engineering student coming to Logan from the regional campus that fall semester, Daniel initially was uncomfortable in his classes and felt out of place among his classmates. He also noticed a strikingly different “mentality” or culture on the Logan campus. He explained,

On the Logan campus it’s completely different because the mentality is that students will take the classes when they are offered. In Brigham City it was nice because things are more tailored towards helping the students achieve success. In Logan I know that the idea of student success is still there but, when you come into it with the perspective I had, it felt like the students in Logan get a little short-changed. I could see that. At the regional campuses the focus was to really try and help these people reach the goals they wanted to achieve. In Logan, as a student you come and you do these things and you’ll get a degree eventually but there’s not quite the same emphasis put on your success. And I think some kids get lost in that.

Daniel was also aware that some of the engineering professors on the Logan campus did not accept the idea of the associates in pre-engineering program, thinking it to be less than what was done on the Logan campus. Daniel explained,

I’ve had some discussions with engineering professors. From what I understand, many of the engineering professors that teach on the Logan campus full time don’t like the regional campus idea. And I know that there are certain engineering faculty members in Logan who wanted to see the regional campus engineering program go away because they didn’t think it was up to par with what they do here. So I saw that.

Today, Daniel “is in a better position than he thought he’d be.” He reflected,

For me, while the transitions were difficult, I think back about some of the people I started with in the regional campus program with and I feel bad for them that they weren't able to move forward. I know that there were a lot of different reasons why they didn't end up making it through the program. Everyone started with the same idea that they wanted to be in a better position in life and a college education can definitely get you there. I don't think, personally, it's the only way but it's a good way I think. And I don't regret having done that. For a lot of those people, it's hard when you're in these difficult classes and the first time you get a grade that's not the best—that can be an unsettling disappointment.

He summed up his experience saying that “to come straight to main campus is very, very hard to do later in life. It's not tailored at all towards nontraditional or working students. I think the regional campus program has done a good job of helping people go back to school.”

Daniel's Epilogue

As part of the requirement of the SMART Scholarship Program, Daniel is working as a software engineer at Hill Air force Base in Ogden, Utah. He anticipates returning to higher education for his doctoral degree in electrical engineering in the future.

Skyler: Flexibility Was the Key to Moving Ahead

Anyone knowing Skyler as a student at Box Elder High, the public high school in Brigham City Utah, could have imagined him having a traditional, all-American college experience. The oldest of four siblings, Skyler was an intellectually bright and athletically gifted high school student who naturally excelled in mathematics and science. He maintained a 3.2 grade point average while taking advanced placement courses and playing varsity football for four years. During his senior year at Box Elder High, Skyler earned college credit in biology and physics by completing concurrent enrollment classes at Utah State University (USU). When he was offered a $\frac{3}{4}$ scholarship to play Division I football at the University of Texas, it seemed as if Skyler would head off to become a “Longhorn” as soon as he had his high school diploma in hand.

Skyler, in fact, never made it to Austin. Dedicated to his religious faith and the Church of Jesus Christ of Latter-day Saints (LDS), Skyler committed himself, in accordance with church teachings, to serve a mission directly after high school. His mission call would send him to a new city, a new state, or perhaps even a new country and his service would last for two years. When the University of Texas made it clear to Skyler that they didn't want him two years from now— they wanted him now, Skyler chose to give up the scholarship. Three months after receiving his high school diploma, he headed out to Hempstead, Long Island, New York to fulfill his call to missionary service. It was September of 2005 and Skyler was eighteen years old.

Today, at twenty-eight years old, Skyler does not regret this decision. Out of several positive outcomes of his missionary service, one important one was how his

experiences in New York influenced him to go on to college and helped him to choose a personally rewarding career. Skyler remembered his own father's frequent and prolonged absences while growing up. His dad had worked two jobs—one as a paramedic and one in construction—just to make ends meet. Instead, Skyler wanted a career that would enable him to provide for his family yet still “be around.” It was during his mission that Skyler—perhaps serendipitously—discovered that that career, for him, was engineering.

It just so happened that the branch president of the local LDS church close to where Skyler was serving his mission was a Professional Structural Engineer who had participated in the design of New York City's “Freedom Tower”—or “One World Trade Center” as it is now called. One World Trade Center (One WTC), which stands in the northwest corner of the sixteen-acre World Trade Center site in lower Manhattan, New York City, is the tallest skyscraper in the western hemisphere and the fifth tallest in the world. It shares the address of the original World Trade Center North Tower that was destroyed in the terrorist attacks of September 11, 2001 and is one a four buildings designed to surround the United States National September 11 Memorial & Museum.

Skyler had to request special permission from the mission president in order to visit his branch president's engineering office, located just outside of the Hempstead, Long Island mission area. A self-labeled “hands-on guy,” Skyler was beyond excited to see how “all of the math and science” he'd been learning in his accelerated high school classes “applies to engineering.” During this visit—while getting a glimpse into what engineers really do—something clicked for Skyler. Skyler started to view engineering as “respectable career”—one that could provide him stability and a solid income to support

a family and that played to his strengths in math and science. Ultimately, Skyler's visit to Ground Zero and the One WTC construction site near the end of his mission "sealed the deal." Skyler made plans for studying engineering upon returning home to northern Utah.

Skyler returned home in August of 2007. The transition period after missionary service was tough, as it is for most returning LDS missionaries. While Skyler had many things to think about, first and foremost on his mind was finding a job to fund his education⁵⁶. The father of one of Skyler's childhood friends offered Skyler a position in distribution at Petzl America, a technical gear and equipment company that provides engineered solutions for sport climbers and work-at-height/rescue professionals. Skyler gratefully accepted the offer and, in many ways, found the job to be a great fit for him at the time. At that time, the Petzl facility is located about thirty miles south of his parents' home in Brigham City⁵⁷. Petzl provided a good starting salary of \$14/hr. as well as a supportive and motivating work environment. Skyler's supervisor and co-workers made him feel appreciated for his strong work ethic and admired for his drive and commitment. After a short time, Skyler became interested in the technical aspects of the climbing gear that Petzl designed, manufactured, and sold. He wanted to learn how the gear worked to keep climbers safe. Soon, these newfound interests led Skyler to decide on mechanical engineering as his undergraduate major.

In August of 2008, thirty-nine months after graduating from Box Elder High, twenty-one year old Skyler began working toward his goal of a bachelor's degree in

⁵⁶ Skyler's parents, who had not attended college themselves, encouraged their children's academic pursuits but couldn't financially support their higher education.

⁵⁷ It is now located at Decker lake industrial complex in Salt Lake City, UT.

mechanical engineering. He started by taking undergraduate general education classes at Weber State University (WSU). WSU is located in Ogden Utah, about twenty miles northeast of the Petzl facility. Although Skyler knew that he would have to transfer to Utah State University (USU)—some seventy miles to the north in Logan—to complete his engineering bachelor's degree⁵⁸, he had heard from friends that it was easier to take the general education courses at WSU first and transfer to USU for the engineering-related courses later. During WSU's 2008 fall break, Skyler married his girlfriend of just under a year and the two bought a house in Brigham City. Skyler spent the next five semesters, including one summer session, taking his "gen eds" at WSU, either online or in the evenings, and working at Petzl during the day.

As fall of 2010 approached, Skyler completed his general education courses and was anxious to start on the meat of the pre-professional engineering curriculum. He began "shopping around," comparing the ins and outs of completing the pre-professional engineering program at WSU or transferring up to USU in Logan. While he was "shopping," Skyler found out about the new Associate's of Pre-Engineering program being offered in the evenings at the USU regional campuses. For Skyler, this new program seemed, almost perfectly, to fit his needs: It enabled him to continue working full time at Petzl while completing his pre-professional degree at night, close to home at the Brigham City campus. As Skyler explained, "It was a no-brainer" since neither the WSU pre-engineering program nor the traditional engineering program at USU main

⁵⁸ While Weber State University, located 53 miles south of Utah State University, offers an Associates in Pre-Engineering degree that is completely transferable to Utah State University, it does not offer ABET accredited bachelors degrees in engineering. Weber State's Associates in Pre-engineering program is only offered during the day.

campus offered a course schedule that would enable Skyler to simultaneously work full time at Petzl and go to class. With the help of the Brigham City engineering advisor, Skyler immediately enrolled in the Associates of Pre-Engineering program at the USU Brigham City regional campus.

As Skyler settled into a new routine of working during the day and going to school in the evenings, he started to feel the effects of his three-year break in education. Skyler described himself as was more of a “planner” than a “bookworm” and understands that he did well in high school by managing the requirements of accelerated courses and sports. Now, he started to feel like high school hadn’t prepared him for what he was facing in the pre-engineering program. Skyler realized that he often relied on his good memory and that getting himself to really sit down and engage with an engineering textbook or problem set, like he needed to, was difficult. Even the time management challenges he overcame as a missionary in New York City didn’t compare to the complex responsibilities he faced in the pre-engineering program. Skyler commented,

As a missionary you’re balancing a whole bunch of different things at the same time, but it’s nothing like trying to balance family life, work, and school and trying to find time for all of it. Especially when you are a newlywed.

Needless to say, Skyler was finding his new routine to be very challenging and everything but “routine.”

In addition to experiencing challenges with studying and time management, Skyler faced other obstacles. The courses that required frequent use of the Internet were often frustrating for Skyler due to the substantial cost of maintaining “decent” Internet service (i.e. internet service of sufficient speed) at home. The internet service on his

smart phone wasn't adequate: Skyler found that, even with an unlimited data plan, after reaching 3.5 Gigabits of data the carrier slowed his transfer speeds down from 4G to 3 G or even 2G— making his phone too slow to use for school work. Skyler learned to manage the online requirements of his courses using the high speed Internet at school (when he was there), at his in-laws or parents' homes, and even at work when necessary.

Although his work supervisors were very supportive of his educational pursuits, Skyler, as most hourly wage employees do, faced a constant threat of mandatory overtime. Unplanned, required overtime wreaked havoc with Skyler's delicately tuned schedule. To manage this ever-present threat, Skyler often worked ahead on homework assignment in order to be prepared in the event that he had to miss class if work needed him to stay late or come in early. This strategy was difficult to sustain, however, since following it meant that Skyler was often working on assignments before the instructor had presented the material to the class.

Early on in his pre-professional engineering studies, Skyler experienced a singular event that had lasting repercussions on his engineering education. While driving his truck to work one day near the end of fall semester in 2008, Skyler was rear-ended by another driver who was traveling at nearly fifty miles per hour in a twenty-five mile per hour zone. At impact, Skyler's right hand was on resting on his truck's steering wheel and, as a result of the collision, two tiny bones in the wrist of Skyler's writing hand fractured. Skyler was taken to the emergency room and later told he would have to have wrist surgery. After the operation, Skyler's right hand and wrist were put into a hard cast. As final exam time came, Skyler grew concerned when he was told that he was not permitted

to have someone write for him on his Calculus I final exam. Skyler was forced to take his exam writing with his non-dominant left hand and, as one might expect, he failed the exam.

In order to advance to the follow-on courses in the pre-professional curriculum, namely Calculus II, Statics, and Dynamics, engineering students must pass Calculus I with at least a C-. When the final Calculus I grades were tallied, Skyler received a D+ in the course. As a result of his grade, Skyler was required to retake Calculus I the following fall⁵⁹. Overall, the accident set Skyler back in his studies, adding one year to his time to Associates in Pre-Engineering degree. Thankfully, due to the quick-witted assistance of the Brigham City engineering advisor, Skyler was scheduled to take depth courses in social science and humanities—that most engineering students take during their senior year—at the regional campus and in place of the follow-on engineering courses the next semester. In this way, Skyler was able to make up a little of the time he lost due to the car accident.

The following fall semester, Skyler retook Calculus I with a different instructor and earned an A⁶⁰. He got back on track with the pre-engineering curriculum and things progressed more smoothly. As he started taking actual engineering courses, such as Statics, Dynamics, and Strength of Materials, Skyler's confidence grew and he confirmed to himself that engineering was, indeed, what he was “meant to do.”

⁵⁹ Pre-professional engineering courses in the Associates of Pre-Engineering program are taught once a calendar year.

⁶⁰ Skyler went on to receive A's in Calculus II and III.

All in all, during the four and one-half years that he spent completing the pre-professional engineering curriculum, Skyler earned two degrees from Utah State University: an Associates Degree in General Education and an Associates Degree in Pre-Engineering. The later qualified him to apply to the engineering professional program at USU's main campus in Logan. While Skyler never received any other specific benefits from receiving these degrees, he believes they were important milestones on the way to his engineering bachelor's degree. He puts them both on his resume because of what they say to any potential employer about his commitment and determination. He counts them and "working through" all of the real-life "stuff" that came his way during this time, including his full time job, marriage, wrist surgery, and fatherhood⁶¹, as successes.

Skyler did find tangible benefits— in addition to evening classes— of enrolling in USU's Associates in Pre-Engineering program. He enjoyed the small classes at the regional campus—where he was a "name" and not just a "number"—and found that the close-knit environment gave him opportunity to get to know his engineering instructors— and for them to know him. Skyler hit it off with one regional campus instructor in particular. The two shared similar backgrounds and experiences in construction⁶². The instructor had worked his way through an engineering doctorate after having a career in the construction industry. Skyler not only learned a great deal about how to survive in engineering education from this instructor, but he also found in him a mentor who could

⁶¹ Skyler became a father to son McCabe in 2012.

⁶² Skyler and his younger brother spent much of their free-time time as pre-teens and young teenagers helping their dad on construction sites. Skyler did framing, sheet rock, and basic electrical wiring, and even learned about building codes from helping his dad. At 14, Skyler held a summer job with a local cement company pouring concrete foundations.

provide guidance and advice about working in the engineering field. This relationship was important to Skyler, whose ultimate goal was to use his bachelor's degree to pursue a career in engineering.

After graduating with his Associates Degree in Pre-Engineering in spring 2013, Skyler applied and was accepted into the mechanical engineering pre-professional program. Skyler gave up his job at Petzl at the beginning of the summer to begin a new job—farther north—that could accommodate his commute to Logan. When he left, his supervisors and fellow employees threw him a going-away party to thank him for his hard work and to wish him well in the engineering professional program. After leaving Petzl, Skyler started almost immediately on the night shift as a 911 dispatcher for Box Elder County, very near his home. The job was interesting an easy commute from home, paid well enough, and he could work nights. Skyler anticipated working there for the rest of his time in school.

Summer ended in the blink of an eye and school was starting. Two weeks into fall 2013 semester, Skyler received notice that he was being laid off from 911-dispatch office due to downsizing. He had been the most recent hire and was the first to be let go. Skyler spent the next month unemployed as he frantically searched for a full time job that could accommodate his daytime course schedule. Finally, in mid-October, Skyler applied for job in Logan at Wasatch Photonics that he found while searching the Utah.jobs website. Wasatch Photonics designs and manufactures volume phase holographic gratings and diffractive optics used in instruments such as telescopes, spectrometers, and Lasik eye surgery equipment. Skyler explained,

I applied for the job at Wasatch Photonics and they liked me. They liked that I had a physics background and was starting in the mechanical engineering program at USU. I was able to take those basic science and engineering courses I had under my belt and apply them and pick up the work that they do really quick.

Skyler got the job and started working full time on swing shift, from 5pm – 3am Monday through Thursday. After four months, Skyler was promoted to swing shift supervisor. As a shift supervisor he manages a crew of four people tuning diffraction gratings. A typical day for Skyler looks like this: 9am wake up, 10am – 3:30pm class, 5pm—3am work, repeat. His employer has been very supportive of Skyler’s educational goals; Wasatch Photonics allows him to do homework on the job when things are slow and are flexible with his hours: as long as he maintains thirty hours per week they allow him leave at 11pm if he has an exam the next day. Skyler considers this added workplace flexibility important to his ability to perform in the engineering professional program.

Skyler’s first semester in the professional program turned out to be tough one. In addition to the stresses of finding a new full time job during the semester, he was also coping with re-learning how to learn in the main campus learning environment—which, Skyler felt, was substantially different than the regional campus learning environment.

He put it:

That transition was tough. I went from being at the regional campus in classes of five and six people, to classes of 120 to 200 people. I went from being a name, to a number, with not a lot of individual help available. I’m one to ask questions in class to make sure that I understand what the professor is talking about. With having a fifty-minute class period, there’s not a lot of time for the professor to make sure that all 200 people are getting it. Now that I’ve been up at the main campus for a little while, it’s gotten a lot easier for me to just show up to class, take notes, record the lecture, and then go back and listen to it. I have a little video camera that a lot of professors let me use to record their lectures, as long as I don’t post the videos on YouTube. That’s been super helpful, but it’s also super time-consuming to go back and re-watch the lectures.

I didn't know anybody when I got to main campus, either. Going into the mechanical professional program, there weren't a lot of students coming out of the pre-professional program going into mechanical engineering that were going up to main campus with me. There were a lot of civil engineering majors going up there with me, but not a lot of mechanicals. That transition was tough, it was hard, it was really hard for me. I almost quit school.

Skyler's lowest point came well into that first semester in the professional program when he realized he was in trouble in two classes⁶³: Thermodynamics II and Fluids. Skyler became sick to think he'd be kicked out of the program if he failed both classes. He was so upset he started to consider quitting altogether. Then, he took a chance to go see his main campus engineering advisor and just ask the question- "what are my options?" His advisor looked through his transcripts and said, "So, how do you feel about civil engineering?" She advised Skyler that he could switch majors to civil engineering and not have to retake any classes, since the courses he was struggling with were only required for mechanical engineering majors, or lose any time toward his degree.

Skyler, feeling an enormous sense of relief, welcomed his advisor's suggestion. While he had become interested in mechanical engineering while working at Petzl, he also realized that he had valuable experience in the civil engineering trades through working with his dad at construction sites pouring concrete foundations as a teenager. And, importantly, he knew people in civil engineering who were from the regional campus that he could study with. Skyler made the change to civil engineering that very semester and, since then, has continued to progress in the program. Of making the change to civil engineering Skyler said,

⁶³ The mechanical engineering professional program allows only 1 course repeat.

When I finally made the transition to civil engineering is when I started really getting into the flow of things again. In the civil engineering professional program I have a group of people that I know and know how they study. They rely on me; I rely on them. That has made the professional program a lot better experience for me.

Skyler's Epilogue

Now, eight years after he began, Skyler expects to graduate with his bachelors in civil engineering degree in May 2016. After graduation, Skyler hopes to get hired at an engineering firm or a municipality. He lists Electrical Consultants, Inc., ARW, and Jones & Associates as potential employers he'd like to work for. While he intends to stay in the state of Utah, Skyler wants to move further south, closer to Salt Lake City where the job opportunities for engineers are more plentiful and better paying. "It's not that I don't like Logan or Brigham City," Skyler said. "It's just that there's more opportunities down that direction."

Connor: Dedicated to Doing What He Loves

A pre-engineering student at the Brigham City regional campus, Connor graduated from the associates in pre-engineering program in May of 2013 when he was 23 years old. He was accepted into professional mechanical engineering program for the upcoming fall semester. Starting in the professional program, Connor made a point to become as much of a “traditional student” as he could. Although he lived at home in Brigham City and commuted to/from the Logan campus everyday, he took out student loans to pay his tuition so that he did not have to work. Using the advice he received from the main campus engineering advising staff to just “plough through the curriculum,” Connor loaded up his schedule with five engineering courses totaling thirteen credits. He explained, “I thought I could do it since I was taking that many credits my last semester at Brigham City.”

Taking a long, deep breath, Connor began to describe his experiences during the transition from the Brigham City regional campus to the main campus. Haltingly, he remembered, “I got overwhelmed. I guess I’ve never been that overwhelmed before. I got to the point where I was having trouble managing even the most basic things.” Expelled from the mechanical engineering program due to poor grades after just one semester⁶⁴, Connor was devastated. “It sucked. You build up an idea of what your life is going to be like. It’s where you put your entire sense of self worth. And then it’s gone.” Connor took “almost a year to recover” and another year to figure out his next steps.

⁶⁴ The mechanical engineering department was, at that time, the only department to restrict course repeats in the professional program to one. Failing two or more courses in the mechanical engineering professional program automatically disqualified a student from continuing in the program.

About half -way through his first semester in the professional program, Connor “started to feel weird about school.” He explained, “I felt like I needed to take a break but I didn’t know how to do that or what to do if I took one.” Connor went to see his assigned engineering advisor, who gave him the advice to keep pushing and “see if you can pull it out.” Connor, in fact, heard similar advice from several people: Engineering was hard and you just have to keep pushing. Yet, while Connor continued to push, he grew more and more out of sync. His performance started to accelerate into a downward spiral –like “one of those logarithmic drop-off curves.” Connor remembered,

To me, the saddest part of the whole thing was not that I got so nervous about my progress in those classes, but that when I finally decided to do something and drop them, I was one day too late. I tried so hard to drop them—I was begging. But they said I was too late.

At the end of fall semester of 2013, Connor’s final grades indicated that he failed three of the five courses. At that point, he was expelled from the mechanical engineering program. Although he appealed the decision at the engineering college level more than once, the expulsion was upheld each time. Being cut off from a career as a mechanical engineer was a devastating blow for Connor—as someone who had already been through a lot of turmoil just getting to the Logan campus and the professional mechanical engineering program.

Connor grew up in Brigham City. While Connor’s mother “went through many different careers,” most recently she was trained and worked as a massage therapist in order to have the schedule flexibility she needed to “wrangle” Connor and his three sisters. Connor’s father initially worked as a lineman at Brigham City Public Power Company. After earning a bachelor’s degree in management from USU Brigham City

before it had a single and coherent campus, Connor's dad eventually worked his way up to becoming the power company's director.

Connor attended Box Elder middle and high schools, both of which are located in Brigham City. He characterized himself as an "amazing student in middle school" who was frequently on the honor roll. Connor continued to do well through his sophomore year of high school. Then things started to change and grades became less important to him. During Connor's junior year, a draftsman from the Nucor Steel Corporation came to visit his high school drafting class. The visit promoted drafting as a career to make money to pay for college. Excited by the idea of getting a drafting job, Connor enrolled in an evening drafting program run by the local branch of the Bridgerland Applied Technology College (BATC). While the program was self-paced, Connor did well and progressed through much of the curriculum offered at the BATC Brigham City campus on his own.

While Connor "liked to keep himself busy," he found he had less and less free time while he participated in the BATC drafting program, swam on his high school swim team, and worked part time at the local pizzeria. Not surprisingly, Connor's grades began to fall. Looking back, Connor blamed his low scores partly on the time he spent doing these extracurricular activities. But, during his junior year, Connor also began hanging out with a group of friends whom he collectively called "the outcasts." He and his friends started going out to lunch and skipping certain classes- like the government class where "all the teacher talked about was football." At the time, Connor didn't worry so much about his falling grades since he had decided he was preparing for a career as a

draftsman and figured that “it was in the bag.” Connor even opted out of taking the ACT in high school because “drafting was his future.”

Connor was able “to keep his grades up high enough to graduate” and earned his high school diploma in May of 2008. Having completed much of the self-paced drafting curriculum at the BATC Brigham City campus by this time, Connor started attending drafting courses at the BATC Logan campus after graduation. Meanwhile, he also took a job working at the fish hatchery in nearby Mantua, Utah to help support himself even though he was still living at home. Connor explained that the hatchery job hadn't been difficult to get: “I was one of only two applicants and the other applicant had his mom drop off his paperwork.”

At BATC Logan, Connor hoped to find more structure to the drafting classes—perhaps similar to the high school drafting classes that he enjoyed. Connor, however, was disappointed to find that the BATC Logan classes were also taught in a self-paced format. He described his experiences in the BATC drafting courses saying:

There's an instructor who sits in an office and just kind of sits there. If you have questions you go in and ask him. Then you go back and keep working until you have another question. It was easy to lose track of what you were doing, or just not stay on task. I did pretty well; it just seemed vague as to what I was working toward. I wasn't clear what I should be doing at any particular time. It was kind of just confusing for me. It was also boring because it was kind of tedious and there wasn't much product. You draw some file and then you save it in a folder and then the teacher eventually looks through it. It's kind of like, are you looking through it? Am I getting anywhere? You can get lost. Eventually I got far enough through the training that I felt I could do the draftsman job.

Keeping his eye out for draftsmen job opportunities, one day Connor saw an opening for a drafting detailer posted on Nucor's jobs board. He decided to apply, even though he had not fully completed his draftsmen training.

I said to myself, “I’ll apply.” I took their math test— I studied up on the math before I took it and researched what their test covered. I studied up on everything. I think they said I got the highest test score they’d seen.

When Connor went in for the interview, the Nucor hiring team walked him through what the drafting detailer position entailed. Connor’s heart sank:

It was like you sit in this cubicle; they bring you a stack of papers; you go through and check them all; and you mark out any mistakes or changes. Then that gets passed onto the engineer who works with the customer. That all went well, but during the final part of the interview—I guess they were picking up on my hesitation—they asked me, so do you want this job? I’m said something like, “So you just sit in that cubicle all day?” They said, “Yeah.” I said, “Uh – yeah?” It was really unconvincing. I just saw a bunch of guys in khaki and shirts with ties sitting around. I was like this is just so un-exciting. I was afraid of going to school and then getting a horrendously boring job where I wasn’t going to have any sort of life adventure. I just felt like it was like this trap. I didn’t want to be in there.

The Nucor hiring committee never called back.

After the Nucor interview, Connor “stopped doing the drafting thing” and continued to work at the fish hatchery “without any clear plan” of what he “was going to do” long term. Around this time, Connor became “obsessed” with a new hobby called First Person Video Piloting (FPV)⁶⁵ that he had seen once in a magazine. Connor recalled,

I became enthralled with FPV while I was in high school and after I graduated. After the drafting thing wound down, I really started getting into FPV. I got on online forums and I started researching it. I bought just a little foam, electric plane that I’d fly on my breaks at the hatchery. My co-workers thought it was really cool. I kept modifying it with more and more electronics. I remember I worked three twelve- hour shifts once to save up money to buy a camera and transmitter kit and receiver kit to get me started. I put that on the plane and I started flying it.

⁶⁵ First Person Video Piloting (FPV) is a type of remote control (RC) flying that allows a pilot to fly an aircraft without maintaining a visual fix on the aircraft itself. FPV requires a video camera and transmitter to be mounted onto the aircraft. The pilot controls the aircraft using the view from the aircraft’s camera through a real-time video downlink that is commonly displayed using video goggles or a portable monitor.

Then I started building antennas and doing a lot of soldering, making wiring harnesses and repairing and modifying electronics. I was obsessively reading what other people had done and tested and then doing it myself. I modified parts, bought used electronics, and even bought old used telephones from the DI⁶⁶. I took them apart and used the wires. Ended up having this whole setup with a camera and transmitter— I had this really fancy, high gain, directional 900 megahertz antenna that I had built and tuned. It had had amazing range. I had my transmitter that I had modified to get more range out of it. I had the receiver antenna for the control uplink to the plane I had modified for better range. I was pushing this thing as far as it could possible go. I'd fly it – I started doing that a lot, like I'd fly it every day after I got off work. I'd come up on a field up in Mantua and I got to the point where I could fly it from the hatchery, up above the mountains – I could look down on Perry and Brigham and the campus.

Connor, who learned to fly regular RC aircraft when he was eight years old, made a lot of friends in the online FPV community. He remembered a trip he took to Colorado to meet up with other FPV enthusiasts:

Some charismatic, personable person on the forum arranged a meeting. So I went up and camped out in West Colorado for four days and flew. I had a head tracking system, so I could slave the camera to my head movements using a deconstructed potentiometer hair out of the controller and parts from a telephone—like the telephone cord—to run the analog signal to the controller. I'd taken apart the controller and modified it so I could plug the phone jack into the controller, flip a switch and it would then take that as control inputs and then that would just go up to the servos that the camera was mounted to. I could look left and right, up and down, while wearing video goggles that I also bought and then modified for it. I also had an onscreen display with voltage and flight times – all of which was the cheapest they could possibly be purchased—like the cheapest version of whatever.

We were all just super interested in what each other had done. We'd go over each other's projects and then fly in formation. The plane I had at that point was this kind of faster delta wing design. I had put the hottest motor I could find on it that it could carry, since it was also laden down with all sorts of gear. It cruised at about 55 mph and then you could go full throttle and get to about 80 mph. At that speed it could almost climb vertically. I never dared just climbing vertically because I always was worried I was going to burn something out, but it

⁶⁶ Desert Industries, commonly referred to as the “DI,” is a local, nonprofit thrift store for clothing and home goods.

had a lot of power and that was fun. I took it to Colorado – I was flying it up there, all the guys were watching. Someone had a big camper that they had a big flat screen on and they were patched into my signal and they were watching my down feed while I was flying. I just took it up, like right up towards the mountain, went into a gully and then flew right into the gully – straight, and then just pulled up. Then went up the gully and was just doing a lot of maneuvers. It was awesome.

As his FPV hobby grew, Connor continued to fund it using some of the money he earned at the hatchery. He also bought a car, paying it off “extremely fast,” and built up a good savings.

One day, however, Connor’s hatchery job came to a rather abrupt end. The director of the hatchery was retiring and there was a big party thrown in his honor. At the party, the district manager of the Department of Wildlife and Natural Resources (DWNR) engaged Connor in conversation and asked him if he was planning to go to school and study wildlife resources. “Trying to answer the question honestly,” Connor told the manager that he was really thinking about going to school to study engineering. Two weeks later, Connor found out that his position at the hatchery had been terminated. As Connor described it, “I wasn’t fired per se, but they discontinued the job that I had.”

Connor remembered, “At the time I was confused, but later on it made sense.” Connor learned that the position he held at the hatchery is one that the DWNR uses to train people into the community of wildlife resource technicians.

So it was kind of like being inducted into that community. Usually they induct people from the hatchery up into the wildlife and natural resources program at USU. Then they take care of you and help you through school. To them, I was just kind of taking advantage of position without any intentions of continuing on.

After Connor lost his job at the hatchery, he “milled around” not knowing exactly what to do next. “I was still obsessed with FPV. As I got poorer and poorer, I got better and better

at improvising with electronics.” Connor started working at a Checker O’Reilly Auto Parts store in town as a delivery driver just to earn some cash. Later he did some work for the U.S. Census Bureau collecting data for the 2010 census. Connor remembered, “During 2008, 2009, and 2010, jobs were hard to come by. I took what I could get.” When he heard that one of his “loser friends from high school” was starting college, Connor decided it was time for him to go to college, too. From his Nucor experience, he had learned that “it’s the draftsmen who sit in the office and the engineers who have the responsibility and make the decisions and go do things.” So Connor officially decided to study engineering.

Using his own savings he had built from jobs at the fish hatchery, the auto parts store, and the Census Bureau, Connor enrolled at the Brigham City campus in the summer of 2009. He explained, “I just fronted the cost of tuition and bought books and got over the sticker shock.” During that summer semester, Connor took psychology and a history class which both turned out to be “a lot of fun.” He retook MATH 1050 College Algebra, which he had taken prior in high school, to meet the USU requirements to get into calculus. All in all, the first semester went well and Connor enrolled in the pre-engineering program in the fall of 2009. He turned twenty years old that semester.

That first semester in the pre-engineering program, however, did not go as well as Connor had hoped. He took four classes. He did well in two of them but “immediately failed Calculus I and chemistry.”

Then my engineering advisor at the Brigham City campus was like “Okay, you only get three repeats during the pre-professional program and you’ve just spent two of them. You’re going to have to be really careful from now on.” My advisor

helped me out there—she’s a really good advisor—she kept track of you. So the next semester I took some lighter classes and an academic success strategies class.

During this time, while beginning to struggle in school, Connor started working the Census Bureau again to earn money to continue school. This time, based on his prior experience Census Bureau experience as an assistant, he was assigned as a crew leader.

Connor explained how the situation unfolded:

When I was an assistant at the Census Bureau, I was the only young person there and, being a young person, I automatically knew how to operate the electronic hand held devices they used at that time. So I was super-helpful. I helped my crew leader who managed all the paperwork. At that time they did all of the payroll and all of the mapping and everything they could through these handheld units. So I was able to help my crew leader understand how to do all that with her handheld unit.

Then, when they hired me a second time, one of my friends from the Census Bureau whom I met during my first job became the Local Area Director. She bumped me up to being a crew leader because she knew I was good at it. Since then the government had sued the manufacturers of the hand held devices and had gotten rid of all the handheld units. So they had reverted back to paperwork. I had no idea how to handle that much paperwork. I was barely 20 years old and all of a sudden I was managing people. It was intimidating managing adults – like 40-plus older people—at that age.

Connor recalled one intense situation with an older employee he managed:

I remember one time I had a phone call with one of my employees, She said, “I can’t find this map.” The paper census maps had to be secure—they were classified. You had to know where they were. They were kept in these three ring notebooks. But I knew I put that in her box. She kept saying that it wasn’t there. So, at some point, I just abstractly decided to try out some management strategies. I tried being submissive, telling her that it’s there and that she just needed to look. She started yelling at me, saying over and over “It’s not there!” Then I went into a more aggressive strategy and said, “You need to go look there right now and find it.” Then she, being my grandmother’s age, went back on me and said, “You don’t talk to me that way!” Then, thankfully, she said, “Oh wait, it is right here. I’m sorry.” And I said, “It’s fine.”

But perhaps it was the younger employees that gave Connor the most angst. As crew leader, Connor was responsible for canvassing all of Box Elder and Tooele

Counties—a huge and mostly remote geographic area. Canvassing meant that someone had to physically drive every navigable piece of road and look for inhabitants. He told of one incredible night as a crew leader:

I was sending people out into the desert. I told them to call me when they leave and when they get back so I could check them in and out. That wasn't part of the Census Bureau's procedure. It was just something I did because their procedure is built for urban areas.

So, I had this kid who was eighteen. I just assumed he could drive a car. He had a license and he had a car that he had access to. When I was canvassing at that age as an assistant, I'd just take up a few jobs that needed taking care of right away. I treated those dirt roads like a rally stage with my new Chevy Malibu and burned down them, having a blast. So I imagined he could handle himself.

He never checked in one night—the same night there happened to be a freak blizzard. He never called to check in and I was worried. I tried calling him and he didn't call back. I tried calling my supervisor, but she didn't answer her phone. I tried calling the Census Bureau Department Head, but apparently I had the wrong number for her. I called his parents too, "Is he there?" They said, "No, he's out working." I told them that I'm his boss and he hasn't checked in. So I went to sleep. Then at midnight my phone rang. I heard it ring and a shooting pain riveted through my entire body. It was his parents saying, "He's not here." They were panicked and said they were going to go out looking for him. I said, "You don't know how big Box Elder county is."

So I looked online and I found some maps accessible to the public. I found the maps for the area he was in and sent that to them. I remember I made a program on my computer called so-and-so's rescue effort. Then I spent all night trying to help find him – I called Search and Rescue and they said, "Well he probably just left. He probably just, as 18 year olds like to, took off to go do wild things." I said, "No, no I'm with the Census Bureau. He's my employee, he's out somewhere in the desert." They said, "Well there's a Sheriff out there." So they talked to the Sheriff and the Sheriff said, "I'm going to drive that area but that road's inaccessible right now because of the snow." I was in pain!

So I stayed up all night and so did his parents, out there driving around. Then, finally, my immediate supervisor called me saying, "Are you going to have that paperwork for me today?" I said, "Where have you been? I have someone lost and an emergency situation!" She said, "Let me call so-and-so." So she called so-and-so and then the Director of the Northern Utah Census Bureau. Then the director called me. She was a really sharp, on-top-of-it person—someone who was going to make things happen. She said, "Give me the information, I will get

Search and Rescue out there.” I gave her the information and then about that same time I get a call from my employee. He said, “ Yeah, I got my car stuck in a ditch and spent the night in it. Then a farmer found me on the road the next morning.”

Connor summed it up as one “sort of stressful situation,” especially for someone his age.

Connor, in fact, had several more accounts of “crazy situations” he encountered as a Census Bureau crew leader. For example, there was one employee who had a medical condition that caused his legs to freeze up at random times. Connor’s assistant had to wade through waist-high mud to get the employee out of his car. And there was the hermit who lived in the west desert who would shoot at anyone who came near. Connor had to coordinate with the Sheriffs anytime he had canvassers in that area. All in all, Connor felt he “did a pretty good job” managing these intense situations on the fly.

Ironically, Connor was fired from his Census Bureau position a short while later not for the outcome of some “crazy situation,” but rather for, of all things, a paperwork violation. He explained,

I ended up getting fired because there was a very, very particular rule that you cannot turn in any unapproved overtime for any employee. Anyone who approved unapproved overtime was automatically dismissed. As a crew leader, I didn’t have the authority to approve overtime. What happened was I had a tracking sheet—and I asked employees to make sure that they checked their own—where I checked employee overtime. My supervisor took my tracking sheet because she needed it for some reason—that was before I had a camera on my phone. She took it saying, “I need it right now.” I said, “But I need this so I make sure I don’t mistakenly approve anything illegal”. She said, “It doesn’t matter, just give it to me.” So I gave it to her and then one my employees turned in four and half hours of unapproved overtime. That got put into the system and they had to dismiss me on the spot.

Connor described how, when his supervisor and the District Supervisor sat him down and told him he was fired, “It was really sad for everyone.” While Connor “was supposed to

just leave on the spot,” he made sure to sort out the paperwork so he didn’t “leave them with a mess.”

Connor kept going to school and started doing better in his classes. He retook the courses he needed the following semester and earned an ‘A’ in chemistry and a ‘B’ in Calculus I. During this time, Connor found an employment opportunity at the local McDonald’s chain restaurant. What might seem to have been a less stressful situation than his position as crew leader with the Census Bureau turned out to be a “soul crushing experience” for Connor. He described some of his experiences working there:

Working at McDonald’s, the managers expected you to do what they said and act how they wanted you to act—like being cheerful to customers. I guess I’m not good at dealing with people, as far as putting up with them. But my manager liked to put me on the register because I could count. There are a lot of really smart people who worked there with me. But people on the grill – a lot of them were immigrants and they didn’t have great English and they didn’t have any formal education. They were really smart people, I honestly enjoyed hanging out with them more than most of the other people, but they couldn’t do the drive-up job. Or the managers didn’t want them doing drive-up jobs. So I did the drive-up job. I honestly preferred working on the grill, even though the grill was hot; you got covered in fat and grease; you got stinky; and you had heat exhaustion every day you worked back there. At least you didn’t have to deal with the people who go to McDonald’s. A lot of the people who go to McDonald’s are looking for someone to belittle because they’ve been belittled. They wanted to find somebody to pick on.

When you’re running the drive-through, you have a headset and you’re taking orders, you’re punching in the orders, you’re taking money, and making change all at the same time. So you’re dealing with two people and the money. The microphones aren’t great and people come up with their engines running and say, “Yeah I want this.” Many of them have really bad English, not because they’re from somewhere else, just because they don’t speak right. You’ll not catch what they want, and say something like, “So that was a medium fries?” Then they’ll say, “No, I wanted a medium fries! You’re an idiot!” And then they’d just drive off, flipping you off as they drive by the window.

While Connor had several demeaning experiences at the drive-up window, he had far worse experiences at the fries station.

The fries station was miserable, and my manager always put me there because she considered me a screw-up. I never screwed-off, I just always analyzed things and liked to think about them. She didn't like that. She wanted me to do what she said. Period. So at the fries station you were just supposed to scoop fries and put them in the bag. But I'd always arrange them and I'd like figure out, based on the time, how many fries I should have prepared. If you have too many then you have to waste them, so they're fresh. The fries station was also a pain for me because I'm six feet five inches tall and the fries station is built for someone who's more like four feet six inches tall. The hood was right here, so I would either reach in there blindly and try scoop with my hands and my head over the hood, or I would bend over and crawl in there to scoop – which was really awkward. I ended up getting caked in salt and fat.

One day, Connor hit his limit.

We were really busy and I was doing fries. The fries weren't that busy, but the register was having a miserable time. The register was swamped; people were getting angry; the situation was bad. I thought, "Alright, I'm going to make a decision here. I'm going to move from the fries station where I've got things lined up and they can grab them if they need them. I can come back over here and refill it if they need it. I'm going to go over to the counter and help with the situation."

My manager saw me going over to the counter and she said, "No you stay at the fries station." I tried to tell her what I was doing. She said, "I know, but you need to be at the fries station." At that point, you know, people describe losing it – I started thinking there is no reality where this is worth it. I don't know, I didn't want to just quit, because I don't just let myself quit things when I'm involved in them. But I couldn't handle that anymore. I guess I had what you'd call a panic attack.

I hyperventilated and sat down. I sat there and the whole situation just kept going through my head and kept bugging me. So I ended up going back in the break-room and they sent me home sick. I was just like – how did this happen? Looking at my life, I how did I end up being here? People don't give credit for how difficult those jobs are.

Connor quit his job at McDonald's one week later.

At that time jobs were still hard to find. Connor decided to concentrate on school and not to look for a new job. Because his parents "didn't have enough money" to send him to school, Connor "figured out the whole student loan thing" but "only took what he

really needed.” He continued to live with his parents, who covered his food, cell phone bill, and car insurance costs. Connor paid for gas and his direct expenses from his remaining savings and student loans.

Despite being in school and working toward his engineering degree, Connor got very depressed after quitting his job at McDonald’s. He recounted that “before that experience I didn’t really believe in depression. But it got pretty serious. I got to where I had evasive thoughts⁶⁷.” Connor went to see a doctor and, at first, was prescribed pills that “only made it worse.” Connor later started to see a counselor, who helped him a great deal.

We talked and he went through things. I came to the conclusion that I expected more out of myself than what I was doing. Even though I was in school, I guess I won't be happy unless I'm doing something challenging and fulfilling. I don't know, I've kind of come to the conclusion that I won't be completely happy unless I'm flying a space ship I built myself to Mars. Until then, nothing will be good enough.

As Connor began to feel more like his old self, he was able to re-dedicate himself to school. While he found the pre-engineering program to be challenging, it was not as tedious to him as high school had been. He got to know more people on campus, made connections, and “spent countless hours in study groups.” He felt that he connected well with the older students who attended the regional campuses because he had more of an “adult mentality” from going to work right after high school. “I wasn’t a good student right out of high school. I wanted practical real life experience.” Connor found that the

⁶⁷ Evasive thought interaction is a type of thought disorder where the expression of ideas and/or feelings come out as evasive or in a diluted form. Extreme stress is considered to trigger the symptoms.

students at the regional campus “were more grounded and looked at things practically,” too.

During this time, Connor also began working on an extracurricular project that helped carry him through the rest of the pre-engineering program. The project was known as the “Lunabot project” around the Brigham City campus. As part of the project, several USU regional campus pre-engineering students formed a team to take part in the NASA Lunabot Robotic Mining competition. The competition required university teams to design and build a mining robot able to traverse a simulated lunar landscape, excavate lunar soil called “basaltic regolith,” and deposit the soil into a collection bin. Although the competition was not an official part of the pre-engineering program, the regional campus administration supported it with working space, faculty advisor support, and funding for supplies and travel to the competition.

Connor started working on the Lunabot while in the midst of counseling. It became an important outlet for his anxiety and helped him renew his personal feelings of self-worth. Connor remembered how he even “lost track of his high school friends” during that period. “They’d call me occasionally but I was always busy with the Lunabot.” Connor, in fact, became so dedicated to the Lunabot project that he nearly missed the graduation ceremony for the associates in pre-engineering program held in April of 2013.

I remember I almost missed the USU Brigham City graduation because we were in Logan working on the robot. Someone called the lab and said, “Graduation is today.” I was like, “Oh okay, whatever, we’re here working.” Then our faculty advisor called and said, “You guys are going to graduation. Stop what you’re doing and get down here.” So we stopped working and drove to Brigham City. I had a dress shirt in my car I put on and threw the robes over that and walked.

After graduation, Connor and the rest of the Lunabot team put in “one and a half or two panicked months,” finishing the robot in time for the competition. Then, the Brigham City Campus Dean bought tickets for the entire team and faculty advisor to attend the competition. The competition took place in late May 2013 at Cape Canaveral, Florida and was the highlight of Connor’s education thus far.

After graduation with his associate’s degree and the Lunabot competition, Connor started to transition the Logan campus. He took two classes, Thermodynamics I and Multivariable Calculus, at the Logan campus during that summer semester. Connor met a few students and formed a study group. Things went well for Connor in both of those classes.

Connor began the junior year mechanical engineering curriculum in the fall of 2013 feeling as if he had gotten a good rigorous education and problem solving ability from the pre-engineering program. He appreciated the staff and faculty at the regional campus who seemed to understand the plight of the nontraditional student. He was thankful for all of the social, emotional, and academic support he received. Connor was also proud of the design and hands-on machining and fabrication experience— “experience that a traditional engineering student might not have”— that he gained while working on the Lunabot project.

Connor’s Epilogue

After leaving the mechanical engineering professional program, Connor served as a teaching assistant (TA) for the first-year mechanical engineering solid modeling course, MAE 1200 for several semesters. During his second year as a

TA, Connor also began taking a few classes and even experimented with changing his undergraduate major to civil engineering just to get around the mechanical engineering department's one repeat (in the professional program) rule. Connor, however, left civil engineering after only one semester because he just "didn't find it exciting enough."

Connor used the machining experience he gained on the Lunabot as a springboard to a job as a machinist. After leaving the mechanical engineering program, Connor spent nine months back at BATC Brigham City working on a machinist certificate. One day, "some people came in looking for machinist to work weekend shifts in Brigham City." Connor volunteered and put in a "really nice application" in which he included all of his education and experience. The hiring manager put Connor's materials in a folder, never looking at them, and gave Connor the job. As Connor explained, "I went to USU for five years and got an associates degree. Then I went to technical school for nine months and got a full-time job."

After graduating from USU Brigham City, Connor found the associates degree in pre-engineering to be of moderate use. He found that most employers looking for people to do mechanical engineering work want to see applicants with a bachelors' degree. He noted that some employers don't even care what a bachelor's degree is in, just as long as it is a bachelor's degree. Since Connor "had that bad semester" in the mechanical engineering professional program, he found there isn't much he can do with his associates degree without transferring to another school. He did find that having an associates degree made transferring credits to another school easier because "it came over

as one whole package” and not individual credits. But, As Connor pointed out, “I still had to have the pre-requisite classes for the classes you need if you are starting a new bachelor’s degree program.” That meant that Connor had to wait a significant amount of time until the new school determined which pre-requisites he had and which he still needed before he could enroll and set his course schedule.

Connor transferred associate degree credits to Weber State University in Ogden where he plans to pursue a bachelor’s degree in manufacturing engineering. He is also working as a machinist pulling “crazy weekend shifts” for True Position Machine Shop located in Ogden. He is excited about school and working on getting involved with study groups and clubs more so than he did at USU.

CURRICULUM VITAE

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EDUCATION and PROFESSIONAL PREPARATION

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Dissertation: *Toward Alternative Pathways in Engineering Education:*

Nontraditional Student Success in a Distance-Delivered Engineering Transfer Program

Co-Advisors: Dr. Oenardi Lawanto, Department of Engineering Education, and Dr.

Sherry Marx, School of Teacher Education and Leadership

Registered Professional Engineer (mechanical) in Colorado (#36281) and Utah (#5105852-2202)

MSME, Georgia Institute of Technology

Mechanical Engineering, 1997, Atlanta, Georgia

National Science Foundation (NSF) Graduate Fellowship

Thesis: *Development of a Heat Transfer Module for the Thermal Management of Sealed Electronic Enclosures.*

Advisor: Dr. Ari Glezer, Department of Mechanical Engineering

BSME, United States Military Academy (USMA)

Mechanical Engineering, 1987, West Point, New York

Deans List (4 years)

Graduated *with distinction*

RESEARCH INTERESTS

Inclusive engineering education

Social Justice

Personalized learning and e-learning

Qualitative methods

PROFESSIONAL EXPERIENCE

2009-P Principal Lecturer, Engineering

Department of Engineering Education, Utah State University

Brigham City Regional Campus, Brigham City, Utah

Develops engineering curricula and instructs core undergraduate engineering courses and laboratories. Actively mentors and advises freshman and sophomore engineering students.

2005-P Adjunct Faculty

Department of Mechanical and Aerospace Engineering, Utah State University, Logan, Utah

Develops curricula and instructs mechanical engineering courses. Specializes in Thermal-Fluids courses. Seeks funding and conducts research in conjunction with other USU faculty.

2004-2010 President and Principal Engineer

CastleRock Engineering, Inc., Logan, Utah

Small business owner and founder. Secured federal and state sponsored research grants (SBIR, STTR, Utah COE) and industry engineering contracts. Conducted research and provided engineering services including thermal-fluids analysis (CFD, FEA) and mechanical design (CAD).

2002-2006 Senior Mechanical /Thermal Engineer

Space Dynamics Laboratory, Utah State University Research Foundation, North Logan, UT.

Lead Mechanical / Thermal Engineer for military-grade electronic systems supporting customers including Raytheon, Lockheed Martin, the Naval Research Laboratory, and NASA.

1998-2002 Research and Development Engineer

Ft Collins Systems & Technology Laboratory, Hewlett Packard Company, Ft Collins, CO.

Lead Thermal Engineer on a high-availability, 32-processor UNIX server product line.

1997-1998 Manufacturing Engineer

All-in-One Division, Hewlett Packard Company, San Diego, CA.

Engineer responsible for troubleshooting and correcting manufacturing issues for the *Office Jet* product line.

1994-1997 Graduate Research Assistant

NSF Microsystems Packaging Research Center, Georgia Institute of Technology, Atlanta, GA.

1987-1994 Active Duty U.S. Army Commissioned Officer (Aviation Branch)

CH-47 C/D (Chinook) Medium Lift Helicopter Pilot. Operation Desert Shield/Storm veteran. As an U.S. Army officer commissioned in the Aviation Branch, served in five countries across two continents. Held wide-ranging leadership positions including Detachment Commander, Flight Operations Officer, Flight Platoon Leader, and CH47D Night Vision Goggle Pilot-in Command. Over 1000 hours flown (58 combat hours). Air Medal recipient.

RESEARCH SUPPORT
Current Funding

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Completed Funding

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3. Kulyukin, V. (PI) & **Minichiello, A.** "STTR: A Wearable Multi-Sensor Navigation Device for the Visually Impaired", \$129,062, National Institutes of Health, National Eye Institute (NEI), Award No. 1 R41 EY017516-01A1, September 30, 2006-August 31, 2008.

2. **Minichiello, A. (PI)** & Smith, B. L. "SBIR Phase I: Particle Sorting via Aerodynamic Vectoring," \$115,674, National Institutes of Health, National Institute of Environmental Health Sciences (NIEHS), Award No.1 R43 ES014506-01, August 15, 2006–February 14, 2008.

1. **Minichiello, A. (PI)** & Smith, B. L. "STTR Phase I: Particle Sorting via Aerodynamic Vectoring," \$99,980, National Science Foundation, Division of Manufacturing Innovation (DMI), Award, No. DMI-0512525, July 1, 2005 – June 30, 2006.

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1. Belady*, C., & **Minichiello, A.** (2003, May). Effective thermal design for electronic systems. *Electronics Cooling Magazine*, 9(2), 16-21.

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3. **Minichiello, A.** (forthcoming, expected 2016). Examining Academic Integrity in the Postmodern: Undergraduates' Use of Solutions to Complete Textbook-based Engineering Coursework. In S. Marx & S. Gregory (Eds.), *Qualitative research in STEM education: Studies of equity, access and innovation*. New York: Routledge.
2. **Minichiello, A.,** Blake, T., Goodridge, W., & Sam, D. (2015). Interdisciplinary team instruction in a distance-delivered first year engineering course. In A. Blackstock & N. Straight (Eds.), *Connected classrooms: Interdisciplinary approaches to distance teaching*. Routledge Research in Education Series. New York: Routledge/Taylor & Francis.
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15. **Minichiello, A.** (expected 2016). Understanding student participation in a first-year calculus online support forum. *Draft submitted for the NSF/AAAS Envisioning the Future of Undergraduate STEM Education: Research and Practice Symposium*, Washington, D.C.
14. Harkness*, D. & **Minichiello, A.** (expected 2016). Exploring student resistance to online discussion forums in calculus. *Draft submitted for the 123rd Annual ASEE Conference & Exposition*, New Orleans, LA.
13. **Minichiello, A.,** Marx, S., Hailey, C., and McNeill, L. (2015). Learning practices of contemporary engineering undergraduates assigned online homework. *Proceedings of the 6th Research in Engineering Education Symposium, Dublin, Ireland*.
12. **Minichiello, A.,** Campbell, T., Dorward, J. T., & Marx, S. (2015). Perspectives of pedagogical change within a STEM classroom. *Proceedings of the 122nd Annual ASEE Conference & Exposition, Seattle, WA*.
11. **Minichiello, A.,** Marquit, J., Dorward, J. T., & Hailey, C. (2014). Emerging themes in a distance-delivered Calculus I course: Perceptions of collaboration, community and support. *Proceedings of the 121st Annual ASEE Conference & Exposition, Indianapolis, IN*.

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7. **Minichiello, A.**, Blake, T., Goodridge, W., & Sam, D. (2011). Team teaching that goes the distance: Team instruction for a broadcast introductory engineering course. *Proceedings of the 118th ASEE Annual Conference & Exposition*, Vancouver, BC.
6. Smith, B. L., Humes, Z., and **Minichiello, A.** (2006). Aerodynamic vectoring particle sorting. *Proceedings of FEDSM2006 ASME Fluids Engineering Summer Conference*, Paper number 2006-98266.
5. **Minichiello, A.** (2006). COTS in space: Developing an environmental control system for balloon-borne air-cooled electronics. *Proceedings of the 10th InterSociety Conference on Thermal and Thermomechanical Phenomena in Electronic Systems (ITHERM)*, San Diego, CA, pp. 1390-1399.
4. Humes, Z. E., Smith, B. L., and **Minichiello, A. L.** (2005). Particle sorting by aerodynamic vectoring. *Bull. Am. Phys. Soc.* 50, p. 251.
3. **Minichiello, A.** and Belady, C. (2002). Thermal design methodology for electronic systems. *Proceedings of the 8th InterSociety Conference on Thermal and Thermomechanical Phenomena in Electronic Systems (ITHERM)*, San Diego, CA, pp. 696-704.
2. **Minichiello, A.** (2000). Flow network modeling: A case study in expedient system prototyping. *Proceedings of the 7th Inter Society Conference on Thermal and Thermomechanical Phenomena in Electronic Systems (ITHERM)*, Volume 1, Las Vegas, NV, pp. 70-77. (**Best Paper Award Finalist**)
1. **Minichiello, A.**, Glezer, A., Hartley, J. G., and Black, W. Z. (1997). Thermal management of sealed electronic enclosures using synthetic jet technology. *Advances in Electronic Packaging, 1997: Proceedings of the Pacific Rim/ASME International Intersociety Electronic & Photonic Packaging Conference*, INTERpack '97, EEP-Vol.19-2, pp. 1809-1812, New York, N.Y: American Society of Mechanical Engineers.

CONFERENCE PRESENTATIONS (student advisees indicated by ❖)

15. Harkness❖, D. & **Minichiello, A.** “Exploring Student Resistance to Online Discussion Forums in Calculus,” 123rd Annual ASEE Conference & Exposition, expected June 2016, New Orleans, LA. **(Co-Presenter).**
14. **Minichiello, A.** “Narratives of the Nontraditional: Stories along a Road Less Traveled in Engineering Education,” Twelfth International Congress of Qualitative Inquiry, expected May 2016, University of Illinois, Champaign-Urbana, IL. **(Presenter).**
13. **Minichiello, A.** “Understanding Student Participation in a First-year Calculus Online Support Forum,” NSF/AAAS Envisioning the Future of Undergraduate STEM Education: Research and Practice Symposium, expected April 2016, Washington, D.C. **(Presenter).**
12. **Minichiello A.** “Storying Nontraditional Student Experience in Engineering Education,” AERA, Annual Meeting, Narrative Special Interest Group Doctoral Student Seminar, expected April 2016, Washington D.C. **(Presenter).**
11. **Minichiello, A.,** Marx, S., Hailey, C., and McNeill, L. “Learning Practices of Contemporary Engineering Undergraduates Assigned Online Homework.” 6th Research in Engineering Education Symposium, July 2015, Dublin, Ireland. **(Presenter).**
10. Farrell, S., Chan, B., **Minichiello, A.** “Year of Action on Diversity Session: Safe Zone/Positive Space Ally Training 1 (Level 1),” 122nd Annual ASEE Conference & Exposition, June 2015, Seattle, WA. **(Co-Presenter).**
9. **Minichiello, A.,** Campbell, T., Dorward, J. T., & Marx, S. “Perspectives of Pedagogical Change within a STEM Classroom,” 122nd Annual ASEE Conference & Exposition, June 2015, Seattle, WA. **(Presenter).**
8. **Minichiello, A.,** Marx, S., Hailey, C., and McNeill, L. “Deconstructing Academic Integrity: Understanding the Use of Solutions by Engineering Undergraduates During Textbook-Based Homework Preparation,” Eleventh International Congress of Qualitative Inquiry, May 2015, University of Illinois, Champaign-Urbana, IL. **(Presenter).**
7. **Minichiello, A.,** Hailey, C., Legler, N., and Adams, V.D. “Online Engineering Course Design, Part I: Toward Asynchronous, Web-based Delivery of a First Course in Thermodynamics,” 43rd Annual Frontiers in Education Conference, October 2013, Oklahoma City, OK. **(Presenter).**

6. **Minichiello, A.** and Hailey, C. “Engaging Students for Success in Calculus with Online Learning Forums,” 43rd Annual Frontiers in Education Conference, October 2013, Oklahoma City, OK. **(Presenter).**
5. **Minichiello A.**, McNeill, L., and Hailey, C. “Comparing Engineering Student Use of Solution Manuals and Student/ Faculty Perceptions of Academic Dishonesty,” 119th ASEE Annual ASEE Conference & Exposition, June 2012, San Antonio, TX. **(Presenter).**
4. **Minichiello, A.**, Blake, T., Goodridge, W., and Sam, D. “Team Teaching that Goes the Distance: Team Instruction for a Broadcast Introductory Engineering Course,” 118th ASEE Annual Conference & Exposition, June 2011, Vancouver, BC. **(Presenter).**
3. **Minichiello, A.** and Belady, C. “Thermal Design Methodology for Electronic Systems,” 8th InterSociety Conference on Thermal and Thermomechanical Phenomena in Electronic Systems (ITHERM), June 2002, San Diego, CA. **(Presenter).**
2. **Minichiello, A.** “Flow Network Modeling: A Case Study in Expedient System Prototyping,” 7th Inter Society Conference on Thermal and Thermomechanical Phenomena in Electronic Systems (ITHERM), May 2000, Las Vegas, NV. **(Best Paper Award Finalist). (Presenter).**
1. **Minichiello, A.**, Glezer, A., Hartley, J. G., and Black, W. Z. “Thermal Management of Sealed Electronic Enclosures using Synthetic Jet Technology,” Pacific Rim/ASME International Intersociety Electronic and Photonic Packaging Conference, June 1997, Kohala Coast, Hawaii.

POSTER PRESENTATIONS (student advisees indicated by ❖)

3. **Minichiello, A.** “Alternative Pathways in Engineering Education: Nontraditional Student Success in a Distance-Delivered Engineering Transfer Program,” 122nd Annual ASEE Conference & Exposition, Graduate Student Division Poster Session, June 2015, Seattle, WA. **(Presenter).**
2. **Minichiello, A.**, Marquit, J., Dorward, J. T., Hailey, C., Fisher❖, A., and Holt❖, E. “Emerging Themes in a Distance-Delivered Calculus I Course: Perceptions of Collaboration, Community and Support,” 121st Annual ASEE Conference & Exposition, NSF Grantees Poster Session, June 2014, Indianapolis, IN. **(Presenter).**
1. **Minichiello, A.** “COTS in Space: Developing an Environmental Control System for Balloon-Borne Air-Cooled Electronics”, 10th InterSociety Conference on Thermal and Thermomechanical Phenomena in Electronic Systems (ITHERM), June 2006, San Diego, CA. **(Presenter).**

INVITED PRESENTATIONS and WORKSHOP PARTICIPATION

(Student advisees indicated by ❖)

9. **Minichiello, A.** “Asynchronous Learning Networks: Accessing the Potential of Online Interaction.” Presentation given for the Department of Engineering Education, The Ohio State University, February 2016, Columbus, OH. **(Presenter).**
8. **Minichiello, A.,** Campbell, T., & Fisher❖, A. “Engaging Students with Technology: Online Learning Forums,” Invited presentation, Empowering Teaching Excellence Conference, Office of the Executive Vice President and Provost and the Center for Innovative Design and Instruction, Utah State University, August 13, 2014, Logan UT. **(Co-Presenter).**
7. **Minichiello, A.** “Beyond Active Learning: Traversing the Constructivist Continuum in e-Learning Courses,” Online Teaching Fellows Webinar Series, Utah State University, March 2014, Logan, UT. **(Presenter).**
6. **Minichiello, A.** “Faculty Research Highlight: Exploring the Perceptions of Collaboration, Community and Support in a Distance-Delivered Calculus I Course,” Invited presentation, Engineering Education Research Seminar, College of Engineering, Utah State University, March 2014, Logan, UT. **(Presenter).**
5. Legler, A., Leike, J., **Minichiello, A.,** & Radford, C. “FAQ Panel: Assessment and Grading in e-Learning Courses,” Online Teaching Fellows Webinar Series, Utah State University, February 2014, Logan, UT. **(Panelist).**
4. **Minichiello, A.** Engineering Education Pioneer Interviewer and Travel Award to 2014 ASEE annual conference: NSF sponsored program “Engineering Education Pioneers Research Team,” January 2014, University of Washington, Seattle, WA. **(Participant).**
3. Etchberger, L. & **Minichiello, A.** “Starting at the End: Teaching with Learning Outcomes,” workshop given at the Utah State University Regional Campuses annual faculty retreat, August 2011, Logan, UT. **(Co-Presenter).**
2. **Minichiello, A.** Women in Engineering Seminar, Invited presentation, College of Engineering, Utah State University, October 2005, 2009, and December 2010, Logan, UT. **(Presenter).**
1. **Minichiello, A.** Selected Participant and Travel Award: “Hands-on Workshop for Three NSF-Funded Innovations in Mechanics Education”, August 2009, Pennsylvania State University, State College, PA. **(Participant).**

PATENTS

5. Clements, B. & **Minichiello, A.** "Mounting Apparatus for Coupling Control Circuitry to an Air-Moving Device," US Patent # 6,924,979, August 2, 2005.
4. Simon, G., V. Srinivas, V., **Minichiello, A.**, Clements, B., & Lucas, C. "Fan-securing device for use with a heat transfer device," US Patent # 6,650,541, November 18, 2003 and US Patent # 6,879,487, April 12, 2005.
3. Clements, B., & **Minichiello, A.** "Externally Mounted On Line Replaceable Fan Module," US Patent # 6,690,576, February 10, 2004.
2. Rubenstein, B. Clements, B., & **Minichiello, A.** "Mushroom Head Clip Fastener," US Patent # 6,662,411, December 16, 2003.
1. Clements, B. & **Minichiello, A.** "Electro-Magnetic Interference (EMC) Gasket Providing Air Ventilation Holes while Spacing Cards on 0.9 inch Centers," (Pending, July 2001).

TEACHING EXPERIENCE
Utah State University Logan Campus

ENGR 2030 Engineering Mechanics: Dynamics (3 credits)
 MAE 2300 (taught as MAE 2400) Thermodynamics I (3 credits)
 MAE 3440 Heat and Mass Transfer (3 credits)

Utah State University Regional Campuses

*‡ ENGR 1000 Introduction to Engineering Design (2 credits)
 * ENGR 2010 Engineering Mechanics: Statics (3 credits)
 * ENGR 2030 Engineering Mechanics: Dynamics (3 credits)
 * ENGR 2140 Strength of Materials (3 credits)
 ‡ ENGR 2450 Numerical Methods for Engineers (3 credits)
 * MAE 2300 Thermodynamics I (3 credits)

Utah State University Distance Education

⊗ MAE 2300 Thermodynamics I (3 credits)

‡ Indicates course with a full laboratory component

* Indicates course taught via IVC Interactive Video Conferencing

⊗ Indicates course taught asynchronously online

HONORS and AWARDS

Graduate Student International Travel Award, Utah State University Office of Research and Graduate Studies, \$400 to attend the 6th Research in Engineering Education Symposium, Dublin Ireland, 13-15 July, 2015.

Ph.D. Student Travel Award, Utah State University College of Engineering, \$250 to attend the 6th Research in Engineering Education Symposium, Dublin Ireland, 13-15 July, 2015.

Research Mentor of the Year. Utah State University Regional Campuses, August 2014.

Undergraduate Research Mentor of the Year. Utah State University, Brigham City Regional Campus, May 2014.

Outstanding Graduate Student of the Year. Utah State University, College of Engineering, Department of Engineering Education, April 2014.

Utah State University Online Teaching Fellow. For demonstrating “outstanding skills and commitment to excellence” in online teaching, Utah State University, September 2013-September 2014.

Small Business Commerce Association Best of Business Award. CastleRock Engineering Inc., Logan, Utah, 2009.

NASA Langley Group Achievement Award. “For exceptional achievements in the successful development and flight of the Far-Infrared Spectroscopy of the Troposphere Experiment,” 2006.

Space Dynamics Laboratory Outstanding Performance Award. “In recognition of outstanding performance and innovation in solving our Navy customer’s reliability and capability problems with the Common Data Link hardware,” 2005.

National Science Foundation Graduate Research Fellowship. 1994-1997.

Distinguished Honor Graduate. (1st in class), US Army Aviation Officer’s Advanced Course, 1993.

Commandant’s List Graduate. (Top 10% of class) US Army Aviation Rotary Wing Flight School, 1988.

Graduate. U.S. Army Airborne and Air Assault Schools, 1987.

First Female Graduate. US Army JFK Special Warfare Center High Risk SERE School, 1987.

Distinguished Graduate. (Top 5% of graduating class, 14th of 1032), US Military Academy, 1987.

PROFESSIONAL SERVICE

ABET Program Evaluator. Engineering Accreditation Committee (EAC) on behalf of the American Society of Mechanical Engineering (ASME), November 2010-P.

Journal Reviewer. *Current Issues in Education*, 2013-P.

Program Chair. Engineering Ethics Division, American Society of Engineering Education, June 2015 - June 2016.

Secretary/Treasurer. Engineering Ethics Division, American Society of Engineering Education, June 2014- June 2015.

Student Member. American Society of Engineering Education National Outstanding Teaching Award Committee, June 2015 - June 2018.

Conference-Related

Peer Reviewer. Mathematics Division, American Society of Engineering Education Conference, New Orleans, LA, June 2016.

Peer Reviewer. Engineering Ethics Division and Mathematics Division, American Society of Engineering Education Conference, Seattle, WA, June 2015.

Peer Reviewer. Frontiers in Education Conference, Madrid, Spain, October, 2014.

Peer Reviewer. Engineering Ethics Division, American Society of Engineering Education Conference, Indianapolis, IN, June 2014.

Session Moderator. Women in Engineering Division, American Society of Engineering Education Conference, Indianapolis, IN, June 2014.

Peer Reviewer. Frontiers in Education Conference, Oklahoma City, OK, October, 2013.

Session Moderator. Mechanics Division, American Society of Engineering Education Conference, San Antonio, TX, June 2012.

Professional Affiliations

- Member, American Educational Research Association (AERA), 2014-P
- Member, American Society of Engineering Education (ASEE), 2009-P
- Member, American Society of Mechanical Engineers (ASME), 1998-P
- Member, Institute of Electrical and Electronics Engineers (IEEE), 1998-2013

INSTITUTIONAL SERVICE

Utah State University

Member. USU Allies on Campus, June 2015-P.

USU Online Teaching Fellow, September 2013- September 2014.

Utah State University, Regional Campuses and Distance Education (RCDE)

Member. Promotion committee for Dr. Jessica Habashi, Department of Biology, Lecturer to Senior Lecturer, October 2013-April 2014, Brigham City, UT.

Member. Promotion committee for Ms. Nikole Eyre, Department of English, Lecturer to Senior Lecturer, February 2012- April 2013, Brigham City, UT.

Member. USU Regional Campus Distance Education (RCDE) Teaching Excellence Committee, Standing Committee to plan annual RCDE faculty retreats (Spring and Fall), May 2010-March 2012, Logan, UT.

Guest Speaker. Brigham City Kiwanis Club “The Future of Engineering and the USU Associates in Pre-Engineering (APE) Program”, March 30, 2011, Brigham City, UT.

Member. Brigham City Peer Evaluation of Teaching Ad Hoc Committee, March 2010-March 2011, Brigham City, UT.

Faculty Co-Advisor. USU Regional Campus Student Engineering Club (FATE), January 2009 - April 2012, Brigham City, UT.

Utah State University, College of Engineering, Logan Campus

Member. Search committee for Associate Dean/EED Department Head, September 2011-May 2012, Logan, UT.

Guest Lecturer. Dynamics Review for the Fundamentals of Engineering (FE) Exam, Utah State University, October 2010, Logan, UT.

Panelist. USU Engineering State Women's Panel, June 2009, 2010, Logan, UT.