Construction Management Technology Students Choice of Major

Dr. Anthony E. Sparkling, Purdue University

Anthony Sparkling is an Assistant Professor in Construction Management Technology (CMT) at Purdue University where he teaches courses in mechanical and electrical systems, electrical estimating, and electrical construction. His research interests include teams, organizations, contract governance, organizational processes, project/team performance and behavioral feedback systems. Meanwhile, he has a growing interest in the skilled-trades shortage in the United States.

He can be contacted at asparkli@purdue.edu.

Dr. Anne M. Lucietto, Purdue Polytechnic Institute

Dr. Lucietto has focused her research in engineering technology education and the understanding of engineering technology students. She teaches in an active learning style which engages and develops practical skills in the students. Currently she is exploring the performance and attributes of engineering technology students and using that knowledge to engage them in their studies.

Ms. Aayushi Sinha, Purdue University

I'm a undergraduate student studying mathematics and statistics who is interested in analysis of data. Working on this paper will give me a good idea of how to analyze data and what goes into writing a research paper.

Mr. Trenton Thomas Hasser, Purdue Polytechnic Institute

Held positions in agriculture, the U.S. military, and logistics prior to attending Purdue University. That experience has expanded to include project management, project engineering, and apprentice electrician work, while pursuing a Construction Management Technology – BS.

Active in student mentorship programs, and the Sigma Lambda Chi: International Construction Honors Society. Pursuing a career in electrical contracting as a project engineer, following graduation in the summer of 2019.

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Abstract

Policymakers and universities continue to bring awareness to societal challenges as they encourage and support science, technology, engineering, and mathematics (STEM) education. A growing urgency in the United States and abroad exist to maintain a strong workforce and leadership in STEM for economic growth in a rapidly growing technological society. K-12 school systems have taken on this challenge with increasing fervor by opening specialized STEM high schools. These high schools not only promote STEM but focus on narrowing the gender, race, and achievement gaps known to persist in this area. They have placed a strong emphasis on those students emanating from underrepresented minority groups and the loss of this potential human and intellectual capital. Researchers over the years have investigated STEM education from the perspective of barriers and factors that influence career decisions using overarching literature and evidence from high school STEM and College Bridge Programs. The research speaks to certain gender differences and environments more conducive for students to excel in STEM majors (e.g., females developing strong social identities in male dominated fields such as engineering). With longitudinal study data, some researcher has articulated the relationship with math anxiety in high school and STEM career trajectories. Moreover, attributing this connection to the lapse in STEM interest during a vital period in which career identities are developing. A recent case study takes a step forward investigating this phenomenon with an emphasis on Construction Management (CM) Programs. There is a growing need to replace an aging construction workforce and shortfall in skilled tradespeople, especially considering many do not consider construction an ideal career choice. A vital point often overlooked is the underlying motivation to pursue STEM or CM as a career choice. Despite attempts, there is an opportunity to gain deeper insights from individuals in CM degree programs. This study explores the following research questions:

1) What are the common attributes of college students that decide to pursue CM degrees; and, 2) What key motivational drivers that encourage students to remain in STEM majors? The study population considered were those students enrolled in CM undergraduate degree program in the United States (US). Over 100 students participated in an online survey to assess their backgrounds and experiences. Results illustrate early career decisions and other underlying motives shape students' decisions to pursue CM undergraduate degree programs. Key drivers such as family background, personal interests, and role models/mentors are related to CM degree program and CM career choices. This study helps inform a broader narrative around STEM education and offers clues for organizations that are often trying to attract and retain a more diverse student body in STEM fields.

Introduction

The lack of diversity continues to garner attention in all facets of our life. Whether in business, politics, or higher education a growing interest exist on how to best tap into this underutilized labor resource. This dilemma is prominent in the National Science Foundation (NSF) initiatives aimed at "broadening the participation of underrepresented minority (URM) groups in science, technology, engineering, and mathematics (STEM) [1]." STEM occupations are increasing at a rapid pace and, despite a limited talent pool, offer a great career opportunity and earnings potential. Construction management is increasingly becoming an avenue for students to pursue STEM careers.

While the construction industry remains a vital part of the economy in the United States (U.S.), it is facing an increasing shortage of skilled workers across nearly 50 percent of major trades [2], [3]. U.S. government agencies are trying to address this problem by tapping into different labor source demographics (i.e. women, minorities, immigrants, and workers transitioning to new careers). Construction is consistently seen as a male dominated, dangerous, and tough career choice by the public despite its great earnings potential [4]. This image translates to the perceptions of career counselors,

high school students, and their parents negatively affecting potential students from majoring and/or pursuing construction as a career [5]. Thus, the construction industry must identify motivating factors to attract and retain construction management workers.

STEM fields, including construction, have traditionally been dominated by males drawing attention to gender disparities known to exist [6]–[8]. This is often attributed to perceived factors such as aversion to mathematics, how well prepared students are for college-level mathematics, and self-efficacy, especially among URM groups [9], [10]. Recognizing the concern, this study explores the perceptions of those who have chosen construction management as major to understand what factors and future aspirations lead to their career choice.

Relevance of Gender on Choice of Major. A construction career generally offers flexible working arrangements, work-life balance, and portable skills yet counselors push males towards these careers more often than females [5]. As with the construction industry, STEM majors such as CM continue to experience gender disparities [11]. Su and Rounds (2015) examined career choices bounded by differential interest of genders. In their study, the focus was on STEM sub-disciplines (e.g., Engineering, Biological and Medical sciences, and Social Sciences) and the relationships between people-oriented versus things-oriented STEM areas [12]. Women favored STEM fields that are more people-oriented while men were completely opposite, thus STEM fields are heterogeneous with more emphasize required to understand the subtle nuances behind career choices. In other words, careers that allow women to express verbal and person-oriented skills are selected more often such as those in the social sciences although caution should be given to external influences such as peers, parents, and counselors. Similarly, Buse et al., (2013) realizing the dilemma faced by the STEM disciplines shifted the focus to assessing why women who do enter the profession persist better than others [13]. According to Buse et al. (2013), women who stick it out in engineering tend to hold a higher internal belief system or self-

efficacy, healthy support networks, and well-defined personal goals all playing an important role in one's career development process.

Career Decisions and Behavior. SCCT expounds on the foundational work on social cognitive theory by Bandura (1986) moving towards a unified theory around career decisions and behaviors [14]. Lent et al. (1994) asserted three areas from which personal agency operates: 1) self-efficacy, 2) outcome expectations, and, 3) goals [15]. Self-efficacy refers to individual's belief that they have control over their actions. For instance, a student holding a high math self-efficacy will believe that he/she can earn a good grade in math class. Outcome expectations, unlike self-efficacy (i.e., "can I do this?") moves to the consequences of individual's actions (i.e., "what will happen if?")[15]. In other words, if a student seeks out information regarding CM careers, they anticipate making an informed decision prior to pursuing this career path. This is important considering that stereotype threats and deeply ingrained cultural images yield tremendous influence on whether those from URM groups, such as women, ultimately will help fill the construction labor shortage[16]. Therefore, individuals career goals symbolically represent outcomes which encourage self-regulation of behaviors to maintain the likelihood of attaining those desired outcomes [15]. Self-efficacy has also been used as a proxy to understand how undergraduate students persistence in their CM programs[17]. Based on findings, females exhibit higher levels of motivation and confidence in their construction education-related abilities than their male counterparts do. Thus, are equally apt to find success in their decision to pursue construction management as a major.

Choice of Construction Management Major. Research on career decision-making in CM is still emerging. Several studies assert how gender and individuals' background characteristics influence career decision-making. Recently Oo, Li, and Zhang, (2018), used case study evidence to identify myriad factors explicit to females enrolled in a CM program in Australia. From interviews and

structured surveys, they found that 88 percent of those surveyed (i.e., 30 participants) intend to persist in CM as a career [10]. Additionally, they ranked important personal and environmental factors that influence decisions to major in CM such as personal interest in construction, career opportunities, family influence, and earnings potential. These findings are also consistent among Hispanic high school students, another URM group [2]. For example, Koch et al. (2009) similarly ranked these factors yet found other attributes such as hands-on type of work and flexibility in working conditions (e.g., inside/outside) highly desirable [18]. Their findings are based on data from 504 undergraduate students enrolled in CM programs from three universities in the Midwest. Interestingly, they also found that having paid/voluntary work experience and father's support/encouragement as the most influential aspects for choosing CM. Despite the advancements, the link between choosing CM as a major, self-efficacy, and career goals is critical to provide both academia and educators insights on a dwindling construction labor pool [1], [19], [20].

Research Questions

As this research was developed, a keen interest on the part of the researchers into the demographics of the students and the things that may have influenced student choice in construction management as a major became intriguing. Thus, the following research questions are being addressed by the work in this paper:

- *Who are the students that choose construction management as a major?*
- *Are there any similarities or differences that provide insight into construction management student choice of career path?*

Methods

This study adopts a multi-method research design incorporating the use of descriptive statistics and content analysis [21] to understand the demographics and perceptions of CM undergraduate students [22]. In this, data represents a snapshot in time from respondents to a survey used to make inferences about the study population. Demographic information was assessed using gender, age, race, and parental educational level. Students were also investigated based on high school preparedness, path to CM as a major, self-efficacy, institutional and curriculum satisfaction, and future career plans. Parental educational level (i.e., completed a bachelor's) is used as a measure of first-generation college student. The measure of high school preparedness evaluates students' math and science experience. For instance, students respond to semester of math in high school, math/science course completed, whether advanced placement courses were offered, and perceived college math preparedness. Students indicated their path students followed to CM major, institutional and curriculum, and future plans. Most of the measures used multiple choice survey options while others, such as self-efficacy, used a 5-point Likert-type scale. The measures utilized in this study are well suited to CM survey data [10], [18].

Data from a large four-year university in the Midwest examines CM students' decision to pursue construction management as a major. The construction management department has 493 undergraduate students enrolled in their program. Upon institutional review board (IRB) approvals, an online survey was used to collect data from this student population. The researchers administered the survey instrument via email to listing of undergraduate students in CM starting over a two-month period starting in Fall 2019 semester. Respondents were informed that this voluntary and anonymous information was being used to learn more about students' high school experiences, path to CM, and the university/program in which they are enrolled. 109 undergraduate students participated in the survey (i.e., response rate 22%). Despite follow up reminders, the response rate was lower than anticipated.

This was partially explained by the end of semester administration where students were busy with projects, preparing for exams and lack of survey piloting all of which are survey development and delivery concerns [23].

Findings

The demographic distribution of the study population is provided in this section. Of the total respondents, 79 percent were male, 18 percent female, and 3 percent as other (e.g., gender neutral identity) (Figure 1). The age range for most of the students participating in this study is between 18 and 22 years (94%) with others between 23-30 years (6%). Freshmen (30%), sophomores (33%), juniors (19%), and seniors (12%) were represented in this study.

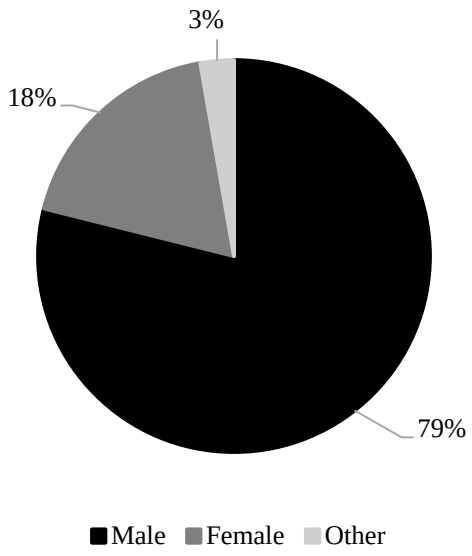


Figure 1. Gender Distribution of Study Population

The results, in terms of racial composition, show that 90 of those students surveyed were White (83%) while 10 were from underrepresented minority groups (9%) i.e., Black/African American,

Hispanic/Latino, or Native American. Six students selected other (5%) representing their race as mixed and three selected Asian (3%). This data is shown in Figure 2.

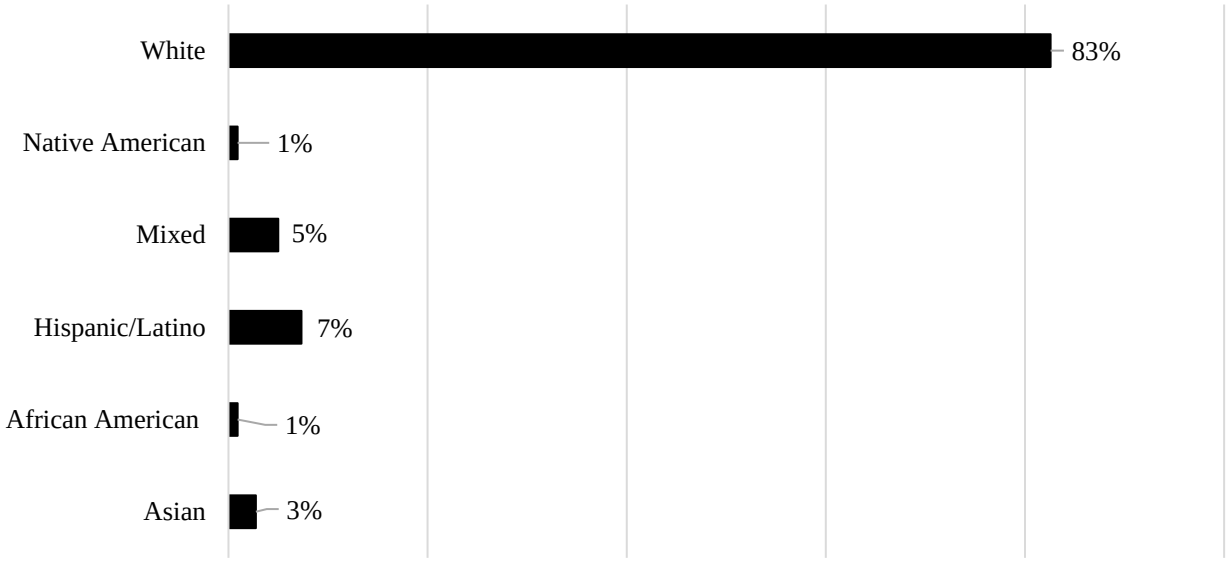
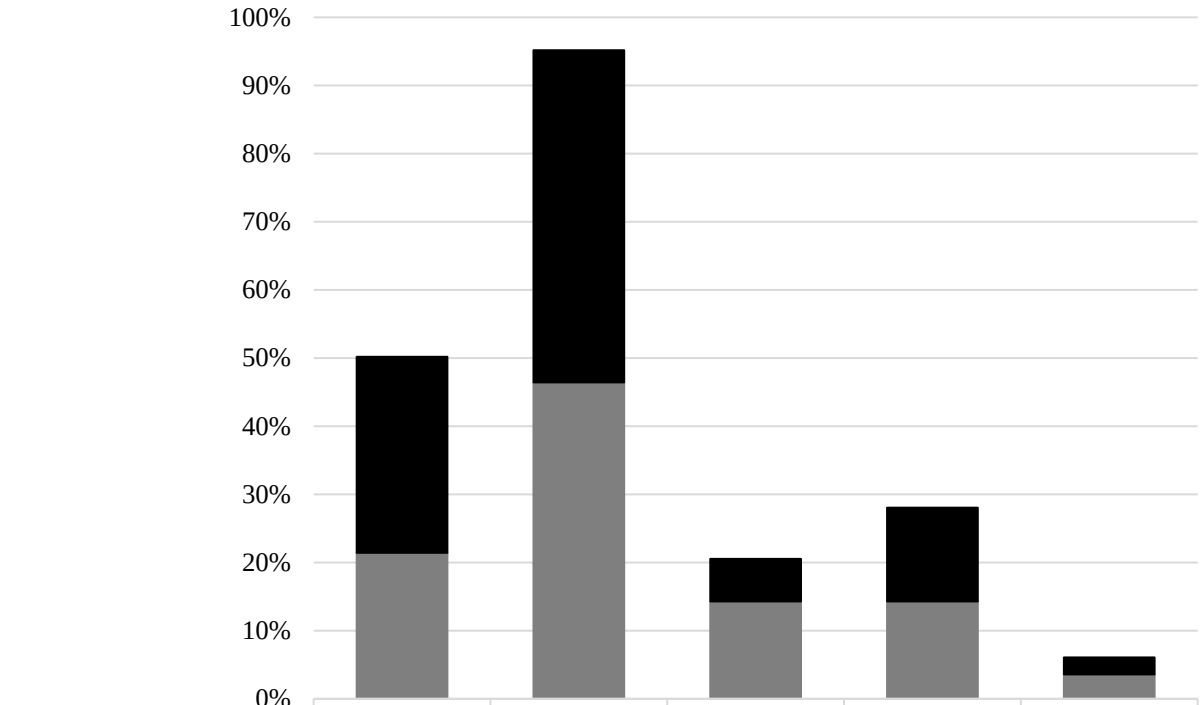


Figure 2. Racial Distribution of Study Population

Meanwhile, all but three students indicated they attended high school in the United States. Based on the data, 26 percent of the students were first-generation college students. The underrepresented group (i.e., including women and minorities) accounted for 28 percent of the total number of respondents in this study. The number of first-generation college students increased to 39 percent among this group.

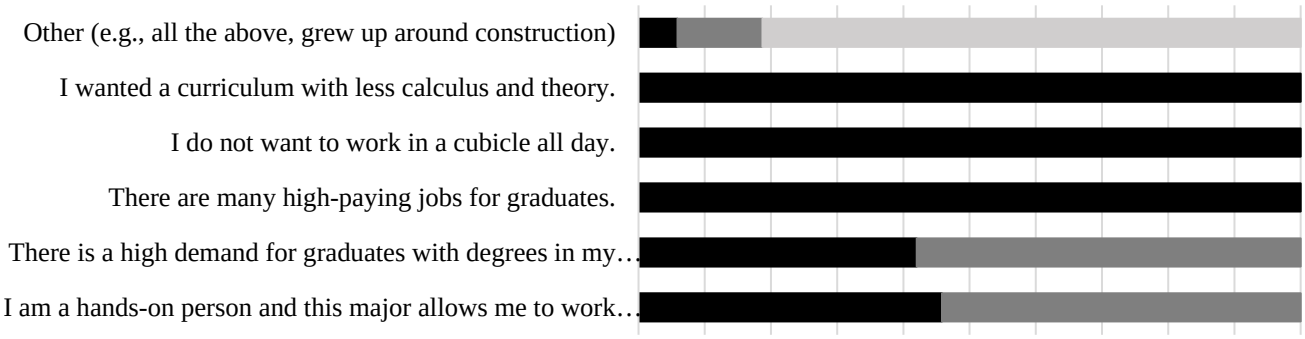
High School Preparation: The students from this study reported on their high school readiness perceptions particularly regarding math. The is no significant difference among the student groups in their prior experiences as most completed at least eight semesters of math in high school (66%). Additionally, many the participants believe they were adequately prepared for college level math (Figure 3). In other words, this means those emanating from URGs showed a similar tendency to complete the same number of math courses as their peers in high school, including advanced placement classes (AP).



	Extremely adequate	Somewhat adequate	Neither adequate nor inadequate	Somewhat inadequate	Extremely inadequate
White	29%	49%	6%	14%	3%
Underrepresented Groups	21%	46%	14%	14%	4%

Figure 3. Readiness for College Level Mathematics

Path to Major: Approximately 49 percent of the students started in CM directly from high school. Interestingly, 34 percent of the respondents transferred into CM from another major in a different college in the same university. Many of these students reported starting in engineering or exploratory studies prior to transferring to CM. The hands-on experience offered by this major explains why students were most interested as seen by the Figure 4. This finding is even more pronounced among female students (i.e., 74%).

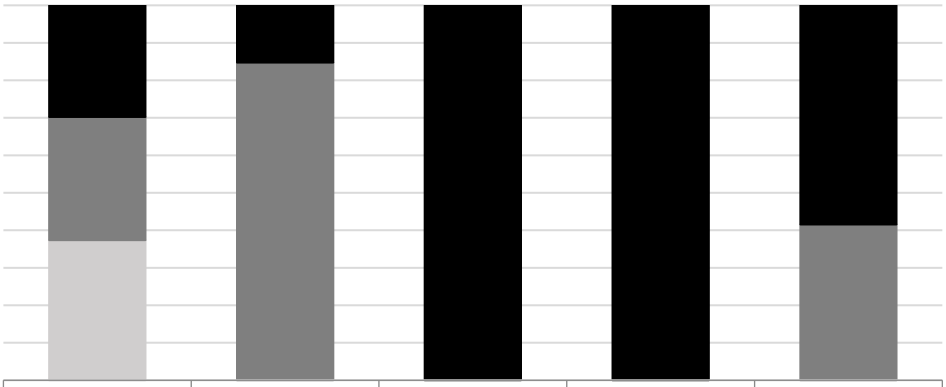


	I am a hands-on person and this major allows me to work with my hands more than others I was considering.	There is a high demand for graduates with degrees in my major.	There are many high-paying jobs for graduates.	I do not want to work in a cubicle all day.	I wanted a curriculum with less calculus and theory.	Other (e.g., all the above, grew up around construction)
Male	62%	7%	6%	12%	6%	7%
Female	74%	10%	0%	0%	0%	16%
Other	0%	0%	0%	0%	0%	100%

Figure 4. Student Interest in Construction Management Major

According to the findings, the students were exposed to CM in myriad ways and it tends to vary based on gender. For example, men learned about CM as a major primarily from their peers already in the program (32%) while females gained insights from their academic advisors or other academic counseling (35%). The researchers also examined the students' prior work experiences in high school and found that most did not participate in vocational/career training work (89%) prior to entering CM program. However, half of the students surveyed participated in paid construction-related work (50%) while forty-four percent reported having been involved in volunteer construction work such as habitat for humanity.

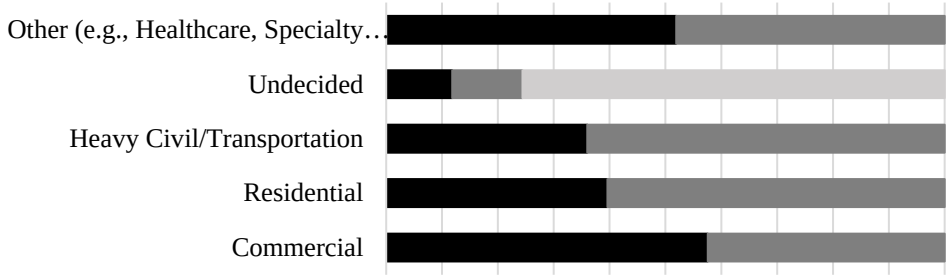
Self-efficacy was also rated important among these students yet does not show a significant correlation to other variables in this study. Figure 5 and Figure 6 help illustrate the persistence and intentions these students have for themselves. As displayed in Figure 5, many students currently intend to work in a field closely related to CM across all genders.



	Work in my field or a closely related area	Go to graduate school	Work in a field not directly related to my course of study	Start my own business	Undecided
Male	80%	1%	5%	6%	8%
Female	88%	6%	0%	0%	6%
Other	100%	0%	0%	0%	0%

Figure 5: Students' Career Plans After Graduating from the CM Program

Based on Figure 6, the students show less certainty with the specific area of the construction industry they are interested in working. Although, many of the male students are aligned with construction.



	Commercial	Residential	Heavy Civil/Transportation	Undecided	Other (e.g., Healthcare, Specialty Contracting, Renewable Energy, Industrial)
Male	52%	11%	9%	16%	12%
Female	38%	17%	17%	17%	11%
Other	0%	0%	0%	100%	0%

Figure 6. Students' Career Construction Sector after Graduating from the CM Program

Discussion/Conclusion

The study population of Construction Management majors yielded confirmation that most respondents were white male. It was noted that there are more females in this program than in other engineering technology programs [24]. The age distribution of the study population suggests that most of these students may be considered traditional, with less than 10% between the ages of 23 and 30. In general, these are the students that choose construction management as a major at this large Midwestern university.

Choice of Career Path. A great deal of the survey focused on learning more about these student's choice of major, and the path they took to get there. Other studies and anecdotal evidence provided suggests that students in these fields are underprepared or not prepared for the level of math required for STEM degrees [25], [26]. The researchers that developed the survey used in this study asked very direct questions about the student's opinion regarding readiness for math in college. While there were some that indicated a lack of preparation, most shared that they felt prepared.

Students were asked why construction management interested them. While nearly one-half of the students indicated they had moved into construction management right out of high school, 34 percent transferred into construction management from another major in the university. Most of these students started in exploratory studies or engineering before making the move to construction management.

Figure 4 shows an interesting reason more female students chose construction management. They said that they were a hands-on person and they would be able to do more hands-on work than in other majors they were considering. The data shows and the findings section noted that male and female students were exposed to construction management in different ways, suggesting their paths to the major are very different. Female students learned about the major from academic advisors or other mentoring situations. Male students were exposed to the major by interaction with peers. Overall, fifty percent of

the entire study population worked in construction in paid positions and forty-four percent had participated in programs such as Habitat for Humanity [27]. Given these responses it follows that they generally indicate that they will work in their field or a closely related area. The survey responses indicate that student career path most often led them to positions in commercial construction.

Overall the gender ratio in construction management is closer to par than in most other technology areas, sans computer technologies [28]. It appears that male students rely on word of mouth or interaction with peers for information regarding majors when choosing construction management as a discipline to study. Female students are influenced in the same way by interaction with academic advising, regardless of the mode of delivery. Recruitment efforts for each gender would prove to be different depending upon the recruiter's demographic goals. Further study in not only this population, but in technology disciplines may serve to provide information on other majors, such as those in engineering technology.

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