Preparing Students for Professional Work Environments Through University-Industry Partnerships: A Single Case Study of the Co-op Development Program

Glenda D. Young

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David B. Knight, Chair
Stephanie G. Adams
Holly M. Matusovich
Catherine T. Amelink

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ABSTRACT (academic)

Collaborations to produce innovative models that link postsecondary education to workforce development initiatives have increased as multiple stakeholders respond to the call to develop a diverse, well-prepared STEM workforce. University and industry stakeholders in engineering agree that collaborating to share expertise and implement programs that aim to support the school-to-workforce transition for engineering graduates is critical. However, in light of existing efforts, a more nuanced view of university-industry partnerships from the student participant perspective is needed to provide data to engineering educators and professionals to support effective partnership design and use of resources.

The purpose of this qualitative single case study was to understand how experiences in the Co-op Development Program (CDP) influence student participants' subsequent career decision-making with respect to pursuing engineering industry positions. Guided by Social Cognitive Career Theory (SCCT), this study examined the role that cooperative education experiences have on how students view and act on the potential employment opportunities that university and industry partners anticipate. Semi-structured interviews with eight former CDP participants, employed in industry at the time of the study, served as the primary data source. Additionally, program related documents, a profile questionnaire, and a conference proceeding were utilized to provide in-depth context of the CDP.

Results indicate that all participants voiced a desire to work in the aerospace industry to explore short-term interests or to accomplish longer-term career entry goals. Furthermore, participants most frequently discussed experiences that required them to employ a sense of self-agency to complete work tasks (e.g., guiding themselves through uncertainty, observations of the environments, and interactions with engineering professionals) as learning experiences. Finally, participants primarily connected their learning experiences to their beliefs about what work looks like as a full-time engineer, their abilities to perform in an engineering role, and perceptions of fit across different engineering roles and workplaces.

Major contributions of this study include extending the analytic generalizability of Social Cognitive Career Theory, creating operationalized definitions of learning experiences, and linking those experiences to students' beliefs of the engineering industry pathway.

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ABSTRACT (general audience)

Persistent calls to the field of engineering education to help develop diverse, well-prepared engineers for the STEM workforce have fostered collaborations across university and industry stakeholders. As stakeholders focus efforts on supporting student persistence at several critical junctures, there has been a renewed interest in supporting the school-to-workforce transition for engineering graduates. With calls to develop a more tech-savvy workforce, innovative approaches to supporting and preparing students to enter the workforce have become even more necessary; thus it is important to understand how university- industry partnerships generate experiences that contribute to students' eventual workforce entry.

The structure of the Co-op Development Program and the perspective of eight former CDP participants addressed how learning experiences shaped the career decisions of engineering participants immediately following graduation. A qualitative single case study approach was used and Social Cognitive Career Theory (SCCT) guided the study. Major contributions of this study include extending the analytic generalizability of Social Cognitive Career Theory, creating operationalized definitions of learning experiences embedded within that framework, and linking those experiences to how students' beliefs were shaped on their pathway to an early career within engineering industry. The themes identified in this study can help CDP managers and university stakeholders better support co-op participants and potentially allocate resources that will serve as the basis for future co-op design recommendations. Stakeholders may also use findings to promote the role of university and industry partnerships in supporting the student workforce transition.

Future researchers may extend the study design across multiple cases and leverage recommendations for qualitative and quantitative investigations to address some of the limitations embedded within this research design and further contribute to the discussion of preparing students for professional work environments through university-industry partnerships. Ultimately, findings of this study give voice to the student partner in university-industry partnerships as themes identified in this study help CDP managers and university stakeholders to establish interventions and serve as the basis for future co-op design recommendations.

Dedication

To my nephews and niece, because each generation should strive to do better than the last.

Acknowledgments

God, for providing a firm foundation for me to stand on throughout this process.

My family, Thank you, without your prayers and support I would not have finished.

Chamel, #faithjourney

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Chapter 1
Introduction

Statement of the Problem

Because the United States has more open jobs today than at any point since 2001, the national agenda in recent years has pushed for a variety of stakeholders to renew their focus on developing a well-prepared, diverse workforce, with a strategic emphasis on science, technology, engineering, mathematics (STEM) jobs (Olson & Riordan, 2012; The White House Office of the Press Secretary, 2015b). The federal government has invested two billion dollars over four years for workforce development at the community college level alone as well as 100 million dollars for the TechHire Initiative to create training programs that establish pathways to well-paying information technology (IT) jobs (The White House Office of the Press Secretary, 2015a, 2015b). These examples illustrate the belief that developing mechanisms that enhance workers' education levels will produce a strong workforce, which will ultimately lead to sustained economic growth. Research supports this notion, as education levels are cited as the best predictors of future economic growth for a region; more specifically, skilled workers drive today's economy (Blumenthal, Wolman, & Hill, 2009; Greenstone & Moretti, 2003; Simon, 1998). Beyond economic growth, workforce development also has been linked to increased personal well-being and improved quality of life (Chicago Metropolitan Agency for Planning, 2010). For these reasons, significant investments at the federal level have been made to approach workforce development with a renewed emphasis on education and has called industry, government, and education sectors to reexamine existing models and develop new, innovative models that link postsecondary education to workforce development.

When examining the field of engineering, some employers in fast growing and fast paced technology and engineering industries have jobs go unfilled because education and industry efforts fail to match the timeliness of workforce needs (The White House Office of the Press Secretary, 2015b). Industry employers cite a poor fit between potential employees' skillsets and the skills needed for those jobs, and some industry partners have gone as far as suggesting that academia produces graduates without the necessary skills to immediately succeed in the workforce (Northeastern University, 2014). Together, employability needs and the dynamic industry climate have spurred conversations between university and industry stakeholders about the complexities of producing workforce ready engineering graduates.

Engineering educators and industry professionals agree that one approach to workforce development is to create broader collaborations between university and industry partners so that students will be better prepared for career pathways after graduation (American Society of Engineering Education, 2012). Although there is agreement that improvements are needed, engineering education researchers and practitioners have consistently identified two issues of concern: 1) curriculum reform can be slow, and 2) business needs can detract industry resources from university sponsorships (National Science Board, 2007; Perkmann & Salter, 2012). These issues can delay the impact of collaborations on developing the future engineering workforce.

Educators have suggested that industry should play a larger role in the engineering education process. Industry can expand its role by incentivizing engineering professionals to serve as adjunct faculty in undergraduate and graduate programs, and corporations with a global presence can offer more student work experiences abroad. Ultimately, engineering educators propose that industry professionals can improve their understanding of student development by actively participating in various "educational innovations" (e.g., interdisciplinary capstone design projects, active learning pedagogies, artifact dissection, integrated curricula, and design projects in first year engineering) (American Society of Engineering Education, 2012, p. 67). Similarly, engineering industry professionals suggest that more of their input is needed in developing curriculum and determining educational outcomes, offering increased opportunities for student engagement with industry earlier in their curricula, and providing feedback on student performance following candidate interviews and work experiences (American Society of Engineering Education, 2013). These suggestions demonstrate that engineering educators and industry professionals have identified several collaborative opportunities to share expertise and implement programs aimed at improving the university to industry transition for students seeking to enter the engineering workforce.

To make collaborative efforts more efficient and to enhance joint efforts to make academia more adaptive in preparing students for the workforce, educational institutions need to "reaffirm and deepen relationships" with industry (American Society of Engineering Education, 2012, p. 20). Such relationships lead to partnerships that vary in structure and purpose. The current state of the literature provides insight on partnerships from a system perspective, such as highlighting benefits to university and industry stakeholders. Some partnerships involve a network of institutions and industry or government partners working on long-range technology solutions to support faster research to industry adoption (e.g., Engineering Research Centers) (Feller, Ailes, & Roessner, 2002). Partnerships may also refer to a single faculty member and industry partner working via a contractual agreement to advance an industry-defined goal (e.g., consulting research) (Perkmann et al., 2013), while others involve specific university groups and an industry partner that provide support for student development activities and gain access to student groups (e.g., Minority Engineering Programs) (Mitchell, Flannigan, Wooten, Pearson, & Daniel, 2007).

Few investigations have examined partnerships to explain how specific experiences within those partnerships influence individual students' workforce intentions. If university-industry partnerships will be used as an approach to support engineering students' career preparation, it is important to understand how such partnerships generate experiences that contribute to students' eventual workforce entry. A more nuanced view of university-industry partnerships from the student participant perspective will provide data to engineering educators and professionals to support effective partnership design and use of resources.

In acknowledgement of the wide variation in the configuration of partnerships, this study focuses on a specific partnership that involves a university and two industry partners that provide students with work experiences during their undergraduate educations. The growing incentive for students to gain work experience, along with the increasing number of students engaging in co-op and internship experiences, suggest that industry partners are investing heavily in students during their university years to build a strong workforce pipeline (National Associate of Colleges and Employers, 2015; National Association of Colleges and Employers, 2016b). University-industry partnerships in this form offer one model for meeting workforce needs at a more rapid pace than large-scale curricular change since they are dynamic and offer flexible elements that can readily adapt to changes in industry. This study is scoped to focus on these kinds of partnerships and is structured to investigate a focal case cooperative education program.

Key Terms

Defining four key terms will clarify discussions throughout subsequent sections, provide context for the study, and clarify assumptions and decisions in the research design:

Academic to Industry Developmental Program (AIDP): AIDP is an university-industry partnership between a Large Mid-Atlantic Private University, a Large Aerospace Company (LAC), and an Engineering Services Firm (ESF). The goal of the AIDP is to educate and train the future workforce by actively shaping the academic experience through academic interaction at four integrated levels: 1) core engineering classes, 2) design project/senior capstone based training, 3) Academic Design Center, and 4) core technology research.

Academic Design Center (ADC): An engineering lab space fully equipped and managed to handle low and moderately complex work packages requested by the Large Aerospace Company in the Mid-Atlantic Region. Full-time engineers from both the Large Aerospace Company as well as the Engineering Services Firm staff the ADC. In this setting, undergraduate engineering students execute actual work packages for the Large Aerospace Company, exposing students to real designs, technologies, and program pressures currently found on Large Aerospace Company's platforms. The ADC houses the Co-op Development Program. The ADC context extends beyond the lab space, as co-ops also work on site at the LAC manufacturing facility. In this setting, students work with ESF and/or LAC engineers to complete projects and have the opportunity to work in the LAC manufacturing environment.

Co-op Development Program (CDP): The CDP is an integrated cooperative education (co-op) program. It aims to develop the next generation of the workforce through intentional personal interaction and formal and informal evaluations. The program provides professional guidance, skill recognition, and personal goal setting to allow students to identify and harness their abilities. The vision of the CDP is to further the professional development of students so they become more competent engineers and are better equipped for the workforce at large.

Engineering industry position: An engineering industry position is defined in two parts for this study. First, an engineering position lists a bachelor's degree in an engineering discipline as a minimum requirement in the job description. Second, "industry" is defined to include: private, for-profit, non-educational institutions; persons who are self-employed and incorporated; and other for-profit, non-educational employers (Fallkenheim & Burrelli, 2012).

Guiding Framework

To understand the context of the Co-op Development Program (CDP) and the program's impact on participants' career decisions, Social Cognitive Career Theory (SCCT) guided the study. Shown in Figure 1.1, Social Cognitive Career Theory (SCCT) applies Bandura's Social Cognitive Theory to describe how individuals develop career decision-making beliefs from various events that occur in the early phases of their careers (Lent, Brown, & Hackett, 1994; Swanson & Fouad, 2014).

Introduction to Social Cognitive Career Theory. Social Cognitive Career Theory (SCCT) provides a lens for understanding participants' self-expectations, interests, and choice behaviors related to engineering career decision-making. The framework has been applied in academic (Byars-Winston, Estrada, Howard, Davis, & Zalapa, 2010; Lent et al., 2003; Lent et al., 2005; Lent et al., 2008; Trenor, Yu, Waight, & Zerda, 2008), industry (Buse, 2009; Fouad & Singh, 2011), and university-to-workforce (Winters & Matusovich, 2015) contexts to investigate how engineering students and professionals develop beliefs about engineering careers and how beliefs about outcomes contribute to career interests, goals, and actions.

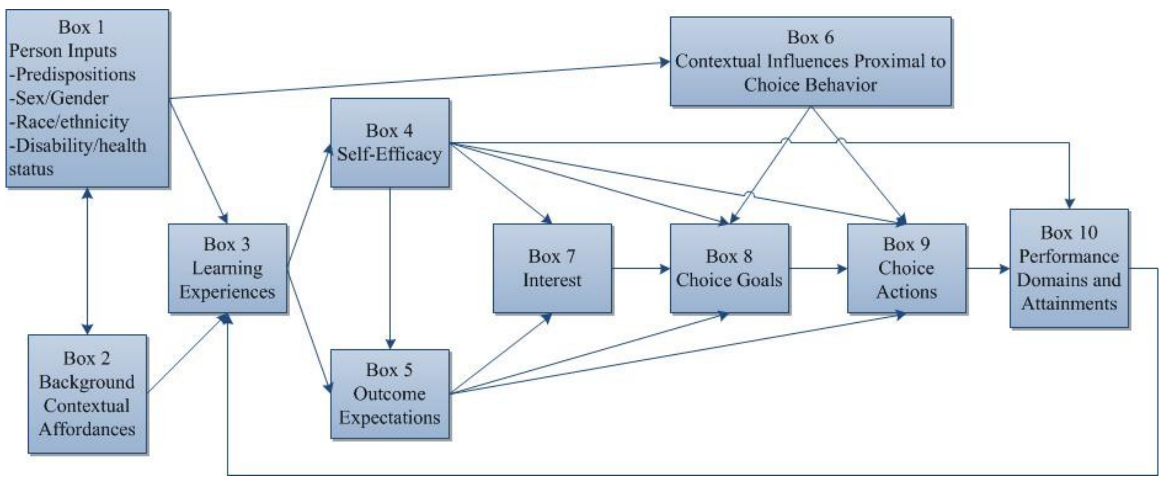

Figure 1.1. Social Cognitive Career Theory (Lent, Hackett, & Brown, 1999).

The left portion of Figure 1.1 posits that *person inputs* (e.g., gender or ethnicity) and *background contextual affordances* (e.g., economic status) influence an individual's *learning experiences*. Engagement in learning experiences then shape one's confidence levels related to his or her abilities to perform while also influencing considerations to pursue a career that will lead to a desired outcome (Lent et al., 1999). The relationship between *self-efficacy* and *outcome expectations* is unique because "individuals can believe that a particular course of action will produce certain outcomes, but they do not act on that outcome belief because they question whether they can actually execute the necessary activities" (Bandura, 1986, p. 392). This relationship plays a significant role in shaping an individual's career decisions through *interests, choice goals,* and *choice actions*. Interests are an individual's likes, dislikes, and indifferences about various activities (Bandura, 1986; Lent & Brown, 2006). Choice goals refer to an individual's intention to engage in a particular activity or to produce a particular outcome, and choice actions refer to an individual's decision to act or not act on goals or interests (Bandura, 1986; Lent & Brown, 2006). Following choice actions, *performance domains and attainments* are defined as "goal fulfillment" or "skill development" (Lent et al., 1994, p. 90). Throughout the model, additional *contextual influences proximal to choice behavior* may occur early or later in one's career decision-making (e.g., family support to take an out of state position).

Role of the Framework in the Study. In this study, Social Cognitive Career Theory (SCCT) provided a broad explanation of the career decision-making process of participants. Creswell (2009) recommends using this approach to generate starting hypotheses to initiate the study of people's behaviors and attitudes. In this way, the SCCT framework served as an up-front explanation of how participants' career decision-making was influenced by engagement in the Co-op Development Program. The study began by exploring relationships between learning experiences, outcome expectations, and career actions; more detailed explanations about the study's initial propositions grounded in SCCT appear in Chapter 3.

Purpose of Study and Research Questions

As previously discussed, little research has taken a nuanced view of university-industry partnerships from the perspective of student participants. The purpose of this qualitative case study design was to understand how experiences in a Co-op Development Program (CDP) influence career decisions to pursue engineering industry positions for CDP participants. The study describes the experiences of participants primarily through interviews with engineering graduates who participated in the CDP. By focusing on the student experience, results of this study provide engineering educators and professionals with empirical data to understand how specific experiences in co-op programs impact student career intentions.

Grounded in Social Cognitive Career Theory, research questions operationalized how *learning experiences* (e.g., participants' interactions and observations of engineering professionals in the workplace environment as well as their work on technical assignments during the CDP) shaped *outcome expectations* (participants' beliefs about their future engineering pathway) and in turn impacted *career actions* (participants' decision to pursue a specific engineering industry position following graduation). Through understanding how students translate their learning experiences to beliefs about the engineering industry to action about such beliefs, university and industry stakeholders can use findings of this study as evidence to promote the role of partnerships in shaping the student workforce transition.

This dissertation addressed the following research questions:

Central question: How did learning experiences during co-op rotations in the CDP shape the career decisions of engineering participants immediately following graduation?
I addressed the overarching research question using the following sub questions:

RQ1. Why did engineering graduates participate in co-op rotations in the CDP?

RQ2. What learning experiences did engineering graduates encounter during co-op rotations in the CDP?

RQ3. In what ways do engineering graduates believe their learning experiences in the CDP influenced their outcome expectations (i.e., beliefs about pursuing engineering industry positions full-time) and subsequent thinking about their career?

Study Design

My study followed a single-case study design, shown in Figure 1.2, to explain how a specific university-industry partnership influenced career decision-making for engineering graduates. A case study design supports a variety of methods, data sources, and data collection techniques to examine a phenomenon in-depth within a set time and activity boundary (Creswell, 2009; Stake, 1995). Eight former Co-op Development Program participants were interviewed and served as the primary entities to explain how participation in the Co-op Development Program (CDP) influenced career decision-making. Secondary data sources, including program documents, personal profile questionnaire, skill matrix, and managers' perspectives (summarized in Young, Knight, Warburton, and Ciechon (2016)), supplemented interviews to provide a comprehensive perspective of the case. Chapter 3 provides a complete description of the case study design.

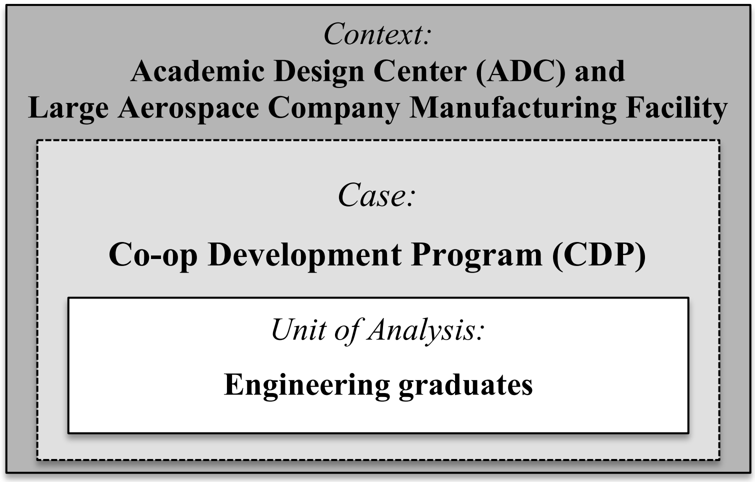

Figure 1.2. Case Study Research Design

Contributions of Research

Scholarly research related to university-industry partnerships has historically focused on identifying supports and barriers to partnerships and more recently on commercialization and technology transfer (D'este & Perkmann, 2011; Perkmann et al., 2013; Perkmann & Walsh, 2007; Poyago-Theotoky, Beath, & Siegel, 2002; Prigge, 2005). While these elements provide some context of how partnerships can be positioned to address workforce needs, this study inserts the voice of the future workforce (i.e., the student) into the conversation. In doing so, this study adds to the body of research on student career development within the context of university-industry partnerships. Results from my study contribute to the body of literature by

- articulating reasons for participating in the co-op development program
- operationalizing learning experiences for the co-op context
- demonstrating the degree of alignment between manager intentions and student experiences
- characterizing four specific relationships between learning experiences and outcome expectations

As both university and industry stakeholder groups are encouraged to develop innovative models that link postsecondary education to workforce development, this work helps align stakeholders' efforts to assist engineering students enter the industry sector of the workforce. By identifying specific elements of participants' learning experiences within the Co-op Development Program that support or discourage entry into an engineering position, this work provides insight into how industry partners can develop strategies for extending recruitment and employee development based on empirical evidence. The industry partner can attract additional candidates to the Co-op Development Program (CDP) and ultimately into industry for full-time work by learning from this study.

With a clearer understanding of participants' career decisions, university and industry stakeholders can collaborate to design student work experiences that will generate impactful opportunities for students to test their career intentions. This study helps stakeholders think about how to design programs that promote career pathways and support students' career decision-making.

Dissertation Overview

Chapter 2 encompasses a review of the literature to situate this study within the context of university-industry partnerships and cooperative education and further explains Social Cognitive Career Theory and its contribution to framing the study. Chapter 3 outlines the case study design and details the data collection and analysis process, and Chapter 4 provides a detailed description of the Co-op Development Program and the study's participants. Chapter 5 describes the emerging themes organized by each of the three research questions, and Chapter 6 relates those themes to the existing literature. Finally, Chapter 7 provides an overall conclusion of the study with a discussion of implications for future research, policy, and practice.

Chapter 2
Literature Review

This literature review first reviews prior work that has articulated the need for further exploration of university-industry partnerships. Second, it highlights the contributions and outcomes associated with cooperative education and the need to understand its impact on career choice. The next section provides a review of the central constructs that comprise Social Cognitive Career Theory (SCCT). The remainder of the literature review relates SCCT constructs to influences on career decision-making for engineering graduates.

University-Industry Partnerships

As noted, this study focuses on university-industry partnerships that include a university and one or more industry partners that involve student interactions. Partnerships can take multiple forms, with varying types and levels of involvement from each partner. In the following sections, I examine university-industry partnerships from a historical perspective to establish how industry, university, and student roles have evolved over time. I also present examples of types of partnerships discussed in the engineering education literature and focus on co-op experiences as a specific type of partnership that warrants further research to explain its contributions to workforce development.

Background. University-industry partnerships stemmed from a renewed interest in scientific discovery following the launch of Sputnik, federal legislation in the 1970s and 1980s, and shifts in university funding models. Academia was forced to reexamine its ability to produce scientists and engineers following the United States' loss to Russia in the race to launch a satellite into space. Consequently, a rebirth of scientific research occurred (Bonner, 1958; Douglass, 1999). Government officials looked to academia as a way to support national security via basic science and technology research and as a way to support economic growth via educating the future workforce; officials believed these efforts would help the United States regain its place as the dominant world leader in innovation (Bok, 2015; Douglass, 2000). The federal government provided $254 million in 1958 (over half of total university research and development expenditures) the year following Sputnik, which represented an 11% increase from the previous year (National Science Foundation, 1958), and continues to make a significant contribution to higher education research and development funds, providing over $37 billion in funds for universities in 2015. Additionally, non-federal funding support continues to increase (Britt, 2016; Slaughter & Rhoades, 2004).

To support and encourage scientific discovery, the federal government established the Bayh-Dole Act in 1980 to loosen automatic federal ownership of inventions and patents, which allowed universities and industry to license and commercialize inventions for profit and direct the profits back to scientific research (Mowery, Nelson, Sampat, & Ziedonis, 2001). Thus, for federally funded projects, universities could retain ownership to inventions as opposed to turning those patents over to the federal government. This ownership enables universities to be better positioned and incentivized to solicit and partner with industry on innovative product and technology projects. Over time, higher education has expanded its focus to include entrepreneurial research activities, technology transfer, and economic development, ultimately generating additional opportunities for university and industry interactions (Bok, 2015). Both stakeholder groups identified ways to interact beyond basic and applied research, identifying additional ways to provide mutually beneficial results.

In summary, university and industry engagement has increased because of a surge in scientific discovery in the years following the launch of Sputnik, adjustments in federal law, and shifting priorities in the field of higher education. The establishment of university-industry partnerships has grown and will continue to do so as stakeholders formalize how resources are used to meet the needs of both academic and the industry sectors (Slaughter & Rhoades, 2004).

Types of partnerships. In the field of engineering, partnerships exist in many forms to address the values and needs articulated by both industry and academia, which has led researchers to examine a wide range of partnerships. Table 2.1 displays the most studied partnerships, which include industrial advisory boards, student work experiences (e.g., co-op/internships), research collaborations, industrial field trips, and targeted programs (Hughes, 2001; Liew, Shahdan, & Lim, 2012; Marbut, Godbey, & Broyles, 2007; Murray, 2009; Perkmann et al., 2013; Richter & Donnerberg, 2005; Walsh, Whited, & Crockett, 2007). The sections that follow review examples of each within the engineering education literature highlighting benefits for university and industry partners and impact on student outcomes.

Table 2.1

Engineering University-Industry Partnerships

Form of Partnership	**Description**
Industrial advisory boards	Industry members (often engineering alumni of the institution) serve on a board to offer advice to academic colleges or departments about current workforce trends and environments. Members often evaluate relevance of the curriculum, evaluate suggestions for student preparedness for industry, and help meet accreditation criteria.
Student work experiences (i.e., co-ops and internships)	Current engineering students work on-site to complete actual industry projects. Students are exposed to current business projects, technologies, and working conditions of engineering professionals.
Research collaborations	Both basic and applied research that is often focused on strategic needs of the industry partner. Research collaborations may include collaborative research, contract research, or consulting research.
Targeted programs	Industry provides financial support and/or employer resources to sponsor academic scholarships, women and minority programs, professional development workshops, and other activities.
Industrial field trips	Students visit an industrial partner’s site to observe engineering in a field environment. Professors, student organizations, or individual students can organize field trips.

Industrial advisory boards. Industrial advisory boards are leveraged by academia to discuss industry trends, gauge relevance of current course and program offerings, and offer commentary on the quality of graduates entering the workforce (Cutlip, 2003; Jenks, Colwell, & Nakayama, 2008; Jones, 2014; Mitchell et al., 2007; Schuyler, Canistraro, & Scotto, 2001; Summers, 2002). Board members typically are graduates or friends of the university, employed in industry or government sectors, and seek to bridge higher education and workforce sectors by focusing on educating engineering students (Daniel, 2006).

A great deal of variation exists in how industrial advisory boards members partner with students and faculty to improve engineering education. One trend is that the role of industrial advisory boards is expanding, especially in assessing student outcomes (Jones, 2014). Advisory board members may serve as resources, mentors, and judges for senior design projects, and they may provide instruction via guest lectures or serving as adjunct faculty members teaching courses focused on their technical expertise (Jones, 2014; Wilson & Cambron, 2007). Industrial advisory board members also are engaged in student team competitions by contributing financial support, technical expertise, and critiquing student designs. Lastly, industrial advisory board members directly contribute to Accreditation Board of Engineering and Technology (ABET) related activities by reviewing coursework and assessing graduates' preparedness to contribute to the workforce (Cutlip, 2003).

Both industrial advisory board members and faculty benefit from board member involvement in several ways. First, industry and faculty collaborations provide opportunities for joint grant writing, development of short courses for industry employees, and sharing of best practices between industry employees. Faculty members gain the opportunity to stay in touch with real world problems and solutions as well as request support for scholarships, equipment, and research grants. Moreover, the institution gains visibility with several employers and employers gain access to institutional research and student resources (Summers, 2002). The increased role advisory members play in assessing student outcomes has created opportunities for students to interact with engineering professionals (Genheimer & Shehab, 2009), which may influence students' career decision-making (Lichtenstein et al., 2009). Jones (2014) discussion of increasing advisory boards' involvement offers examples of student outcomes related to career decision-making. He hypothesized that students receive a "reality check" when they receive industry feedback on design problems and have "frank discussions" during mentoring experiences that help students better prepare for the job search and future career experiences (pp. 5-6). Advisory board members offer a business perspective on the feasibility of designs and communicate the balance of engineering and business decisions.

Currently, research focuses more on the development and implementation of advisory boards with little empirical evidence of how student outcomes are articulated. Thus, while interactions with industrial advisory board members add value to students' experiences during college, more evidence of outcomes is needed before making conclusions about the benefits of that relationship.

Industrial field trips. In the engineering education context, field trips are primarily used to supplement technology and manufacturing curricula in introductory and upper level undergraduate courses as well as community college courses. During these visits, students engage with engineering professionals to learn about their roles and responsibilities, contextualize classroom discussions, and observe technology and manufacturing processes in real-time (Frempong, Derby, & Ofosu, 2005; Lucas & Koch, 2002; Shaalan, 2003; Vollaro, 2002).

University and industry stakeholders benefit from these kinds of interactions in multiple ways. From the university perspective, faculty members gain knowledge by accompanying students to facilities, thereby allowing them to observe and bring workplace contexts to classroom discussions. Local industry partners have the opportunity to showcase their work environment and market themselves to potential employees. These interactions allow industry stakeholders to articulate their hiring preferences and therefore tailor their recruiting to better fit their needs (Frempong et al., 2005; Shaalan, 2003; Townsend & Urbanic, 2013). In turn, students gain knowledge by discussing job roles and responsibilities (Lucas & Koch, 2002; Shaalan, 2003; Vollaro, 2002) and are exposed to equipment and tools not available in university labs, multiple types of technology, and real world contexts that are difficult to replicate in laboratory settings (Frempong, 2005).

Students also gain an appreciation for course material and, as a result, show improved course performance by participating more in class discussions, providing more detail in case study analysis, and scoring higher on exams (Townsend & Urbanic, 2013; Vollaro, 2002) . Townsend and Urbanic (2013) examined student learning before and after a field trip in a third year industrial engineering Manufacturing Process Design Course. Students' pre- and post-test interest surveys and technical reports identified the development of several learning outcomes. Evidence of enhanced student engagement was demonstrated through a 95.5% on time assignment completion and 45-minute student driven Question/Answer session during the field trip. Also, students' perceptions about the field also improved, as 42% of students noted significant changes in attitudes and beliefs about manufacturing after the visit. Students' demonstrations of increased engagement and learning provide evidence that industrial field trips serve as valuable learning experiences for students.

In summary, industrial field trips provide an opportunity for students and faculty to visit an industry site to observe engineering in context. Field trips expose students to examples of engineering work, ultimately can impact student engagement, and familiarize students with potential engineering roles and processes that can be used as reference points during career decision-making.

Research collaborations. Research collaborations between university and industry partners often focus on developing basic and applied research to meet the needs of the industry partner. Partners may engage in three types of research interactions: collaborative research, contract research, or consulting research by individual faculty members (Perkmann et al., 2013). Collaborative research, or sponsored research, involves the university, industry, and/or government stakeholders to work toward a common goal from the onset, and university researchers exercise academic freedom to generate new knowledge. Contract and consulting research is more stringent for university researchers, as industry defines the scope and project deliverables, and the university is paid when objectives are completed. Consulting interactions often occur when faculty researchers have expertise in an area, while contracted research often requires faculty members to generate new knowledge (Perkmann & Walsh, 2007).

Faculty members benefit from these opportunities through greater direct exposure to industry problems and expertise; students benefit through established future employment connections (Perkmann & Walsh, 2007; Prigge, 2005). In addition, in research-focused partnerships, academia gains funds to support research and test theory in empirical environments. As a result, some faculty gain increased research revenue via direct industry sponsorships or through grants that encourage industry supported projects to support their research and graduate students. Industry gains access to new research techniques, development of new products and patents, sustained relationships with the university, and a mechanism by which they can develop techniques for solving technical problems (Perkmann & Walsh, 2007; Prigge, 2005). Moreover, industry generates knowledge and advances technology by leveraging faculty and student expertise, engaging with potential employees, and using university facilities and equipment (Lee, 1996).

More recent literature focuses on faculty outcomes related to research collaborations, but little evidence exists related to student outcomes of research collaborations with industry partners. Student outcomes related to engineering research collaborations are most often measured pre- and post-participation in summer research experiences for undergraduates (REU). There is little evidence in the literature that relates student participation in industry-sponsored REUs to students' career outcomes. Because REU experiences may or may not involve industry partners, REU experiences are not discussed in this literature review.

In summary, research collaborations allow university and industry partners to engage in research activities that generate benefits for both partners. Students primarily serve as research assistants on projects, but little focus has examined student outcomes in industry focused research collaborations aside from acknowledging that undergraduate research experiences may be byproducts of industry-sponsored projects.

Targeted programs. Engineering partnerships are also established to target specific student needs, including financial aid, broadening participation in engineering, and professional development. Universities benefit from these programs by gaining resources to recruit and retain students who are traditionally underrepresented in engineering. Financial support for scholarships provide opportunities for the university to accept additional students or reassign funds to offer students additional resources (e.g., conference travel sponsorship). Professional development workshops provide industry with opportunities to engage with potential employees and help develop students' skills that will ease their transitions to full-time engineering roles. Industry partners also benefit by gaining important access to underrepresented students through extracurricular organizations and minority program offices.

One example of a targeted program is the Professional Learning Institute (PLI) at Colorado State University. PLI aims to support the professional development of non-technical skills that students will need to successfully navigate the workforce. Students participate in seminars and workshop sessions that are parallel to employee training in an industry environment. Engineering professionals engage students in discussions on ethics, culture, adaptability, innovation, leadership, and civic and public engagement (Siller & Durkin, 2013). Through PLI, industry partners benefit by speaking to freshman and sophomore engineers, which helps foster earlier connections with potential recruits. Also, networking events provide engineering professionals and industry human resources representatives with the opportunity to discuss best practices for developing and training the future engineering workforce. The authors cited difficulty in measuring the student outcomes that were influenced by this specific experience. Student outcomes were gauged by advisory board member feedback (e.g., citing increases in graduates' awareness of non-technical skills) as well as observations that students took more ownership by self-selecting to attend sessions that they felt supported their skill development versus attending mandatory sessions in the institute (Siller & Durkin, 2013).

Similar to other partnerships, students benefited from exposure to real time industry problems and decision-making and gained insight into potential career pathways.

In summary, targeted programs are partnerships that allow students and industry to accomplish specific goals related to financial aid, underrepresented student support, and professional development skills. These targeted programs provide students with opportunities to learn about non-technical skills and establish relationships with potential employers that may influence their entrance into the engineering workforce.

Student work experiences. University-industry partnerships often generate work experiences for current engineering students in the form of cooperative education and internships. Cooperative education is a career related work experience for current students in which students complete multiple paid rotations between university study and workplace employment. Co-op participants receive academic credit for participation and work 40 hours per week or part-time 20 hours per week while enrolled in coursework. Internship experiences are paid or unpaid career related work experiences that most often occur during the summer, although some can occur during the semester. In contrast to co-ops, internships are single period commitments (i.e., there is no multi-term commitments for students to return to their internship employer) and may or may not be linked to academic requirements at the institution. ("History of cooperative education and internships," 2015). During co-ops and internships, students work on site with the industry partner and are exposed to current business projects, technologies, the industry environment, and engineering professionals. These university-industry partnerships often stem from an industry partner identifying a university as a "flagship recruiting school" based on certain areas of technical expertise, past performance of graduates, or proximity of the university to industry facilities (National Association of Colleges and Employers, 2016a).

Members of industry utilize such student work experiences as a recruitment mechanism by identifying, training, and evaluating potential employees during students' work experiences. Even if students do not receive or accept full-time positions with the industry partner, the industry community benefits by having more current and recent graduates with some real-life work experience as applicants for the engineering workforce. Industry also benefits by having students complete real-time projects at a lower cost (Walsh et al., 2007; Wanless, 2013).

In a survey of 200 faculty members at the six largest engineering cooperative programs in the country (i.e., Georgia Institute of Technology, Kettering University, Drexel University,

University of Cincinnati, Rochester Institute of Technology, and Northeastern University), faculty members cited that students with co-op experiences made more positive contributions to the academic environment relative to students without co-op experiences. Attributes of these students included higher motivation to perform well in class, contextualized contributions to class discussions, and more relevant and sophisticated questions (Baber & Fortenberry, 2008). The researchers considered students' academic characteristics prior to their work experiences in the analysis and still identified unique contributions of work experiences to student outcomes.

Students' benefits from co-ops and internships are most often referred to as "student outcomes" in the research literature. For example, Bailey (2007) found that industry work experiences had a small impact on students' design process knowledge. Considering design process knowledge across five measures, senior students with industry experience developed an increased understanding of the need for documenting throughout the design process—not only during final design presentations—as compared to freshman students enrolled in a hands-on design course. Bailey (2007) hypothesized that design process measures beyond documentation would be more prevalent but concluded that some aspects of the design process could not be assessed for internship experiences because those experiences were often focused on a small scope of a larger project and occurred during a brief time period. Bailey (2007) echoed previous researchers who suggested that the shortened time of internships likely leads to variations in developed outcomes (Borrego, Pierrakos, & Lo, 2008). Thus, time in the workplace likely explains some of the variation in students' development of outcomes. For example, a student intern may only focus on data collection and analyses, while a co-op student may be involved in problem definition, data collection, analyses, and solution implementation. While both students have work experiences, they are likely to leave the experience with varying depths of skills.

In summary, internship and co-op work experiences provide engineering students with opportunities to expand their coursework knowledge by applying that knowledge within professional engineering environments. In doing so, students who participate in these kinds of experiences are more likely to look toward engineering employment post graduation during their career decisions (Sheppard et al., 2010). A review of the literature highlights the need to distinguish internship and co-op experiences, as the typical duration of the experiences likely impacts participants' outcomes, including graduates' career decisions.

Summary. Each type of university-industry partnership has the potential to play a vital role in developing the future engineering workforce. Industrial advisory boards help improve curriculum, and student work experiences and research collaborations provide opportunities for students to work on real-time industry problems to develop workforce ready skills. Industrial field trips, targeted programs, and student work experiences create opportunities for students to interact with engineering professionals, which provide insights to engineering career pathways.

To advance this overview of the literature on university-industry partnerships, Hughes (2001) suggests that researchers focus on the students involved in the partnership. To dissect benefits of partnerships and to focus on student-centered outcomes and educational components, this dissertation meets this call and focuses on the *student work experience* partnership that aims to develop student outcomes related to career decision-making. More specifically, this dissertation focuses on longer-term co-op experiences and examines how longer duration experiences—relative to internships—may influence engineering students' career decisions. The following section focuses on the literature that has investigated cooperative education experiences specifically.

Cooperative Education

Research about cooperative education historically has centered on practitioners' needs and has used observational data to promote co-op programs, most frequently discussing academic achievement and persistence to graduation as supported outcomes. As co-op programs grew in the 1970s, practitioners generated empirical evidence of the value of such experiences by comparing co-op students to a control group of non co-op students. According to Fletcher (1989), student outcomes from cooperative education could be categorized into three groups: 1) career development (i.e., student beliefs about career choice, fit, as well as career identity), 2) career progress (post graduation outcomes including starting salary and work responsibilities), and 3) personal growth (e.g., maturity, sense of self).

As the field matured, researchers began to ground studies in theoretical frameworks and explored "how" co-op experiences helped students develop such outcomes (Fletcher, 1989), and the current literature continues to highlight questions of "how" (Johrendt et al., 2010; Parsons, Caylor, & Simmons, 2005; Pittenger, 1993). The evidence provided in the sections that follow regarding "how" cooperative education impacts career decisions reflects the student work experience related literature. Researchers have examined "how" co-op students experience learning in the work context; "how" co-op programs can be better organized to maximize learning that occurs during the experiences; and "how" the quality of a co-op rotation influences students' perspective of the work experience (Johrendt et al., 2010; Parsons et al., 2005; Pittenger, 1993). This evolution of cooperative education research provides the backdrop for the current state of the literature. In line with recommendations for further research, my study adds to cooperative education literature by exploring "how" student experiences link to career related outcomes. My study examined participants in a single co-op to understand the variation that occurs within that co-op. Discussions of findings address issues related to the types of learning experiences participants recognize within that co-op as well as how the quality of experiences relate to career decisions. Notably, some researchers do not draw a distinction between co-op and internship experiences and combine students with either type of work experience into one sample. When this is the case, the sections that follow distinguish differences between internships and cooperative education.

Career Development Outcomes. Career development outcomes refer to co-op participants' understanding of career options prior to graduation. Researchers have examined job offers following participation in a co-op (Schuurman, Pangborn, & McClintic, 2008), career knowledge (Borrego et al., 2008; Sheppard et al., 2010), career identity (Pittenger, 1993), and career IQ (Fletcher, 1990). Across those studies, researchers reported a positive relationship between each outcome and co-op participation.

Using the National Engineering Students' Learning Outcomes Survey, Borrego et al. (2008) asked 60 engineering students how helpful their co-op/internship experience was in enabling them to achieve Accreditation Board of Engineering and Technology (ABET) related learning and personal and professional outcomes using a 5-point Likert scale. When asked how their work experience enabled them to develop specific outcomes, participants on average highly rated knowing what they wanted to do after graduation and what they needed to do to meet their post graduation goals. This positive relationship demonstrates the potential for industry based work experiences to influence students' perceptions of career decision-making (Borrego et al., 2008). These findings align with prior findings of Pittenger (1993) who found that students further along in their programs with more work experiences reported higher career knowledge, career related skills, and "self-in-occupation." Smaller gains, however, were seen for students with more than three co-ops. Thus, Pittenger (1993) concluded that the quality of the co-op experience also must be considered, moving beyond the notion that participation alone drives the outcome. Noting a correlation between career relevant work experiences and three measures of career growth, Pittenger offered that future work should examine variables that impact how students perceive the quality of a co-op experience (i.e., how co-op work assignments relate to a career field). My study addresses this call by defining co-op learning experiences and how they influence career related outcome expectations.

In a larger-scale study, Sheppard et al. (2010) surveyed 3,911 engineering majors across 21 institutions, including first year through fifth year students, to understand why students study and eventually select careers in engineering. Two major findings were uncovered: 1) senior and freshman level students cited work experiences as sources of engineering knowledge, and 2) students who participated in professional engineering environments through co-ops and internships were more likely to aspire to engineering employment post-graduation (Sheppard et al., 2010). Regression analyses also identified participation in co-ops and internships as negative predictors for plans to pursue non-engineering jobs following graduation.

Using a qualitative approach, Winters (2012) interviewed thirty professionals to explain career goals and actions of early career engineering graduates. When asked about factors that influenced their career goals near the ends of their undergraduate studies, five engineering graduates referenced internships as learning experiences that shaped their career goals directly (Winters, 2012). Participants noted that the exposure to the actual work environment and various job tasks were experiences that influenced them to maintain or change their career pathways. While these participants represented less than a quarter of the full sample, Winters' (2012) findings align with previous work that suggests that specific learning experiences during internships (and similarly co-ops) may influence the career decisions of engineering graduates (Lichtenstein et al., 2009).

Leveraging participants from Sheppard et al.'s 2010 study, Brunhaver (2015) conducted a quantitative study to investigate the work and career choices of 415 engineering graduates. Co-op and internship experiences were found to have a small but significant effect on graduates' choices of their current positions. Chi-square analysis showed that graduates in engineering-focused positions had more co-op or internship experience when compared to graduates in non-engineering focused positions. These findings suggest that co-op and internship experiences are likely to have some influence on the career related actions of engineering graduates. A limitation of this study is its general and dichotomous treatment of the co-op/internship variable. Participants were asked if they participated or not with no detail on frequency or level of participation. Additionally, no details about elements of the cooperative education were discussed, nor how co-ops influenced their career decisions.

The authors suggest that engineering students' interests are confirmed through participation in such experiences, and students who identify less with engineering opt to not participate in these work experiences. Although these findings provide evidence that work experiences support pathways to engineering post-graduation, it was unclear whether or not those work experiences were required for the degree. Co-op experiences that are required for graduation may have a significant impact on how participants select their co-op experiences, how their interests are developed, and ultimately their post graduation career choices. For example, engineering students who identify less with the engineering industry pathway who are required to participate in work experiences may self-select specific industries or companies that reinforce their interests, or they may be forced to take a position that does not align with their interests. By doing so, participants may have a positive experience that alters their anticipated career pathway or a negative experience that reinforces their decision to make non-engineering career choices. My study further explores this issue by focusing on participants who were required to participate thus offering post-graduation perspectives on how required co-op participation influences an engineering career choice.

Career Progress (post graduation outcomes). Fewer studies have investigated the impacts of participation in cooperative education as it relates to post-graduation outcomes; most examine starting salary for co-op participants versus non co-op participants (Blair, Millea, & Hammer, 2004; Gardner, Nixon, & Motschenbacker, 1992; Joseph & Payne, 2010; Schuurman et al., 2008; Somers, 1995), while others have examined career satisfaction (Ingram and Mikawoz, 2006).

Findings related to the impact of cooperative education on starting salary are inconclusive and complex. Schuurman et al. (2008) examined data from 1,479 engineering seniors from 2001-2004 and found that of the 630 students who reported salary data, students with co-op experiences achieved higher starting salaries than those without such work experiences. Moreover, the authors identified the relationship of compounding work experiences. For each additional work experience, starting salaries were $1,471 higher, even after controlling for students' academic performance prior to completing the experience and as well as variables that might interact with the effects of co-op on starting salaries. In a 2004 study of 773 engineering co-op students at a large southeastern university, Blair et al. (2004) found that completion of three semester-long co-op rotations added $17, 279 to engineering co-op students' starting salaries. Co-op students also were more likely to take two semesters longer to graduate, and so comparisons should take into account an extra year of higher education expenses. In 2010, Joseph and Payne examined starting salary data for 285 computing students who reported data to the Cooperative Education and Career Services office of a university between 1998 and 2006. The authors investigated differences between starting salary for co-op and non co-op students and further examined a subsample of computer science co-op students. No statistical differences in the median salary for computing students were found for the sample of all students nor for the sub sample of computer science students. The limitation of these studies is the difficulty of considering the many external factors that may influence salary offers, even when comparing co-op students to non co-op students. Comparing the two groups yielded complex results because students might have participated in technical projects, part-time jobs, or had well-established networks (Joseph & Payne, 2010). Additionally, industry choice and job market climate influence post graduation job access. Together, these external factors may impact salary offers for all students, regardless of co-op participation. The authors suggested that future work should examine the relationships between starting salary and additional environmental factors (e.g., type of industry and on the job performance) to better understand the influence of co-ops on early career salary.

In relation to on the job performance, career satisfaction has been examined as a post graduation outcome. Ingram and Mikawoz (2006) explored how company specific experiences influence career satisfaction for former co-op participants. The authors concluded that cooperative education encompasses different types of learning experiences that shape participants' perceptions of their abilities to be successful in full-time roles. The authors interviewed 18 female Canadian engineers as part of a mixed methods study to explore career mobility using a grounded theory approach. Participants with a history in co-op identified several specific learning experiences that were vital to their career decisions, including shadowing engineering professionals and formal and informal mentoring programs. Both experiences expanded participants' networks and expanded their views of available engineering roles in the company. Participants also stated that informal and formal mentoring conversations about technical and personal issues generated relationships that continue to remain valuable in their full-time positions. Participants also noted the opportunities to engage with people through volunteer work assignments, which created experiences that were valuable for growing their communication and technical knowledge. Lastly, the absence of mentoring also was identified as a learning event because it required a participant to "figure things out" independently, thereby increasing self-confidence and assertiveness (Ingram and Mikawoz, 2006). A limitation of this study is that former cooperative education participants in the study worked full-time with the company in which they completed co-op assignments. Participants may have expressed biased opinions about their co-op experiences considering their current employee status with their co-op employer.

Career progress outcomes have received less attention in the literature as compared to the prominence of career development outcomes. Researchers have frequently identified the contributions of co-op experiences to students' beliefs about the engineering field at the point that they return to the university setting. While some studies have involved engineering graduates, few have focused specifically on the relationship of co-ops to post graduation career decision-making. My study incudes the engineering graduates' perspective to examine the influence of co-ops on graduates' full-time career choice immediately following graduation—investigating how co-ops actually shaped decision making versus having current students predict the impact of co-ops on their future decision making.

Interactions of other variables with Co-op Experiences. Several variables have been found to interact with co-op experiences that might lead to differences in measured student outcomes. Researchers have identified both individual and workplace characteristics that affect experiences during co-op and affect how students report outcomes from their co-op experiences.

Individual characteristics. Grade point average, major, sex, and number of work experiences are factors that researchers often hypothesize will interact with students' co-op experiences. Findings regarding these interactions have been mixed. Schuurman et al. (2008) considered GPA prior to co-op, major, and sex in a regression model to predict starting salary of co-op participants. He found that the interactions were not significant, but the study showed that the number of work experiences positively correlated with GPA upon graduation, starting salary, and the likelihood of receiving a full time job offer prior to graduation. In contrast, engineering students with more coursework and higher GPAs reported receiving higher performance ratings during co-op rotations (Parsons et al., 2005), which may in turn influence their beliefs about career choice (Lent et al., 1994). This effect is likely because these students arrived with more technical knowledge and self-confidence to contribute to work assignments during their co-ops. Schuurman et al.'s (2008) findings additionally suggest that the quality of co-op experiences may have more impact on career related outcomes than individual characteristics like major, GPA, and sex. Because authors identified distinct interactions of individual characteristics with co-op experiences as well as a workplace characteristic, there is a need for more research to better understand the interactions of longer-range career related outcomes. My study acknowledges the influence of person input and background contextual affordances by including former co-op students across majors, sex, and racial/ethnic backgrounds, which provide context for understanding participants' reasons for participating in the co-op and their subsequent post graduation career decision-making.

Workplace characteristics. Workplace socialization (i.e., professional mentoring and student-supervisor interactions) and workplace structure influence how students feel their skills develop during co-ops (Fifolt & Searby, 2010; Fletcher, 1990; Gibson & Angel, 1995; Parsons et al., 2005). Gibson and Angel (1995) identified mentoring as a key element in supporting students' transitions to co-op work environments in STEM fields. Moreover, co-op students who reported receiving positive feedback and sequenced assignments were more likely to report the development of non-technical outcomes like communication skills, ethics, and multidisciplinary teamwork from their co-op experiences. Perhaps these opportunities provided students with more opportunities to practice their non-technical skills so they were better positioned to report them as outcomes.

In summary, these findings suggest that outcomes reported for co-op experiences may vary across participants based on individual characteristics of co-op students and workplace characteristics of their selected or assigned industry co-op partner. Thus, it is important to understand how an individual's characteristics may shape their reasons for participating in co-ops (research question one) and to understand participants' perceptions of the learning experiences to capture workplace socialization opportunities (research question two).

Conclusion. The present state of university-industry partnerships has been impacted by a resurgence of scientific research, supportive legislation, and growing need for alternative university funding sources. University and industry partners benefit through increased research funding and technology development, access to expertise and laboratory resources, and student employment opportunities. Among the different types of partnerships, student work experiences (specifically cooperative education) are most relevant to this study and have been shown to make positive contributions to the undergraduate engineering experience. Prior work examines students' perceptions of career choice and career identity post co-op and how participation in co-op experiences relates to career attainment metrics (e.g., salary, career satisfaction). Few researchers, however, have examined how specific elements of cooperative experiences shape how students view and act on the potential employment opportunities that university and industry partners anticipate. More research is necessary to understand the link between the elements of the cooperative experience and students' perspectives about engineering career decisions following participation in a co-op.

Social Cognitive Career Theory

Social Cognitive Career Theory (SCCT) provides a broad explanation of how participation in a co-op development program theoretically impacts students' self-expectations, interests, and choice behaviors related to engineering career decision-making. With prior application in both university and industry contexts (Buse, 2009; Byars-Winston et al., 2010; Fouad & Singh, 2011; Lent et al., 2003; Lent et al., 2005; Lent et al., 2008; Trenor et al., 2008), SCCT has been used to explore how engineering students and professionals develop beliefs about engineering careers and how beliefs about outcomes contribute to career interests, goals, and actions.

In this section, I provide an overview of Social Cognitive Career Theory. Second, I define each construct and its role in the theoretical framework, relate each construct to influences of career decision-making for engineering graduates, and offer how Social Cognitive Career Theory will influence my study.

Overview. Shown in Figure 2.1, Social Cognitive Career Theory (SCCT) applies Bandura's Social Cognitive Theory to explore how an individual's constructions of events relate to career decision-making in the early phases of his or her career (Buse, 2009; Fouad & Singh, 2011). SCCT explains the cognitive and environmental elements of career decision-making to frame the complex process of an individual's career decisions. The process is iterative, involving ten constructs with multiple pathway links as well as a feedback loop. Table 2.2 displays definitions of each construct.

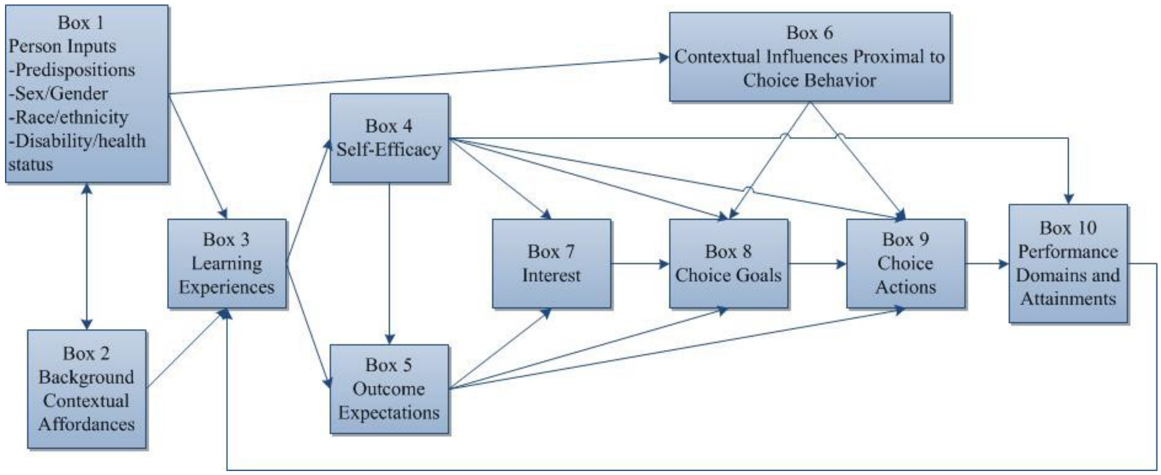

Figure 2.1. Social Cognitive Career Theory (Lent et al., 1994).

Table 2.2.

Constructs of Social Cognitive Career Theory

Social Cognitive Career Theory Construct	**Description**
Person Inputs	Personal characteristics including sex, race/ethnicity, disability/health status, and others. Personal inputs also include genetic predispositions (Lent et al., 1994; Lent, Hackett, Brown, 1999).
Background Contextual Affordances	External factors that influence self-efficacy, outcome expectations, and interests. Most often occur prior to the formation of career interests and include family background, cultural and gender role socialization, and, exposure to mentors (Lent Brown et al., 1994; (Carrico, 2013).
Learning Experiences	Activities that are educationally or occupationally related to one's goals (Lent et al., 1994, p. 90). These experiences occur through vicarious learning, past performance accomplishments, verbal (social) persuasion, or via physiological reactions (Bandura, 1977; Lent et al., 1994).
Self-efficacy	An individual's confidence in his or her ability to successfully perform a given task (Lent, Hackett, Brown, 1999).

Outcome expectations	An individual's' beliefs about what occurs following certain behaviors (e.g., 'if I try doing this, what will happen?' (Robert W Lent et al., 2005, p. 104).
Proximal contextual influences	External factors that occur during career decision-making. Encompasses the supports, barriers, demands, and events that stem from an individual's perceived or actual environment.
Interests	An individual's likes, dislikes, and indifferences about various activities (Bandura, 1986; Lent et al., 1994).
Choice goals	An individual's intention to engage in a particular activity or to produce a particular outcome (Bandura, 1986; Lent & Brown, 2006).
Choice actions	An individual's decision to act or not act on his or her goals and interests (Bandura, 1986; Lent & Brown, 2006).
Performance domain and attainments	An individual's fulfillment of a specified career goal or skill following career actions (Lent et al., 1994).

Person Inputs and Background Contextual Affordances. *Person inputs and background contextual affordances* exist in a bidirectional relationship. This relationship suggests that one's individual characteristics (i.e., sex, race/ethnic background, disability/health status, socioeconomic status, and genetic predispositions, which refer to intellectual abilities) interact with environmental factors (i.e., family background, cultural and gender role socialization, and mentoring relationships) to influence how an individual perceives and engages in learning experiences. Together, these constructs highlight the dynamic relationship of person-environment interactions that shape career behaviors (Brown, 2002).

For example, SCCT suggests that gender and family background are characteristics that may impact career related experiences based on gender-role stereotypes and familial influence. These factors influence exposure and access to learning experiences as well as perceptions of learning experiences (e.g.,Tokar, Thompson, Plaufcan, & Williams, 2007). Relevant to this study, co-op participants may enter their work experiences with assumptions about career pathways available to male versus female engineers based on the persistent notion that engineering is a male dominated field with a chilly climate toward females. Additionally, familial influence serving as a background context affordance can affect an individual's perceptions of fit within an engineering career. Winters, Matusovich, and Brunhaver (2014) found older siblings play a prominent role in the career decision-making of early career engineering professionals, while older family members (e.g., parents) played lesser roles. These findings suggest that engineering graduates select career paths that consider both personal makeup and background environmental factors. In this study, *person inputs* and *background contextual affordances* may influence the types of learning experiences co-op participants select and encounter within the co-op work environment. Although the intent of this study is not to investigate differences related to gender, ethnicity, and other person input or background contextual affordances directly, participants were allowed to self-identify differences across sex, racial/ethnic background, and co-op experiences.

Proximal contextual influences. *Proximal contextual influences* are affected by person inputs and encompass social, cultural, and environmental factors that shape an individual's career decision-making. *Proximal contextual influences* occur closer to an individual's choice goal and choice action and affect how choice goals and actions are implemented; this element contrasts with background contextual affordances, which occur early and impact the development of self-efficacy and outcome expectations (Swanson & Fouad, 2014). For example, an individual's socioeconomic status is a background contextual affordance that might afford networking opportunities for students to gain highly sought after engineering co-op positions; college financial aid, on the other hand, may support the student's intention to major in engineering and would be considered a *proximal contextual influence* (Carrico, 2013; Swanson & Fouad, 2014). *Proximal contextual influences* operationalize as perceived (or actual) supports, barriers, demands, and events that shape co-op participants' decisions to pursue (or not pursue) engineering careers.

In engineering, student career considerations and pathways are often influenced by social capital acquired through professional networks and extracurricular involvement (Trenor et al., 2008). Such experiences may provide students with access to extensive networks of engineering professionals and offer supportive gateways to industry positions. For example, involvement in professional organizations like the National Society of Black Engineers has been shown to enhance students' perceptions of their skills desired by industry (Simmons, Young, Adams, & Martin, 2014).

Relevant to this study, co-op participants likely encounter additional *proximal contextual influences* through their workplace experiences. As previously discussed, workplace characteristics (e.g., professional mentoring programs and student-supervisor interactions) can generate relationships and interactions that can serve as supports and barriers to how engineering graduates make decisions about their future careers in engineering. For example, engineering graduates may be hesitant to enter the industry pathway based on the host co-op company's gender or racial climate (Ingram & Mikawoz, 2006), or African American engineers may make decisions to avoid environments they perceive to foster tokenism (Walsh, 2001). In ideal form, co-op experiences potentially eliminate barriers that might otherwise prevent entry into the industry pathway by increasing student preparation, awareness, and access, thereby supporting retention in engineering education and the workforce (O'Neil et al., 1980; Raelin, Bailey, Hamann, Pendleton, et al., 2014). These studies show the applicability of SCCT in exploring how workplace cultures and practices act as *proximal contextual influences* in engineering graduates' decisions to pursue career pathways in engineering.

Learning Experiences. *Learning experiences* are defined as activities that are educationally or occupationally related to one's goals (Bandura, 1986; Lent & Brown, 2006). These experiences occur through vicarious learning, past performance accomplishments, verbal (social) persuasion, or via physiological and affective states (defined in Table 2.3) (Bandura, 1977; Lent et al., 1994). Person inputs and background contextual affordances impact how individuals engage in learning experiences, which in turn influence individuals' development of self-efficacy and outcome expectations.

Table 2.3.

Learning Experiences depicted as informational sources

Informational Source	Definition
Vicarious learning	Learner partakes in observation of other people's behavior and its consequences for them; behavior is not being overtly performed by the observer during the exposure period. Learner decides if behavior should be modeled in his or her own response when in similar situations.
Past performance accomplishments	Learner's self-perceived personal mastery and failure experiences serves as a reference to the ability to perform current or future tasks (i.e., learner recalls the outcome of previous work experiences)
Verbal (social) persuasion	Learner experiences encouragement or discouragement to participate in particular activities.
Physiological and affective states	Learner's affective state (e.g., arousal, anxiety, vulnerability) impact beliefs about personal competency and may lead to avoidance behaviors in stressful/taxing situations.

In the context of this study, participation in cooperative education exposes students to learning experiences in a workplace environment prior to the choice action to work in engineering full-time. Research suggests these experiences may involve being exposed to senior management and engineering professionals, feedback in the form of performance assessment evaluations, and mastery through technical work assignments (Raelin, Bailey, Hamann, Pendleton, et al., 2014).

Few studies have examined the relationship between participants' learning experiences and career choice after receiving their degrees using Social Cognitive Career Theory. As previously discussed in the cooperative education section, researchers have used qualitative and quantitative approaches to explore the impact of undergraduate experiences on career decision-making (e.g., Winters, 2012; Brunhaver, 2015). Through the use of interviews, Winters (2012) found that engineering graduates referenced internships (and similarly co-ops) as learning experiences that shaped their career goals directly, while Brunhaver (2015) surveyed over 400 engineering graduates and identified that co-op and internship experiences were found to have a small but significant effect on graduates' choices of their current positions. These findings suggest that co-op and internship experiences are likely to have some influence on the career related actions of engineering graduates.

Ultimately, the Brunhaver (2015) and Winters (2012) studies were guided by Social Cognitive Career Theory and present findings that are consistent with prior studies, some guided by SCCT and others not, that identify co-op and internships as experiences that affected participants' post graduation engineering pathway (Ingram & Mikawoz, 2006; Raelin, Bailey, Hamann, Pendleton, et al., 2014; Reisberg et al., 2012). My study further explores co-op participants' perceptions of learning experiences and expands current research by investigating whether learning experiences encountered in the co-op environment generate influences for participants' careers even if they chose to work for a different employer than that of their co-op. This study also teases out specific elements of learning experiences encountered to understand how they shape outcome expectations related to entering engineering industry positions.

Self-Efficacy and Outcome Expectations. *Self-efficacy* and *outcome expectations* are related yet distinguishable: "individuals can believe that a particular course of action will produce certain outcomes (outcome expectations), but they do not act on that outcome belief because they question whether they can actually execute the necessary activities (self-efficacy)"

(Bandura, 1986, p. 392). This dynamic relationship is directional in that self-efficacy beliefs regarding what can be done influences what an individual believes will be done. Individuals' career interests, goals, and performance are shaped by confidence in their ability to perform while simultaneously considering the pursuit of a career that will lead to a desired outcome (Lent et al., 1999). Therefore, as postulated by Social Cognitive Career Theory, both self-efficacy and outcome expectations play a role in the decision to enter an engineering industry pathway.

Self-efficacy. Several studies have examined the effects of specific out of class experiences on undergraduates' STEM self-efficacy (Betz & Schifano, 2000; Dunlap, 2005; Luzzo, Hasper, Albert, Bibby, & Martinelli Jr, 1999; Raelin, Bailey, Hamann, Pendleton, et al., 2014; Reisberg et al., 2012). Relevant to work experiences and career related outcomes, Hackett and Byars (1996) and Evans and Herr (1994) used the social cognitive perspective to examine how African American women choose to enter certain career fields and change career goals to navigate feelings of sexism and racism at work. The authors confirmed the need for African American women to develop a stronger self-efficacy to overcome challenges related to racism and sexism to create career opportunities for themselves. Trenor et al. (2008) used SCCT to uncover ethnicity differences between African American and Hispanic women's perceptions of supports, barriers, and major choice goals. Once in the workplace, self-efficacy was not found to be a significant factor to explain the differences between women who remain versus leave engineering careers (Matchett, 2012). These studies highlight the emphasis that has been placed on self-efficacy as an influencer on the career intentions of engineers broadly.

Fletcher (1990) proposed the relationship between cooperative education and self-efficacy while building a theoretical model relating self-esteem and cooperative education. Fletcher hypothesized that cooperative education increases self-efficacy by providing opportunities for co-op students to have successful mastery experiences. Thus, co-ops provide students with opportunities "in which the individual uses skills, abilities, and coping strategies to perform the task at hand" (Fletcher, 1990, p. 43) and opportunities to discern success (or failure) of their experiences. Co-op experiences can increase (or decrease) self-efficacy because co-op environments provide students with feedback, reality checks for proposed solutions, and authentic work life. Such mastery experiences generate performance accomplishments, which Bandura (1986) outlined as the most influential source of self-efficacy. Beyond mastery experiences, co-op experiences provide peer models, professional mentors, and verbal encouragement that can be viewed as additional sources of self-efficacy (i.e., vicarious learning and verbal persuasion) (Lent et al., 1999).

Advancing Fletcher's (1990) theoretical propositions, researchers have studied undergraduate engineering students' self-efficacy in relation to cooperative education, undergraduate retention, and contextual support (Raelin, Bailey, Hamann, Pendleton, et al., 2014; Reisberg et al., 2012). Raelin, Bailey, Hamann, Reisberg, et al. (2014) conducted a longitudinal survey study of engineering cooperative education students from sophomore (n=1637) to senior (n=699) year, hypothesizing that co-op experiences would improve self-efficacy, which would lead to increased retention of engineering co-op students. The authors compared the change in mean rating for three components of self-efficacy: work, career, and academic for co-op and non co-op students from the 2009-2010 to 2010-2011 school years. Work self-efficacy refers to an individual's belief that he or she can successfully master non-technical and social skills needed in a work environment (Raelin, Bailey, Hamann, Reisberg, et al., 2014). Career self-efficacy refers to an individual's belief that he or she can successfully perform career development, choice, and adjustment behaviors (Anderson & Betz, 2001; Nasta, 2007; Niles & Sowa, 1992). Academic self-efficacy refers to an individual's belief that they can successfully achieve an academic task or goal (Eccles & Wigfield, 2002; Linnenbrink & Pintrich, 2002).

Raelin, Bailey, Hamann, Reisberg, et al. (2014) found that following the first work experience, co-op students increased in work self-efficacy, and non co-op students showed decreases in work self-efficacy. There were no differences on career and academic self-efficacy. Researchers also explored each self-efficacy measure following the co-op experience. Results suggest that quality of the co-op experience impacts self-efficacy. Among ten quality indicators evaluated in the study, three were significant predictors of post co-op work self-efficacy, including co-ops that: 1) made a difference to their assigned unit or organization, 2) supported students working in teams, and 3) allowed students to apply discipline specific knowledge. These findings illustrate the link between learning experiences and self-efficacy as postulated in SCCT by highlighting how specificities of experiences predicted self-efficacy in particular areas. As noted by Raelin, Bailey, Hamann, Pendleton, et al. (2014), the literature suggests that undergraduate experiences like cooperative education might alter engineering co-op students' self-efficacy and subsequent career choices based on relationships proposed in Social Cognitive

Career Theory. Findings also highlight that specific elements of learning experiences contribute to self-efficacy that, in turn, influence outcome expectations.

Outcome Expectations. Outcome expectations refer to individuals' beliefs about what occurs following certain behaviors (e.g., 'if I try doing this, what will happen?' (Bandura, 1986, p. 392)) and may develop through observations or direct experiences (Lent et al., 2005, p. 104). Relevant to my study, I investigated whether co-op students develop beliefs about pursuing engineering industry positions full-time following participation in the Co-op Development Program. Outcome expectations contribute directly to the development of career interests, goals, and actions, and can be influenced by an individual's self-efficacy beliefs (Lent & Brown, 2006).

For engineering students, the literature identifies two prominent findings related to student outcome expectations. First, engineering students often do not know what to expect of an engineering profession and do not know what it means to be an engineer even in the senior year (Lichtenstein et al., 2009). This finding warrants additional exploration, as no details on participants' participation in work experiences were given. Previous research suggests that students with co-op experiences develop an actual idea of engineering work and are more oriented to engineering careers after participating in a co-op (Linn, Howard, & Miller, 2004). Second, engineering students and engineering employers have different expectations of what skills are needed for engineering work. For instance, early career engineers are often surprised or disenchanted by the importance of social skills in navigating the engineering workplace (Matusovich, Streveler, Miller, & Olds, 2009). These findings highlight the need to further explore if and how co-op students develop outcome expectations while working to understand how these expectations impact the pursuit of an engineering industry position post degree.

In summary, the relationship between self-efficacy and outcome expectations is complex in that self-efficacy beliefs regarding what can be done influences what an individual believes will be done. Also, each construct separately may directly impact an individual's career interests, goals, and actions. My study explores the relationship between co-op participants' expectations of the engineering profession to understand the ways in which engineering graduates believe their experiences in the co-op rotations influenced their outcome expectations (i.e., beliefs about pursuing engineering industry positions full-time) (research question three).

Interests. *Interests* refer to an individual's likes, dislikes, and indifferences about various activities (Korte, Brunhaver, & Sheppard, 2015; Korte, Sheppard, & Jordan, 2008). According to

Social Cognitive Career Theory (SCCT), an individual's self-efficacy and outcome expectations determine their interests, and, in turn, interests influence their career goals. Interests can be examined at many levels and can be defined with broad or narrow specificity (e.g., interest in receiving superior performance ratings, interest in returning to work with a co-op employer, interest in working in the aerospace industry) (Carrico, 2013; Lent & Brown, 2006). In my study, interest is viewed as an interest in pursuing (or not pursuing) an engineering industry role and the reasons for that determination that derived from participating in a co-op experience.

Although little work has examined *interest* as it relates to cooperative education, previous research provides evidence to explain the role interests play in SCCT (Dutta et al., 2015; Tang, Pan, & Newmeyer, 2008). Particularly in shaping STEM career aspiration, Tang et al.'s (2008) work examining factors that influence interest in STEM careers for high school students generated noteworthy findings. Tang et al. (2008) studied 141 high school students attending a Midwest public school and identified significant relationships between interests and career choice and notable differences in career interests by gender. Using Prediger's (1982) classification of career interests, the authors found that high school girls were most interested in working with "People/Ideas," and boys were most interested in occupations that focused on "Data/Things." Moreover, the findings of this study provide insights about the relationship between career interest and career choice. For male students with an interest in "People/Ideas," males did not choose occupations that were aligned with their interests. The authors hypothesize that males did not choose specific careers because of the negative relationship between outcome expectations and career choice (i.e., males did not expect high prestige or financial reward from careers related to "People/Ideas"). These findings suggest that students' interests are weighed against additional considerations (e.g., gender role socialization and/or perception of prestigious occupations) during career decision-making. Thus, researchers should not assume *interest* and *actions* will directly align.

A limitation of Tang et al.'s (2008) study is that students were asked to predict their career choice as high schools students via a single open-ended question ("What is your current career choice?"). Thus, student responses were predictions of choice actions, not actual career behaviors. Student predictions at the time point of the study may not represent their actual career actions, since additional factors (e.g., outcome expectations, proximal contextual influences) prior to and during their post secondary studies are likely to impact their choice actions (Lent et al., 2005; Lent et al., 2008).

In summary, researchers have explored the role of *interest* in Social Cognitive Career Theory as it relates to STEM careers. One significant finding points to the notion that an individual may choose a career that does not align with their interests because other factors (e.g., outcome expectations) may overrule their interest. Although my study focuses on *career action* more than *interest*, Tang et al.'s (2008) findings contribute to how I can understand the indirect influence of *interest* on engineering graduates' career actions.

Choice goals and choice actions. Goals describe one's intention to engage in a particular activity or to produce a particular outcome, and actions relate to one's decision to act or not act on their goals and interests (Bandura, 1986; Lent & Brown, 2006). Interests directly influence choice goals, and self-efficacy and outcome expectations may influence both choice goals and choice actions.

Previous research has examined how interests link to engineering students' career goals and actions post degree. Literature suggests that students might start their study of engineering with the goal of not pursuing a career within the profession (Bandura, 1986; Lent & Brown, 2006). Guided by SCCT, in a study of over 500 early career engineering alumni, Brunhaver (2015) found that one of the most common reasons graduates select non-engineering jobs is their own *goal* to pursue some other career interest as opposed to being influenced by constructs such as self-efficacy or prior learning experiences. Additional exploration is needed to validate these findings since Brunhaver (2015) was one of the first to explore post degree decision making with early career professionals using Social Cognitive Career Theory. Moreover, the quantitative survey based approach had limitations, in particular that some learning experiences were operationalized as dichotomous variables (e.g., work in a professional engineering environment as an intern/co-op). While appropriate for the Brunhaver (2015) study that aimed to explore a broad use of SCCT constructs, this approach prevents full exploration of the impact of specific learning experiences on career goals and actions. For example, specific characteristics of co-op experiences (e.g., number of co-ops, quality of co-op) have been shown to impact how students perceive outcomes of co-op (Pittenger, 1993; Schuurman et al., 2008). Therefore, the single variable used in Brunhaver's study likely does not capture the complexities and unique contributions of the co-op experience.

My study contributes to literature by using a qualitative approach to unpack the contributions of co-op learning experiences to later career actions. Using SCCT, I examine how co-op experiences impact career actions through deeper exploration of engineering graduates' reasoning. I add to an understudied area in the engineering career decision literature by taking a nuanced view of the Co-op Development Program to understand how engineering graduates relate outcome expectations about pursuing engineering roles to their career actions immediately following graduation (research question three).

Performance domain and attainment. The authors of Social Cognitive Career Theory hypothesize that after setting a goal and taking action steps to achieve the goal, performance domains and attainments refer to an individual's fulfillment of the specified career goals (Lent et al., 1994). Self-efficacy shapes performance domain and attainment, as individuals assess and evaluate their own performance (Brunhaver, 2015), and performance domain and attainment are also directly influenced by career actions. An individual's performance also contributes to future learning experiences that iteratively affect the outcome expectations of future behavior, which refine existing choice goals and choice actions or generate new ones. Finally, an individual aspires to new levels of persistence and performance in their career decision-making (Swanson & Fouad, 2014).

Researchers have not specifically explored the *performance domain and attainments* construct in relation to co-op or career decision-making literature broadly. To provide context for my study, performance domain and attainments may be considered as the outcome following a decision to pursue (or not pursue) a full-time engineering role in industry—for graduates who persist in engineering industry roles, perceptions of their levels of achievement after taking their full-time roles can be examined. This construct is not a focus of my current study because I am interested in engineering graduates' *decisions* to work full-time (career action), not on the *outcomes* of their decision (performance domain and attainments). Future work is needed to better understand its role in career decision-making because performance domain and attainments provide feedback to individuals via learning experiences that reshape self-efficacy, outcome expectations, and future career choices.

Conclusion. Social Cognitive Career Theory "emphasizes the means by which individuals exercise agency in their own career development, as well as those influences that promote or constrain agency" (Brown, 2002, p. 302). SCCT has been used substantially in career related literature to examine social cognitive variables present in undergraduate engineering career decision-making. Additionally, a few researchers have used SCCT to examine early career engineers' career related decisions. To date, the engineering education literature has focused on person inputs, background contextual affordances, proximal contextual influences, and self-efficacy components of the model. Researchers have produced empirical evidence to validate the applicability of these constructs with the engineering population and to cooperative education experiences (Fouad & Guillen, 2006; Swanson & Gore, 2000). Though some constructs of SCCT have been studied more in the engineering cooperative education context than others, an extant review of the literature demonstrates the usefulness of SCCT as the guiding framework for my study of engineering graduates' career decision-making.

In my study, Social Cognitive Career Theory is leveraged to explain influences on the career decision-making of engineering graduates by focusing on three constructs: 1) learning experiences 2) outcome expectations 3) career actions. These constructs allow a researcher to consider how co-op learning experiences may shape students' expected outcomes and further impact career actions. Previous work demonstrates that learning experiences, outcome expectations, and subsequent thinking about their career are impacted by students' interactions with industry and should be studied further in the university-industry context. Because research indicates that learning experiences can have variable impacts on career choice, it is important to investigate *how* the learning experiences that students encounter in programs such as the Co-op Development Program (CDP) impact their pursuit of an engineering role post degree. By better understanding how student participation in the CDP impacts outcome expectations and subsequent thinking about their careers, interventions to better prepare students to make career decisions and pursue engineering roles can be initiated. Such interventions could support the ultimate goal of understanding how a student-centered university-industry partnership can support workforce development.

Chapter 3
Methodology

This study was guided by the following central research question: **How did learning experiences during co-op rotations in the CDP shape the career decisions of engineering participants immediately following graduation?** I addressed the overarching research question using the following sub questions:

RQ1. Why did engineering graduates participate in co-op rotations in the CDP?

RQ2. What learning experiences did engineering graduates encounter during co-op rotations in the CDP?

RQ3. In what ways do engineering graduates believe their learning experiences in the co-op rotations influenced their outcome expectations (i.e., beliefs about pursuing engineering industry positions full-time) and subsequent thinking about their career?

The first section of the Chapter will introduce the case study approach and selected data sites, followed by a discussion of the applicability of the case study approach to this study. The next section discusses the research design by explaining the role of the researcher, data collection methods, interview protocol, and data analysis procedures. The final section discusses the research rigor and limitations of the research design.

Case Study Inquiry

I utilized a case study strategy to explain how a specific university-industry partnership influences career decision-making for engineering graduates. Case studies are a common research method that is used across a range of disciplines including education, psychology, political science, nursing, and economics. This strategy supports researchers who seek in-depth exploration of activities, individuals, programs, or events to understand complex phenomena (Leydens, Moskal, & Pavelich, 2004; Yin, 2009).

Case study selection. I selected a university-industry partnership within engineering because the field of engineering has been targeted for improving education and workforce initiatives. The engineering field exhibits five characteristics that make it an appropriate test case for this study:

1) Bachelor's degrees (along with some associate degrees and certifications) in engineering are considered workforce-ready degrees (Maltese, Potvin, Lung, & Hochbein, 2015).

2) Fast-paced technology and engineering industries change rapidly, and skills gained in a more traditional classroom-based education can fall behind the needs of industry (*Ready to work: Job-driven training and american opportunity*, 2014).
3) Engineering educators and professionals frequently debate about career readiness of graduates and skills required for early career success within engineering (e.g., American Society of Engineering Education, 2013).
4) University-industry partnerships currently exist in the engineering field (e.g., Feller et al., 2002; Mitchell et al., 2007).
5) Engineering faculty members are more receptive to curricular innovations that connect students with industry partners relative to other engineering education pedagogical innovations, and thus university-industry partnerships serve as a fertile foundation that faces less resistance than newer innovations (American Society of Engineering Education, 2012).

Case study data sites. The focus of this dissertation is a single case study involving a three-way partnership commonly referred to as the Academic to Industry Developmental Program (AIDP), which supports four different types of interactions between universities and industry. A Large Mid-Atlantic Private University, an Engineering Services Firm (ESF), and a Large Aerospace Company (LAC) partner via an Academic Design Center model to execute detailed design/analysis work packages and support recruiting and hiring efforts by training the future engineering workforce. Table 3.1 outlines the roles and descriptions of the university and two industry partners involved in the AIDP as it relates to this study.

Table 3.1

Partner Descriptions and Roles

Large Mid-Atlantic Private University (University partner)	*Description* • Private university with an ABET-accredited engineering program • Houses a comprehensive and world-renowned cooperative education program that provides 18 months of co-op experience to students spread over three cycles of equal duration (six months each) *Role* • Supplies student candidates for co-op positions
Large Aerospace Company (Industry partner)	*Description* • Large engineering firm in the aerospace industry • Client to Engineering Services Firm *Role* • Contracts work packages to Engineering Service Firm • Supplies software and hardware access and technical expertise and additional resources as needed
Engineering Services Firm (Industry partner)	*Description* • Third party engineering services company contracted by Large Aerospace Company to complete work packages *Role* • Operates and performs project work packages throughout the entire cycle • Manages day-to day operations of Academic Design Center (e.g., student recruitment and hiring, training, business development, work package execution, status reporting and student performance evaluations) • Supports the Large Aerospace Company's recruitment efforts of the top tier students upon graduation and also provides a secondary employment market for candidates who do not join the Large Aerospace Company

This case study focuses on a single entity within the AIDP, the Academic Design Center (ADC), which includes a Co-op Development Program (CDP). I selected the Academic Design Center (ADC) as the study site because it offers a unique model for university-industry partnerships, as subsequently described in Chapter 4, and its program outcomes had not been examined from the participating students' perspectives nor using a rigorous research approach. The ADC is an engineering lab space fully equipped and managed to handle low and moderately complex work packages requested by the Large Aerospace Company in the Mid-Atlantic Region. The ADC context extends beyond the lab space when co-ops work on site at the LAC manufacturing facility. In this setting, students work with Engineering Services Firm (ESF) and/or LAC engineers to complete projects and have the opportunity to work in the LAC manufacturing environment. The ADC houses the Co-op Development Program.

Applicability of Case Study Strategy to this Study

Yin (2009) offers four conditions for selecting the case study strategy, each of which is met in this study.

Condition one. The first condition notes that the case study should appropriately align with Yin's (2009) two-part definition of a case study— 1) the boundaries between the phenomenon and context are not clear, yet the relationship between the two is important, and 2) utilizes multiple data sources along with prior theoretical propositions.

Part one refers to the scope of a case study.

> 1. A case study is an empirical inquiry that investigates a contemporary phenomenon in depth and within its real-life context, especially when the boundaries between phenomenon and context are clearly evident.
> (Yin, 2009, p. 18)

In part one, Yin highlights the importance of preserving the context when studying the phenomenon of interest. As it relates to part one of the definition, the *context* of this case study is the Academic Design Center (ADC) and the Large Aerospace Manufacturing Facility, and the *case* is the Co-op Development Program (see Figure 1.2 in Chapter 1). Context is defined as "the sets of conditions that give rise to problems or circumstances to which individuals respond by means of action/interactions/emotions" (Corbin & Strauss, 2008, p. 229). The Academic Design Center and the Large Aerospace Company manufacturing facility are the two work environments where co-ops completed their work assignments. The two sites enabled a set of work conditions for co-op participants via a workplace structure and culture that required co-op participants to complete work assignments, interact with professionals, and experience career related emotions.

Yin (2009) defines a case as "a contemporary phenomenon within its real-life context, especially when the boundaries between a phenomenon and context are not clear and the researcher has little control over the phenomenon and context" (p. 13). The Co-op Development

Program serves as a case of the phenomenon of undergraduate cooperative education and sits within the ADC and LAC manufacturing facility context. The case is bound geographically and programmatically by focusing on experiences that occurred while participants engaged in the Co-op Development Program.

Boundaries between the case and context are not strict. The ADC and LAC manufacturing facility served as the primary work environments for participants in the CDP. As such, the context defined the types of engineering professionals that participants interacted with and governed the technical focus of their work projects because engineering projects were relevant to the goals of the sites. That is, the interplay between the context and case indeed created experiences (i.e., professional mentoring, work assignments, and professional development and training) that engineering graduates encountered throughout their participation. The phenomena of interest are influences on career decision-making that take place during cooperative education experiences, as recalled by former participants in the program (who participated in the 2010-2015 time frame and are now engineering graduates) who are the primary unit of analysis in this study. Because participant and engineering professionals' interactions as well as work assignments might vary greatly in a different context, it is appropriate to employ a case study strategy that considers the overlap of the phenomenon and its context.

The second part of the definition refers to technical characteristics of the approach:

> 2. The case study inquiry relies on multiple sources of evidence, with data needing to converge in a triangulating fashion, and as another result benefits from the prior development of theoretical propositions to guide data collection and analysis (Yin, 2009, p. 18).

Using program documentation, gathering data from managers and students, and utilizing an interview protocol grounded in Social Cognitive Career Theory satisfies this part of the definition. Specific descriptions of how these elements were operationalized will be further discussed in an upcoming section.

Condition two. Research questions should seek to *explain* a phenomenon, and, as described in Chapter 1, the purpose of this case study design was to understand how experiences in the Co-op Development Program (CDP) influence career decisions with regard to pursuing engineering industry positions.

Support for qualitative procedures. In this study, qualitative methods offer several advantages in explaining the influences of engineering graduates' career decision-making. First, qualitative methods give researchers freedom to focus on detailed reflections of engineering graduates and present a holistic view of their experiences (e.g., Carrico, Winters, Brunhaver, & Matusovich, 2012; Rynes, 1987; Winters & Matusovich, 2015). As Creswell (2013) and Johnson and Onwuegbuzie (2004) note, such an approach to research will provide: 1) understanding and description of personal experiences of phenomena, and 2) a description of phenomena, in rich detail, as they are situated and embedded in local contexts. Second, as not all participants in the Co-op Development Program will agree to be interviewed or surveyed, qualitative methods are useful in studying a limited number of participants in-depth as well as gathering individualized information from participants (Patton, 2002; Seidman, 2013). Third, as engineering graduates' post-graduation career choices will vary and may not all be easily categorized into neat "buckets", qualitative methods offer the opportunity to identify and thoroughly explore information from a purposeful sample of participants that meet select criteria (Patton, 2002). For example, engineering graduates' experiences could vary greatly based upon their assigned project or supervisor. Such variation in participants' experiences could be hidden or impossible to explore in a quantitative research design (Creswell, 2009). Fourth, qualitative methods offer the reader the advantage of determining transferability of findings; rich descriptions of the setting, participants, and researcher's role allow the reader to evaluate if the findings relate to another context (Borrego, Douglas, & Amelink, 2009). Because my study examines a single case of cooperative education, offering rich, thick descriptions support readers' abilities to compare and contrast elements of that specific co-op program to co-op programs in their own environments.

Quantitative approaches could also be useful in exploring the experiences of engineering graduates, offer the advantage of testing an established theory or hypothesis, and can be used to identify if findings within a sample translate to a larger population (Borrego et al., 2009). In this study, however, only a small group of co-op participants have graduated and transitioned into full-time employment, so the sample lacks the statistical power required to make any strong conclusions from a quantitative approach. The qualitative findings of this study highlight issues for a small group of engineering graduates that can be used to guide future quantitative studies of larger samples of engineering graduates.

Condition three. The researcher is likely to have neither control over nor the ability to manipulate the behavior of participants. For this study, engineering graduates participated in predetermined work assignments within a pre-established program structure. I did not play a role in establishing or managing the Co-op Development Program, and so I did not have the ability to manipulate behaviors. Moreover, the participants in this study have completed the program, so I had no way of directly observing, and potentially influencing, their behavior. Therefore, my study satisfies the third criterion of having no control of behavioral events.

Condition four. The fourth condition refers to the focus of a contemporary event. A contemporary event is preferred over a historical event. Contemporary events provide a case study researcher the opportunity to study actual behavioral events by connecting with participants directly, while historical events may cause a researcher to focus on documents and artifacts to explore behaviors because participants are no longer alive (Yin, 2009). My study satisfies this criterion because the first cohort of students entered the Co-op Development Program as early as 2007 with estimated graduation dates ranging June 2011 to June 2016. Using “time on the job” criteria used by previous engineering educators (Brunhaver, 2015; Winters, 2012), participants were considered "early career" engineers and were less than five years removed from the university and able to provide accounts of their own experiences. Though five years may be considered a substantial time period post participation, interviews remain an appropriate approach for learning about former experiences instead of quantitative alternatives. A quantitative approach would limit the amount of details that can be gathered from the study. To assist participants with recall, the conversational nature of the interview supported the use of probing questions and the use of time prompts to situate the interviewee in the time of their co-op (Corbin & Strauss, 2008).

Researcher’s Role

Yin warns that when using the case study approach, the researcher must be careful not to “seek only to use a case study to substantiate a preconceived position" (Yin, 2009, p. 72). My own experiences in having bachelor’s and master’s degrees in engineering and my participation in three internships in industry present potential bias for this study. Although I did not formally participate in a co-op rotation, I completed a formal co-op interview round and multiple internships, and I acknowledge these experiences impacted my pursuit of an engineering career in industry. Also, over the course of this study, I have established a relationship with the Academic to Industry Developmental Program’s developer and manager and engaged in conversations about successes and challenges of the program. While managerial viewpoints provide valuable insights, I know that I likely developed a bias towards recognizing the potential gains of the program for participants based on these conversations. To address this potential for bias, I acknowledged that participants might offer a range of perspectives (negative to positive) as it relates to experiencing program outcomes. I also designed the interview protocol with open questions to allow participants to describe their experiences without high levels of prompting, and I avoided asking leading questions to prevent potentially introducing the management perspective. As later described, I took appropriate steps to ensure trustworthiness for the study, thereby limiting the opportunity for my bias to influence data collection, reporting, and discussion. Before data collection, I did not have any prior interactions with the participants nor am I likely to interact with the participants outside of interview protocol. I shared with participants that I did not directly represent any of the stakeholders, that all views were accepted, and that the purpose of this research was to hear about a range of experiences.

Access. The developer of the Academic to Industry Developmental Program (AIDP) served as the primary gatekeeper for this study. He has 33 years of experience in the aerospace industry. I initially contacted the developer to learn more about his career path and job opportunities as it related to engineering student recruitment and employee development. He presented the AIDP construct in our discussion, and we both identified several questions that could be explored by taking a deeper look at the program.

I submitted a brief proposal to the developer for the study, and he approved the plan with only slight modifications. Most of those adjustments related to the descriptive details about the program. There were no disruptions to the ongoing ADC operations during this study, and data collection occurred from remote locations with former participants. Data collection incorporated program related documents provided by the gatekeeper. To support the study, he provided access to the program manual, participant data, and provided input on the program logistics and goals. More discussion on how these sources were used to describe and explain influences of the Co-op Development Program is subsequently described.

The gatekeeper can use these findings and empirical data points in his continued efforts to expand and improve the AIDP construct to include additional university-industry partners. In addition, he can help establish communities of practice in the aerospace industry and help disseminate the lessons learned from this dissertation to professionals in other industries.

Ethical Considerations

I obtained written approval and permission from the Virginia Tech Institutional Review Board to conduct this study and to identify any potential sensitive ethical issues. Processes to ensure anonymity are clearly outlined in IRB protocol #16-295, *Preparing Students for Professional Work Environments Through Academic-Industry Partnerships: A Single Case Study of the Co-op Development Program*. Some participants were currently employed at the Large Aerospace Company or worked in industries that supplied products to the Large Aerospace Company, so there was a potential ethical issue when speaking about their employer (or business client) as input into a published work. Since participants were asked to share both positive and negative experiences, participants may have been sensitive to sharing a perspective that might reflect at poorly on the company's image. In an attempt to protect participants' identity, participants were assigned pseudonyms. Data were stored in a secured location during the study, and any identifying information was removed from transcripts after pseudonym identifiers were assigned. Participants were also given the opportunity to review their interview transcripts and participant profile (presented in Chapter 4) for proprietary or self-identifying information and were allowed to edit the text if desired.

Data Sources

This study drew on multiple data sources to explain how the Co-op Development Program relates to career decision-making for engineering graduates. Table 3.3 provides a description of five data sources that were used in my study. Interviews of former participants served as the primary data source, and program documentation (i.e., Skill Matrix and AIDP Management Plan), the personal profile questionnaire, and the managers' perspectives served as secondary sources.

Table 3.3

Data Sources

Data Source	Description	Role
Interviews of Engineering Graduates (Qualitative)	Captures how former participants in the program perceive how their engineering career beliefs and actions were influenced by experiences encountered in the CDP. Used as main source to describe participant experiences.	Primary
Skill Matrix (Quantitative)	Captures participants' individual performance assessments, racial/ethnic background, sex, type of work assignment, number of co-op assignments, and technical training background. Supported identifying participant pool.	Secondary (pre-existing document)
Personal Profile Questionnaire (Qualitative/Quantitative)	Captures participants' demographics, co-op and current employment status and history, and consent to participation. Used to validate the Skill Matrix (when appropriate), provides context to build an in-depth description.	Primary
Managers' Perspective (ASEE Paper) (Qualitative)	Describes how the CDP supports professional socialization of students using CDP developer and manager as key informants. Used to identify intended learning experiences and provide context for case.	Secondary (pre-existing document)
Program Document (AIDP Management Plan) (Qualitative)	Describes the AIDP structure, management strategy, and resources. The plan is written for an industry partner who seeks to start and manage an AIDP with a third party engineering services firm and academic partner. Used to provide context for case.	Secondary (pre-existing document)

Data Collection Procedures

Interviews. Interviews offered several advantages for describing career decision-making from the perspectives of participants in my study and are often used in case study research (Trochim, 2006). I used semi-structured interviews so that data collection was systematic and consistent across multiple interviews yet flexible enough for the interviewee to provide specific details regarding a situation as well as details about past behaviors (Leedy & Ormrod, 2005).

Using a conversational approach, I directed participants' discussions to gather data that addressed the research questions while still allowing the participant to provide background and details about their experiences that I may not ask about directly. Interviews were conducted via phone and were audio recorded and transcribed for subsequent analysis.

Interview protocol. I conducted semi-structured interviews to explore participants' perceptions about how experiences in the Co-op Development Program shaped their career decisions. In case study research, Yin (2009) suggests that the protocol should remain more "fluid than rigid" (Rubin & Rubin, 1996, p. 106) and outlines the importance of asking questions in a conversational way that also explores the phenomena of interest. Following Yin's (2009) recommendations, I used an interview protocol that remained flexible through the pilot stage and formal data collection to provide a common set of questions that align with the framework of the study.

Pilot. I conducted two pilot interviews to test and validate the interview protocol. Both interviews provided insights that led to adjustments in the interview protocol, format, and approach. Participants were selected because they had been involved in student work experiences, worked full-time in industry, and were conveniently accessible. The first pilot interview was conducted via WebEx with a Virginia Tech graduate student. Prior to starting graduate school, the participant completed an internship and joined the host employer in a full-time engineering industry position after completing a B.S. in engineering. The second pilot interview was conducted via Skype with an individual who had completed multiple co-ops while an undergraduate and accepted an engineering industry position immediately after earning their bachelor's degree in engineering. The participant was not employed with a former co-op employer at the time of the interview.

The first interview was conducted with the primary focus of understanding how the interviewee could understand, interpret, and answer interview questions. The participant was allowed to provide feedback throughout the interview. The first interview was conducted via WebEx to simulate the context in which interviews were proposed to occur and ran for 48 minutes. The second interview was conducted to simulate the data collection experience. The IRB script was read, and the protocol was followed verbatim, allowing for flexibility provided via semi-structured interviews. Feedback and discussion about the interview experience occurred after completing the interview protocol. The interview ran for 70 minutes via Skype. I utilized Skype following a suggestion from a committee member that WebEx could present challenges because of employer firewalls.

The pilot interviews provided an approximation of interview length, led to terminology clarification, and revealed participants' abilities to recall prior experiences. I evaluated the time length of pilot interviews and made adjustments to keep interviews within an hour in duration to encourage participation and to be mindful of engineering professional workplace responsibilities. Additionally, I reduced the number of questions in the protocol. Repetitive questions were removed, and other questions were reframed as probes to facilitate more detail when needed. Interview protocol questions were also re-organized to improve the conversation flow and to help frame the various time references in the interview (i.e., building from initial co-op experience, to return to school, additional co-op experiences if applicable, to graduation, to full-time employment). Also, some terminology changes were discussed with participants when they experienced difficulty interpreting or answering questions (e.g., "beliefs about the future" was reframed as "expectations"). Lastly, both pilot interviews helped validate participants' abilities to recall details from their past work experiences, as both recalled experiences from seven years prior. While I could not verify the accuracy of the accounts, the level of detail that pilot participants used to describe their experiences (e.g., meticulous accounts of interactions with other co-op students and engineering professionals and the use of supervisor and co-worker full names and titles) provided me with confidence that participants in this study could provide in-depth explanations of their cooperative education experiences.

Table 3.4 displays the adjusted interview protocol used to guide data collection for this study. The table displays how interview questions map to the study's four main research questions as well as to the focal constructs of Social Cognitive Career Theory. The complete interview protocol with introduction and background text that I read to participants can be found in Appendix A.

Table 3.4

Interview Protocol

Interview Question	**Research Question**	**SCCT Construct**
1. Describe your decision process to participate in a co-op with ESF (or LAC). Probing Prompts: • Did you have other co-op offers at the time? • If so, why did you select a co-op with ESF over others?	**RQ1.** Why did engineering graduates participate in co-op rotations in the CDP?	Understanding Participant beliefs (Person input/Background and Contextual Affordances)
2. Tell me about your experiences in the CDP. Probing Prompts: • Where did your co-op take place? • What type of projects did you work on? • Can you share an example of your o interactions with engineering professionals o involvement with work assignments o experiences with other co-op participants 3. What were the most meaningful experiences that you encountered, and Why? Probing Prompt: • What was it about these experiences that you think made them meaningful? 4. Is there anything you feel that you learned from these experiences? Probing Prompts: • How did the co-op impact your technical knowledge? • How did the co-op impact your professional skills?	**RQ2.** What learning experiences did engineering graduates encounter during co-op rotations in the CDP?	Learning Experiences Adapted from Lent et al., 1994 and Raelin, Bailey, Hamann, Pendleton, et al. (2014)

5. How did your experiences in the CDP influence your expectations about working in an engineering industry position post degree?
Probing Prompts:
• What specific examples can you remember shaping your expectations about working in an engineering industry position post degree?
  • interactions with engineering professionals
  • involvement with work assignments
  • experiences with other co-op participants
	RQ3. In what ways do engineering graduates believe their learning experiences in the co-op rotations influenced their outcome expectations (i.e., beliefs about pursuing engineering industry positions full-time) and subsequent thinking about their career?	Learning Experiences and Outcome Expectations Adapted from Lent et al., 1994 and Raelin, Bailey, Hamann, Pendleton, et al. (2014)

6. If you performed well during your time in the CDP, what do you expect to happen after you completed your co-op rotation with respect to…
  • entering an engineering industry career full-time
  • returning to work for ESF or LAC
  • exploring other career opportunities
  • having an attractive salary
  • adapting to future workplaces (e.g., navigating politics)
		Adapted from Brunhaver, 2015; Singh et al., 2013; Fouad and Singh, 2011

7. How did you feel about pursuing an engineering industry job after your co-op rotation?		Outcome Expectations and Career Actions
8. Why did you (did you not) decide to pursue a full-time role with ESF or LAC following your co-op rotation?		
9. (If not in an engineering position) How did you decide to pursue a career in (X-industry/Y-occupation)?		
10. Overall, how would you describe the influence CDP had on your decision to pursue (or not pursue) an engineering industry job? • Rate the level of influence: 1 (no influence); 2 (little influence); 3 (neutral); 4; (some influence); 5 (much influence)		
11. Is there anything else you would like to share?		

Limitations of interviews. The use of interviews presented several limitations. First, while phone interviews provided a cost-effective solution, they diminish the interviewers' ability to observe body language and react (e.g., a confused look or a positive shift in engagement on a topic) (Opdenakker, 2006). Face-to-Face interviews were not feasible as participants were geographically scattered. I took notes throughout each interview to capture real-time observations of the participants' vocal variations (e.g., hesitations, excitements) and my reactions and thoughts as an interviewer to strengthen my approach. Also, I completed participant summary sheets following each interview to capture issues and themes that surfaced, new or interesting questions to ask subsequent participants, and salient or interesting characteristics of the interviewee.

Second, participants discussed their experiences through a filtered perspective. Interviewing former participants required interviewees to be reflective about their experiences. Participants may have filtered their experiences from the most recent perspective of their selected career actions or the actions that they deem best represent them in the present time, which may or may not represent all of their learning experiences in the CDP. Seidman (2013) discussed that interviewees' memories are challenged when asked to remember an experience from the past, and interviewees are likely to report information "partially based on memory and partially on what the participant now senses is important about the past event" (p. 88). Seidman (2013) suggests that interviewers expect interviewees to reconstruct information regardless of the time differential (i.e., interviewing immediately following an event or with delay). To work through these challenges, I listened for instances when participants spoke of events prior to the co-op rotation and used time sensitive probes to navigate interviewees to the time bounds of the case study. In doing so, I guided participants through "reconstruction as directly as possible" (Seidman, 2013, p. 88). I also asked some participants if their responses would have changed based on their first year on the job versus their current year of experience. These approaches increase credibility by situating interviewee reflections in the appropriate time frame (Corbin and Strauss, 2008).

Third, interviews occurred outside of the natural setting. Because the participants no longer resided in the CDP setting, they could not rely on physical observations or reminders of the CDP environment. This limitation was addressed by drawing on secondary data sources to remind participants about the physical setting and program elements of the Academic Design

Center environment. I utilized the program management document to describe the facility layout, management structure, and work packages completed by co-op participants. I also used the managers' perspectives to generate probes about specific experiences following participants' descriptions of activities.

Fourth, my presence as a researcher may have introduced some bias in participants' responses (Creswell, 2009). I have not had any prior interactions with the participants nor am I likely to interact with the participants outside of interview protocol. For some participants, I was perceived as a neutral third party, which encouraged open dialogue about positive and negative experiences. For others, participants seemed to focus on the positive evaluation of experiences to prevent casting a negative reflection on the CDP or CDP stakeholders. As I recognized this trend, I made participants aware of the study's goals and the measures I was using to protect anonymity by using the approved IRB protocol. I also sought to build rapport with participants early in the interview. Additionally, I respected participants' time by remaining on schedule, clearly explaining the purpose of the study and my research role, and encouraged participants to be open to sharing any experience. IRB-approved consent forms provided the participant with additional assurances that their participation was limited and my role is solely to collect data and not provide any participant-level data to former, current, or future employers.

Documents. Four documents were used as additional data sources in this study: the Skill Matrix, Participant Profile Questionnaire, AIDP Management Plan, and an ASEE Conference Proceeding (Young et al., 2016)**.** The Skill Matrix is used in practice by the Engineering Services Firm to track student progress and retention through the CDP and full-time employment. This document offers data that help describe participants in a more holistic way. Variables include participants' technical training, graduation date, racial/ethnic background, sex, academic classification, number co-ops, participant performance assessments, decision to interview with the LAC or ESF for a full-time position, and reception and/or decision to accept job offer with the LAC or ESF. Appendix B provides a sample screenshot of the Skill Matrix data. Participant level data listed in the Skill Matrix was used to identify the participant pool via purposeful sampling (discussed in the following section) and guided the interview approach, as I asked participants with multiple co-ops within the CDP to differentiate between those experiences.

A limitation of the Skill Matrix is that it has some missing and/or incomplete information at the participant level. The incomplete data did not affect identifying the participant pool because I have complete first and last name data and graduation date. However, the incomplete data regarding the number and period of co-op participations potentially affected how accurately I could probe participants about specific co-op experiences.

The Personal Profile Questionnaire was used to validate existing Skill Matrix data and to complete some of the missing data points of the Skill Matrix. The questionnaire captured participants' demographics, co-op and current employment status and history, and consent to participate (see Appendix C). Data from the questionnaire were also used to build participant summary profiles and provide context to build an in-depth description of the case (see Chapter 4 for more detail). Additionally, I used employment status data as time point references during interviews to navigate participants' stories about specific experiences encountered during the participants' co-op and full-time career decision-making.

The AIDP Management Plan provided details about the day-to-day operations of the Co-op Development Program and provided an in-depth description of the AIDP context (see Chapter 4 for more detail). This document also contributed to the development of the interview protocol. Because I am interested in the learning experiences that occurred within the CDP, I used the AIDP Management Plan to identify experiences that managers planned to provide and developed impromptu probes to encourage dialogue if participants had difficulty sharing or recalling certain experiences (e.g., What type of mentoring relationships did you develop-formal or informal?; How do you feel the training you received impacted your ability to complete work assignments?).

Both the AIDP Management Plan and Skill Matrix documents were either developed or last updated in December and November 2013, respectively. Because the program started at the university site in 2007, the AIDP Management Plan may reflect a program structure that early participants did not experience as participation spanned from 2010-2015. I adjusted the interview protocol if participants were not familiar with a certain experience being offered during their time in the CDP. Ultimately, these documents reflect the managers' perspectives of the program, which paint a more holistic description of the case and enables the study to determine whether participating students in fact realized the intended designs of their co-op experiences.

Additional data to articulate the managers' perspectives were obtained from *Developing Student-centered Partnerships: Professional Socialization and the Transition to Industry*, an ASEE Conference Proceeding that I authored with the AIDP program developer, CDP manager, and David Knight, dissertation advisor (Young et al., 2016). The article describes how the AIDP supports professional socialization of engineering graduates using the AIDP developer and CDP manager as key informants. It highlights intended learning experiences and provides context to support the in-depth description of the case study description. The content from the article was reviewed to compare managers' and participants' perspectives.

Purposeful sample selection. The participant pool was identified using the Skill Matrix document as well as through communications with the AIDP program developer and CDP manager. Following a low initial response rate, additional participants were identified via snowball sampling. Snowball sampling involves identifying participants based on other recommendations of another participant who can provide rich detail and add to the study (Creswell, 2013). At the conclusion of an interview, participants were asked to recommend former CDP participants.

Selection criteria included engineering graduates up to five years post-graduation who completed the CDP between 2010 and 2015 and were employed full-time in engineering industry positions following their engineering bachelor's degree. An engineering industry position was defined in two parts: 1) an engineering position lists a bachelor's degree in an engineering discipline as a minimum requirement in the job description, and 2) "industry" includes private, for-profit, non-educational institutions; persons who are self-employed and incorporated; and other for-profit non-educational employers (Fallkenheim & Burrelli, 2012). Participants' descriptions of their current employment were verified against this definition.

Additionally, participants were required to have had at least one complete co-op rotation and have had at least one job placement post-graduation. By requiring a complete co-op rotation, I was able to explore a more complete view of the learning experiences participants may encounter from the start to finish of a rotation in the CDP. Employment post-graduation provided the basis to explore a specific point of reference when discussing a participant's career action (i.e., the pursuit of an engineering industry position after graduation). Participants who were not employed in full-time engineering industry positions were not within the scope of this study.

I contacted the participant pool via direct email (when available), LinkedIn messaging, and phone (when available). Because participants were no longer situated on a single campus, I relied on phone and online solicitation, which are not as direct and effective as face-to-face recruiting (Singleton & Straits, 2010). A questionnaire was emailed to all participants who responded to solicitation emails and messages to capture data about their former and current employment. All participants who met the selection criteria were included in the study and represented a diverse set of industry full-time roles to support varied explanations of engineering graduates' career decisions to enter an engineering industry position. Participants were asked to complete the study on a voluntary basis with no gift or monetary reward incentive.

Sample. The sample included six males and two females from diverse racial/ethnic backgrounds. I exhausted all available methods of contacting participants. In addition, data saturation (Creswell, 2013; Seidman, 2013) was reached during my data collection, as participants with similar career actions spoke of the influences on their career decision-making comparably. In evaluating characteristics of the eight-person sample, I adjusted the scope of the study to reflect participants' choices to enter specific industry positions (as opposed to attending graduate school, starting their own business, or working with the federal government)—all participants worked in industry full-time. Participants represented a variety of industries, however, including aerospace, software, and oil and gas. Additional descriptions about participants are provided in Chapter 4.

Data Analysis and Interpretation

The analysis had two aims: 1) provide a detailed description of the Co-op Development Program and its participants, and 2) uncover themes related to influences on the career decision-making of engineering graduates with cooperative education experiences. Data analysis aligned with characteristics of qualitative research broadly and reflected explanation-building techniques aligned with the case study strategy. Explanation building is an analytic technique with the goal of analyzing a case by building an explanation of the case (Yin, p. 140). This technique leverages existing theory to hypothesize causal links in explaining how and why a phenomenon occurs. In my study, this technique is demonstrated by using three focal constructs of Social Cognitive Career Theory as predetermined codes to guide data analysis.

Analysis approach. I used a six-step approach to qualitative data analysis developed by Creswell (2009) that incorporates approaches suggested by Rallis and Rossman (1998), as shown in Figure 3.1. Creswell (2009) emphasizes that while appearing linear, the coding process is iterative, and steps can occur out of sequence and can be revisited at any point to refine codes, themes, and descriptions.

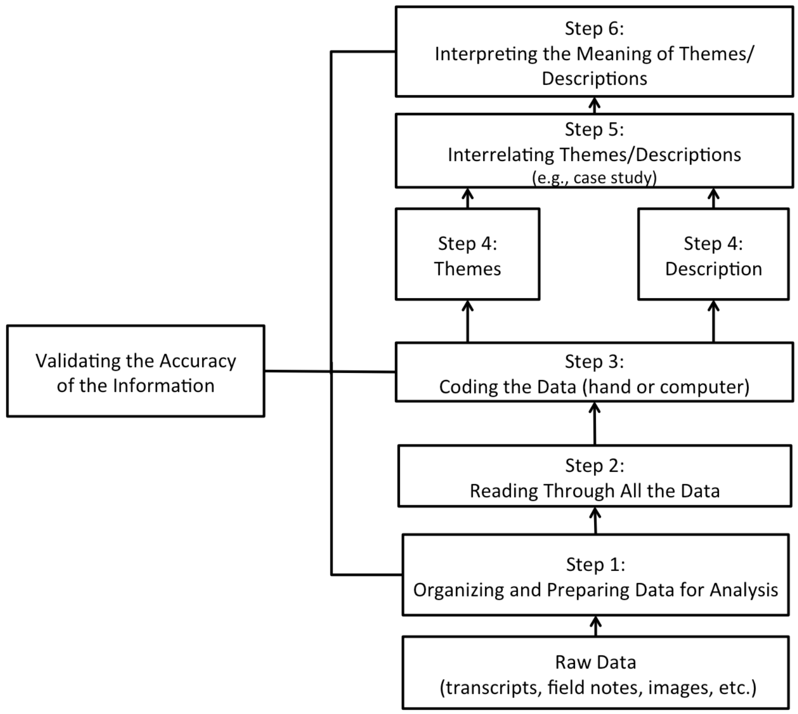

Figure 3.1. Data Analysis in Qualitative Research (Creswell, 2009)

Steps one and two involve organizing and preparing data for analysis and reading through the data (Creswell, 2009). Following data transcription, I read through all transcripts and field notes to gain an overall picture of the data. In reviewing all the data at once I developed initial ideas related to participants' perceptions and levels of depth and breadth of the information collected. During that initial read, I captured my questions and initial thoughts in the margins of the transcribed text.

Step three involves coding the transcription, which entailed organizing the data into meaningful segments to support the interpretation of the study's findings (Rossman & Rallis, 1998). I primarily used a deductive approach utilizing a priori coding via three major constructs of Social Cognitive Career Theory as predetermined codes: 1) *learning experiences*, 2) *outcome expectations*, and 3) *career actions.* I also incorporated open coding to capture early subcodes that I identified when reviewing transcripts in steps one and two. Step four generates themes from categories using the subcodes developed in steps one and two; descriptions of the study's setting and participants were also developed in step four. I used MaxQDA, a qualitative analysis computer software program, to complete this coding process.

Because the guiding framework does not directly address reasons for participation in learning experiences, to address research question one (i.e., "Why did engineering graduates participate in co-op rotations in the CDP?"), I utilized a different coding approach than what was used for research questions two and three. I first used open coding and analyzed the text complete thought by complete thought. Following open coding I created categories by grouping together similar open codes. Then, themes were created to describe why participants chose to complete their co-op rotations in the CDP. Although not directly linked to an SCCT construct, this question was included to understand the reasoning behind why the engineering graduates that chose to participate in the CDP.

For research question two ("What learning experiences did engineering graduates encounter during co-op rotations in the CDP?"), I examined transcript data using *learning experiences* as the predetermined code. I used the formal definition to identify participants' thoughts that relate to Lent et al.'s (1994) definition of *learning experiences* (i.e., activities that are educationally or occupationally related to one's goals and occur through vicarious learning, verbal (social) persuasion, past performance accomplishments, or via physiological reactions). After these code segments were identified, I generated emerging sub codes following an open coding approach to describe experiences with more specificity. Then, I clustered similar codes into categories, and using those categories, I identified themes that ultimately explain learning experiences as described by the participants. The identified themes encompass the engineering graduates' perceptions of learning experiences, which I then compared to the program documentation that captures managers' perspectives of the intended learning experiences. Both participants' and managers' perspectives are useful in describing the case in detail as well for discussing conclusions of the study, and differences in those perspectives offer support for the need to consider the student voice in university-industry partnerships as well as suggest revisions of the objectives of the co-op experience.

For research question three ("In what ways do engineering graduates believe their experiences in the co-op rotations influenced their *outcome expectations* (i.e. beliefs about pursuing engineering industry positions full-time and subsequent thinking about their career?"), initial coding followed a similar approach that identified complete thoughts mapping onto predetermined codes of *outcome expectations* and *career actions.* After initial codes were identified, I followed an open coding approach to generate emerging sub codes that describe *outcome expectations* and *career actions* with more specificity. Next, I clustered similar codes into categories that describe participants' beliefs about pursuing engineering industry positions full-time and the action taken to pursue (or not pursue the role). Then, I identified themes related to outcome expectations and career actions.

Additionally, for research question three I identified text that connected together *learning experiences*, *outcome expectations,* and *career actions*. This approach gathered evidence that was used to explain causal links between the constructs. This process gave further support for explaining how engineering graduates related learning experiences in the co-op to their outcome expectations and subsequent thinking about their career immediately following the CDP experience.

To complete step four, which involved developing themes and descriptions, I composed a detailed description of the case study using multiple data sources (see the description in Chapter 4). I used the Skill Matrix and Personal Profile Questionnaire to describe information about the interview sample. Then, I used the managers' perspectives (summarized in Young et al., 2016), AIDP Management Plan, and interview data to provide details about the day-to-day operations of the Co-op Development Program and an in-depth description of the Academic Design Center and Large Aerospace Company manufacturing facility context. This in-depth description is essential for single case study research to support transferability of findings (Borrego, Douglas, & Amelink, 2009; Yin, 2009).

Step five involves representing themes and descriptions in a meaningful way, and step six focuses on the interpretation of themes and description. In these final steps, data captured during interviews was summarized to provide a detailed explanation and evidence of the generated themes. I provide a table in Chapter 4 to present aggregate information about participants across four descriptive variables: number of co-op rotations, current employment status, racial/ethnic background, and sex. Findings are displayed in multiple figures and tables in Chapter 5 to display how themes emerged from categories and provide a snapshot of how themes are represented across interview participants. Tables 5.1, 5.2, and 5.4 (displayed in Chapter 5) serve as visual representations to demonstrate how multiple participants' perspectives were represented in each theme. Each table also displays how often a participant mentioned elements that were associated with a specific theme. Mentions were defined as distinctive complete thoughts within a category, i.e., a single description of an experience (regardless of the number of times it was referenced) was considered a single mention. For instance, one participant referenced a high stakes interaction of defending his work to top LAC managers on multiple occasions throughout his interview. To quantify mentions, I treated the experience as a single mention even though it was discussed on more than on occasion during the interview.

Reliability, Validity, and Generalizability

When discussing trustworthiness, Yin (2011) uses the terms creditability and trustworthiness jointly to describe the quality of a study. Yin (2011) suggests researchers should demonstrate trustworthiness and credibility via three measures credibility: transparency, adherence to evidence, and methodic-ness. Transparency refers to a clearly articulated research approach and accessible data that would allow another individual to critically review the study's findings. Adherence to evidence refers to the researchers' need to make data based claims when drawing conclusions from the study, and "methodic-ness" is demonstrated when a researcher uses a deliberate approach from the beginning to completion of a research project as well as a researcher's avoidance of "unexplained bias and deliberate distortions (Yin, 2011, p. 20)."

Credibility strategies. I enhanced credibility by looking for negative evidence, conducting peer debriefing, and providing rich, thick descriptions to convey transparency. In doing so, I present accurate information that the reader can trust (Creswell, 2009; Robson, 2011; Yin, 2011).

- *Present Negative/Discrepant Information:* In data collection, I looked for information contrary to what is assumed. Also, when discussing the results of the study, I present evidence to support both how the major themes are supported and how they were seemingly contradicted. I discuss any outliers, surprises, and rival explanations, and how these situations relate to the body of literature relevant to the study (Creswell, 2009, p. 191; Maxwell, 2009 as cited in Yin, 2009). These processes improve the trustworthiness of the study by presenting a holistic view of the data, which overcome biases of only presenting data that support hypotheses.
- *Peer debriefing:* Throughout the study, I engaged in discussions with peers who provided non-biased evaluations of methods and procedures. I asked four peers (two engineering education graduate researchers and two external peers with industry experience) to develop and interpret the final categories and themes that resulted from data analysis. This evaluation helped build credibility by demonstrating that findings resonate across

multiple researchers. Additionally, I used group peer debriefing sessions via the VT DEEP Lab to consult on various elements of the research study throughout my dissertation timeline.

- *Rich, thick description:* I provided an in-depth explanation of the influences on the career decision-making of engineering graduates by presenting multiple participants' perspectives, utilizing program documentation, and providing detailed profiles of the participants. I also presented representative quotes as a form of adherence to evidence to illustrate themes identified in data analysis, establishing data-supported claims for the study's conclusions. This thick description provides the reader with a multi-faceted view of the Co-op Development Program. A significant level of detail is essential for case study research because readers must gain a deep understanding of the context to understand whether the results of the study are transferable to another setting (Robson, 2011).

In addition to Yin's views of credibility, I utilized recommendations from Creswell (2009) to demonstrate dependability and transferability of the study and consequently strengthen trustworthiness of findings in qualitative research,

Dependability strategies. Creswell suggests several strategies to enhance the dependability of qualitative methods including proofreading transcripts, cross checking, and checking for drifting codes. These strategies align with Yin's "methodic-ness" measure by demonstrating a clear and unbiased research approach.

- *Proofread transcripts.* An initial step toward dependability is reviewing the transcripts after they have been transcribed to identify any errors. I checked the transcripts for potential mistakes in both the interviewer and interviewee dialogue. Participants also were given the option to review transcripts to ensure their accounts were appropriately captured prior to data analysis and interpretation Robson (2011).
- *Cross-checking.* Cross-checking was used to ensure my codebook supported consistent coding across participant interviews (Creswell, 2009). At the beginning stages of data analysis, I asked another engineering education graduate researcher to review and code an interview transcript independently from my work. I provided the researcher with the codebook to discuss and clarify code definitions beforehand. After we coded the transcripts independently, we met to establish how well we agreed on the codes. We

compared coded sections of the transcript to identify whether we would use the same codes when reading a similar passage. When we identified differences, we reasoned until agreement, and I returned to the literature for clarity of the definition or construct before revising the codebook.

- *Check for drifting codes.* There is the potential that as coding progressed, I drifted away from the original code definitions and slightly changed the meaning of the codes over time, which would impact the dependability of results. I utilized a codebook as a reference to record both predetermined and emerging codes that surfaced during data analysis. The codebook helped me be consistent across analyzing different interviews and was used when cross-checking codes with outside researchers.

Transferability. In qualitative research, the reader is tasked with the role of deciding how results relate to other contexts. Rich descriptions of the setting, participants, and researcher's role allow the reader to evaluate if parts of the findings may apply to another context (Borrego et al., 2009; Leedy & Ormrod, 2005). I provide ample detail so readers may assess whether findings from the Co-op Development Program case can be applied to another environment.

A limitation of this study is the focus on a single university-industry partnership. The generalizability of findings to other contexts is limited because one university, one industry sector, and one co-op program were examined. This institutional site has a strong emphasis on co-op opportunities, where 91% of undergraduates participate in a co-op program; 97.5% of engineering students participated in a co-op in 2013-2014 (Career Center of Large Mid-Atlantic University, 2015). While there are no clear data to contrast co-op participation nationally, it appears as if this institution may have a unique co-op culture. For example, a different institution has 35% undergraduate participation with ~11% of engineering students participating in co-ops. Another institution with a mandatory engineering co-op program has an overall undergraduate co-op participation rate of ~23%, with engineering accounting for ~11% of the undergraduate co-ops (Cooperative and Experiential Education Divison, 2013). Therefore, it is likely that the institutional co-op culture may impact how students experience workplace learning and pursue industry careers in a unique manner. Moreover, the industry partner in this study is a member of the aerospace industry; while the learning experiences may offer positive or negative influences, a participant's views of the aerospace industry might also influence their intent to pursue an engineering career. Therefore, conclusions related to how students develop in university-industry partnerships should be considered in light of the context of the partnership examined in this study. An additional limitation of this study relates to participant bias. Participants in this study self-selected to engage in the Co-op Development Program (CDP). These participants may have held different perceptions about pursuing engineering careers relative to their undergraduate peers.

As the study examines a case within a certain time and activity, results and conclusions must be discussed within those contextual elements. Although the specific results and conclusions may be limited, this approach is useful in contributing to the development of Social Cognitive Career Theory via analytic generalization. With respect to case study inquiry specifically, Yin (2009) discusses transferability in terms of analytic generalizability, “where an investigator is striving to generalize a particular set of results to some broader theory” (p. 43). This approach is useful in that it transfers the findings from a single case study toward contributions to theoretical constructs and propositions of the guiding framework. I contribute via analytic generalization by generating evidence that may confirm, challenge, or extend Social Cognitive Career Theory within an undergraduate engineering co-op environment. To fully establish analytic generalizability, my approach will need to be repeated for other co-op programs and demonstrate similar findings to more fully support the theory. This approach would provide additional ways in which the reader may decide how the findings might transfer to the context of another university-industry partnership.

Despite these limitations, the case study approach provides a rich, detailed description of the defined and bounded context. The research design allowed participation in the study from people who completed at least one co-op cycle over a five-year range of the CDP experience. This approach permitted exploration of multiple perspectives to understand how participation in the Co-op Development Program (CDP) influences students’ intentions to pursue engineering industry roles after finishing their undergraduate programs.

Chapter 4
Context

This chapter provides in-depth details related to the context of the Co-op Development Program and the engineering graduates who served as the primary unit of analysis in the study. First, I discuss the specific objectives of the Academic to Industry Developmental Program, Academic Design Center, and Co-op Development Program. Then, I provide summaries of the eight participants to highlight the varied perspectives included in the study.

Context and Case

As described in Chapter 3, Figure 4.1 illustrates the overlapping relationship of the Academic Design Center (ADC) and Large Aerospace Company (LAC) manufacturing facility context and Co-op Development Program case. The CDP is offered through the Academic to Industry Developmental Program (AIDP), a program that establishes strategic partnerships with universities support future workforce development.

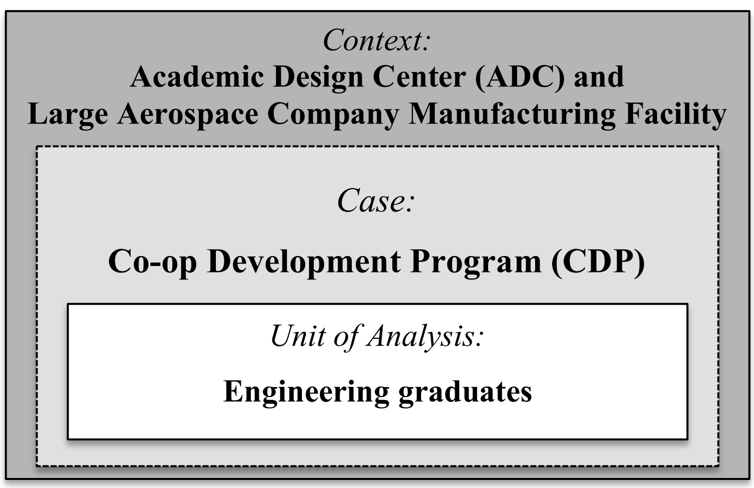

Figure 4.1. Case Study Research Design

Academic to Industry Developmental Program (AIDP). The AIDP began in 2001; The AIDP developer, worked within the Large Aerospace Company as the Chief Functional Leader for the Mechanical/Structural Engineering (MSE) team within the Defense and Space business unit. As the Functional Chief Engineer for the Philadelphia MSE team, the developer sought ways to "build" a strong technology focused team as well as retain high-performing engineering personnel. Also serving as hiring leader, the developer began to seek out the most productive personnel and identified that the most "productive" and innovative personnel within his group of

700 engineers were the employees who had the shortest tenures with the large aerospace company. Many of the high performers were either students on Internship or Co-op assignments or recently graduated "early career" engineers.

Based on these experiences, the developer sought to increase team performance by integrating student engineers into a focused business model while concurrently enhancing students' visions of what it was like to work as an engineer at the Large Aerospace Company. Ten universities were identified to focus on certain technical skill sets, one of which was the Large Mid-Atlantic Private University, which has Structures Design as a technical skill focus. The program was developed in phases with the goal of providing a better, more integrated "thread" between student employees' experiences and the needs of the Large Aerospace Company's program teams. Figure 4.2 illustrates the progressive phases of the AIDP, and each phase is outlined in Table 4.1.

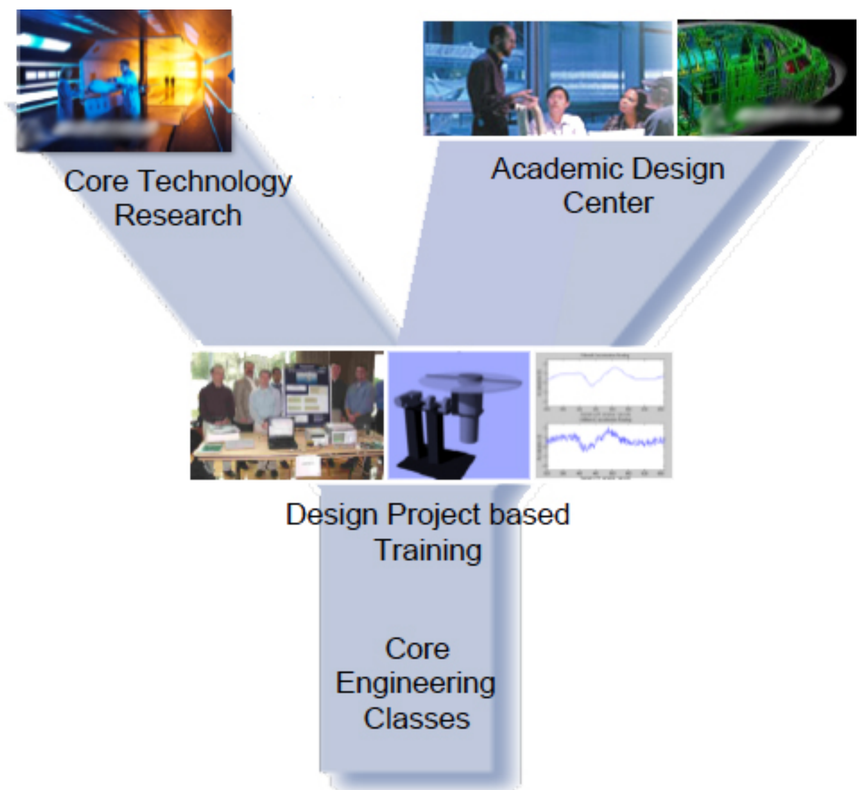

Figure 4.2 Academic to Industry Developmental Program Phases (Young et al. (2016))

Table 4.1

Academic to Industry Developmental Program

Tenets of "Academic Interaction"	**Description**
Core engineering classes	Provide a feedback loop into undergraduate and graduate coursework to more closely align with industry standard tools and practices.
Design Project Based Training	Identify and support relevant "Design/Analysis" projects that address real world problems of clients and the aerospace industry in general. The goal is to incorporate this early on in curriculum.
Academic Design Center (ADC)	Utilize undergraduate engineering students to execute Large Aerospace Company's work packages, exposing them to real designs, technologies, and program pressures currently found on the Large Aerospace Company's platforms.
Core Technology Research	Both Basic and Applied –focused on strategic needs.

Many aerospace and defense companies have benefited from such university relationships and use student work experience programs as testing grounds for hiring. Most of these firms also have at least several overlapping corporate organizations focused solely on integration with academia for research and development (R&D) (Grossman, Reid, & Morgan, 2001). The AIDP is unique in its intentional and purposeful design to embed the four tenants within a single partnership and to allow partners to focus on their distinct needs and goals. However, no single company or university to date has executed all four tenets at one time. For this study, I concentrate on the Academic Design Center tenant to focus on a Co-op Development Program between the Large Mid-Atlantic Private University, Large Aerospace Company, and the Engineering Services Firm.

Academic Design Center (ADC): The Academic Design Center is an engineering lab space fully equipped and managed to handle low and moderately complex work packages requested by the Large Aerospace Company (LAC) in the Mid-Atlantic Region. The former CDP Manager, describes the ADC as an entity that can:

> provide both a strategic and tactical advantage to our clients. It is 'self-funded' through execution of low to moderate complexity technical work packages at extremely low costs compared to industry average rates, thereby providing substantial savings relative to other options. Although important, this tactical

> advantage is surpassed by the strategic benefit of the future workforce development benefit of the ADC (2013, p. 24).

Full-time engineers from the Large Aerospace Company and the Engineering Services Firm staff the ADC. In this setting, undergraduate engineering students execute actual work packages for the Large Aerospace Company from the center, which exposes students to real designs, technologies, and program pressures currently found on Large Aerospace Company's platforms. The ADC context extends beyond the lab space when co-ops work on site at the LAC facility. In this setting, students work with Engineering Services Firm (ESF) and/or LAC engineers directly to complete projects and have the opportunity to work in the manufacturing environment. The Co-op Development Program operates through the Academic Design Center environment.

Co-op Development Program. The Co-op Development Program operates as a component of the Academic Design Center and aims to develop the next generation of the workforce through intentional personal interactions and formal and informal evaluations. Students work for up to six month co-op cycles on work packages concentrating on wiring installation design, aircraft structures, and project management initiatives for specialty aircraft. The program is designed to provide students with early exposure to the aerospace industry "giving them the opportunity to deselect the field as a career path prior to graduation which will result in greater retention rates" (Ciechon, 2013, p. 25). Supervisors serve as technical and professional mentors and meet with co-op students at least six times during the co-op experience. These supervisors guide co-op participants through skill recognition, development, and personal goal setting and meet collectively to gauge all co-op students' progress to evaluate the overall effectiveness of the CDP (Ciechon, 2013). The vision of the CDP is to further the professional development of students so that they become more competent engineers and are better equipped to enter the workforce at large. Figure 4.3 displays the CDP program logic model which provides a summary of the resources needed to support the program, activities and expected outcomes, as well as anticipated short, medium, and long term impacts of the program.

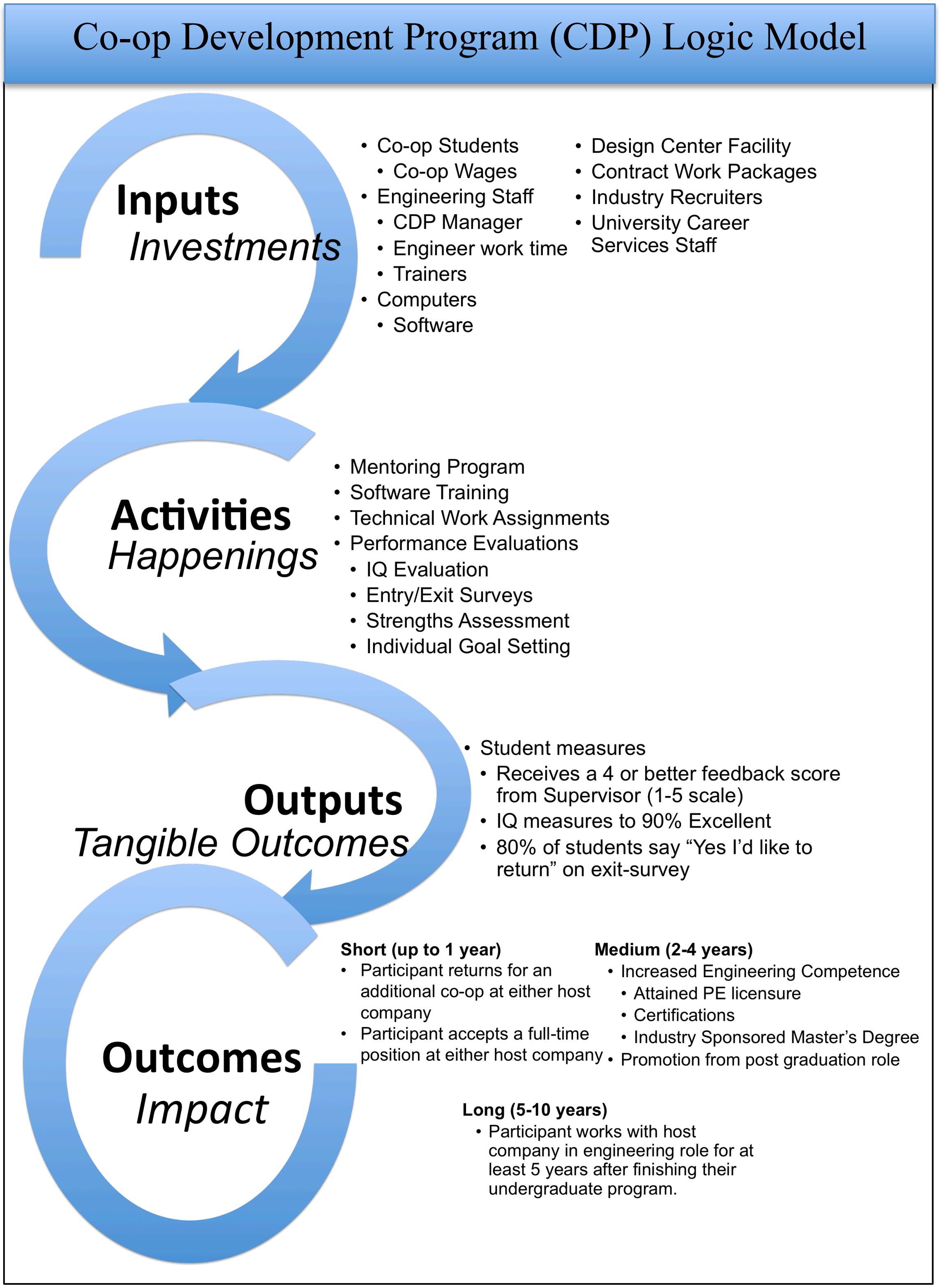

Figure 4.3 CDP Logic Model summarizing the programs inputs, activities, and outcomes

Interview Participants

The eight participants in this study represent multiple industries and engineering roles. Table 4.2 identifies participants' demographics, co-op history, and job title at the time of the interview. Each participant was assigned a pseudonym to provide anonymity.

At the time of their co-op, all participants were full-time students at the Large Mid-Atlantic Private University. One participant had previously obtained a bachelor's degree in architecture before pursuing a second bachelor's degree in mechanical engineering at the Large Mid-Atlantic Private University. Several participants held non-engineering related jobs prior to their first co-op experience (e.g., bank teller, restaurant server); one student had information technology/engineering related experience prior to the start of his first co-op. Prior to graduating, all participants had completed at least two co-op experiences.

At the time of their interviews, all participants were early career (i.e., within the first five years of working full-time post graduation with experience ranging from one to three years). Five participants were employed with the same employer they began employment with following graduation, while three have held multiple positions. Two participants' started full-time with the Engineering Services Firm (ESF) and were employed in the defense and manufacturing industry at the time of the interviews. The other participant took a retail position immediately following graduation until securing employment in the oil and gas industry.

All participants described their current work positions as engineering positions; in this study, engineering work was defined from the participants' perspectives. At various points in interviews, some participants offered definitions of engineering work versus non-engineering work. Participants described engineering work to include managing projects through completion, ensuring equipment runs properly, communicating technical knowledge across audiences, and applying foundational engineering concepts in a real-world setting. Two participants discussed non-engineering elements of their full-time roles, which referred to elements of their job related to sales (e.g., managing customer relationships and negotiating pricing). Four participants were enrolled in workplace sponsored graduate programs at the Master's level at the time of their interviews; two were pursuing mechanical engineering Master's degrees, one was pursuing a Master's in materials science and engineering, and one was pursuing a management focused engineering degree.

Table 4.2

Demographics of Participants (N=8)

Pseudonym	Sex	Racial/ Ethnic Background	Grad Year	B.S. Degree[1]	Total # of co-ops	# of co-ops at ESF[2]	# of co-ops at LAC[3]	Most Recent Job Title	Aerospace Related Role
Chris	Male	White	2013	ME	3	1	2	Mechanical Stress Analyst	Yes
Chloe	Female	White	2013	CE	2	1	1	Structural Analysis/Design Engineer	Yes
Carter	Male	Multi-racial	2013	ME	2	1	0	Sales Engineer	No
Cobb	Male	White	2013	ME	3	2	0	Composite Engineer	Yes
Abigail	Female	Multi-racial	2015	ME	3	1	0	Reliability Engineer	No
Jack	Male	White	2013	ME	3	2	0	Design Engineer II	Yes[4]
Drew	Male	White	2014	ME	3	2	1	Structural Design Engineer	Yes
Ray	Male	Prefer not to respond	2015	ME	3	2	0	Software Developer	No

1. ME-Mechanical Engineering; CE-Civil Engineering
2. ESF-Engineering Services Firm
3. LAC-Large Aerospace Company
4. Participant self-identified as working in the defense industry within the aerospace business

Participant Profiles

Chris. When Chris began his search for his first co-op opportunity, he was interested in working with the Large Aerospace Company (LAC) and acknowledged that a co-op with Engineering Services Firm (ESF) was a step in the right direction. Chris described his co-op experience with ESF as the first time he had worked in an office, which he identified as a valuable learning experience. During his co-op he spent the majority of his time at the Academic Design Center with a few days on-site at the LAC Facility. He described the work as “cookie-cutter following rules that didn't require too much intelligence” at the Engineering Service Firm and desired to have a role that supported creativity and independent work tasks. Chris reconciled his time at ESF as a stepping-stone and eventually completed two co-ops with the Large Aerospace Company; he favored those experiences over his time as a co-op at the ESF. He enjoyed the quicker pace of learning offered by industry, which influenced his decision to enter industry following his bachelor's degree. Chris noted that he "learns way more on the job and prefers to do so" but is obtaining a technical engineering graduate degree to "fulfill the CV bullet on his resume." When asked about the next steps in his full-time career, he saw himself remaining in his current technical area but shifting from the role of a student to a teacher. He interviewed and accepted a full-time position as a Mechanical Stress Analyst with the Large Aerospace Company following his last co-op.

Chloe. Chloe added a unique perspective to the study as the sole civil engineering major; all other participants obtained a mechanical engineering degree. Additionally, prior to attending the Large Mid-Atlantic University, she earned a bachelor of science in architecture at an international institution and desired a shorter co-op experience to reduce time-to-degree. She was interested in exploring the aerospace industry, and ESF gave her the opportunity to work in the field.

Chloe leveraged her civil engineering training in her first co-op rotation to assist with stress analysis projects. She spent an initial period at the Academic Design Center and constantly asked managers, "When am I going to the Large Aerospace Company? When am I going to work on-site at the Large Aerospace Company?" A few weeks later, she began work on site at the Large Aerospace Company facility. Chloe firmly believed that "if you try hard enough, you can get great work" during co-ops and completed two co-ops: one with the Engineering Services Firm (ESF), and one off cycle co-op with the Large Aerospace Company working 40 hours per week as a full-time student. The ESF co-op impacted how she saw herself fit into the field, as she noted, "I realized that you learn a lot on the job and that these guys are still learning themselves. And that no one knows everything. I have enough determination to learn things and actually be you know, an engineer." Following her ESF co-op experience, she shifted her career plans. She did not pursue a Master's degree in architecture as she had originally planned and instead accepted a full-time position with the Large Aerospace Company.

Carter. Carter was one of the first students to participate in a pilot version of the Co-op Development Program. He participated in one co-op with the Engineering Services Firm, working at both the Academic Design Center and the Large Aerospace Company facility. He openly shared that "I really didn't have a good experience. It wasn't terrible, but it really shifted me toward not wanting to work in the mechanical design field." During his co-op, Carter discussed that he did not receive exposure to the engineering process and viewed the environment as a "sweat shop for mechanical design work." While he noted several takeaways from his work experience, he declined the opportunity to work with the LAC directly for a second co-op.

Nearing graduation, Carter cast a wide net during his job search and applied "anywhere and everywhere." At one point he considered entering finance, but concluded he would not be interested in the type of work and instead focused on engineering roles for the salary opportunity and alignment with his interests. Following graduation, he left the local area because of low salary offers and worked in a non-engineering role temporarily before accepting a full-time position in the oil and gas industry. When describing his career future, he said that ideally he would stay in oil and gas because of the high salary potential and keep an engineering title because of the value that it offers in the job market.

Cobb. Cobb completed two co-op assignments with the Engineering Services Firm. He worked on-site at the Academic Design Center full-time during his first co-op and on-site at the Large Aerospace Company (LAC) facility during his second co-op. He also worked part-time for the ESF between co-op assignments. Prior to joining the ESF, Cobb completed his first co-op experience, which he described as bookkeeping. He held his ESF co-op experience in high esteem and described several meaningful experiences in detail. He cited his ESF experience as a major contributor to his professional development, stating that after a successful encounter with management, "that was definitely a meaningful moment, when I knew I had really made an engineering career." Cobb described himself as a "wrangler" who brought co-op participants together for social and work events. Cobb developed relationships with the manager of the program—working part-time during the academic year and assisting as an interviewer for later ESF co-op cycles. For Cobb, being able to handle the pressure of multiple work tasks as a co-op student demonstrated his ability to work as an engineer.

Following graduation, Cobb was not offered a full-time role with the LAC because of a hiring freeze and instead accepted a full-time role with the ESF. He currently works as a composite engineer for a large engineering company within their aviation business and is exploring project management opportunities and considering exploring the business route (i.e., serving as an operations leader and within project manager roles). Cobb mentioned that he and the AIDP managers joked about him one day managing an Academic Design Center.

He is currently pursuing a technical graduate degree to build knowledge in composites.

Abigail. Abigail's first statement in the interview was, "I became an engineer because I wanted to work in Aerospace. When I graduated high school, [the] Large Aerospace Company was my dream job." After completing co-op experiences in three different industries, she "found her niche" outside of aerospace. The ESF was her second cooperative education experience as a student. She spent a few weeks at the Academic Design Center (ADC) and then worked on-site at the Large Aerospace Company (LAC) facility. From her ESF co-op, she learned that design work was not for her. She did note, however, that her ESF co-op validated that she was doing the right thing by remaining in the field of engineering. Near graduation she inquired about an advertised position with the ESF, but the firm did not provide additional information. Ultimately, her desire for fieldwork and travel and an opening with her final co-op employer led her to a full-time position as a reliability engineer in the oil and gas industry. She enjoys her current work, although returning to the aerospace industry is not out of the question. In the long term, she said, "I think I [will] always see myself as an engineer, in an engineering role. Some kind of engineering role, whether it's managerial or not."

Jack. Jack transferred to mechanical engineering in his junior year after having a difficult time finding his first co-op as an architectural engineering major. For his second co-op cycle, he still faced struggles and ultimately accepted his only offer with the ESF to prevent having to extend his co-op search. Jack offered extensive details about the climate at the ESF and noted issues related to quick turnover with co-op students and managers as well as knowledge sharing. He uniquely experienced being let go when the ESF lost contract funding, but he was immediately retained after offering constructive feedback to management prior to the downsizing. He later returned to the ESF for a second co-op where he worked on-site at the Large Aerospace Company (LAC) facility. He described his time on-site by saying, "at the end of the day, we didn't necessarily feel 100% included in the LAC culture even though we were there and it definitely made an impact." From his co-ops, he noted, "I learned that personality kills. I know far and away that I was not the best engineer."

In the end, Jack declined a full-time position with the LAC after receiving what he considered a low salary offer. After graduating, he worked full-time for the ESF and shifted to a defense company where he currently works as a design engineer. Forecasting ten years, he asserted that he would be a manager and is focused on moving up the organizational ladder quickly. He is currently pursuing an engineering graduate degree with a management focus.

Drew. Drew described his co-op job search as “rough” primarily because “for the first co-op you really don't have that many skills…that can help you out in the workforce trying to search for something.” He chose the ESF co-op offer over one other offer and eventually completed two co-ops with the ESF, working first at the Academic Design Center and on-site at the Large Aerospace Company (LAC) facility for his second co-op. He also worked part-time for the ESF between co-op assignments. Drew noted that the ESF gave him the opportunity to interact with professionals and learn office etiquette, but “career wise I feel like I didn't really get much out of it because it was very mundane kind of work.” During his third co-op, he worked directly with the LAC, identified his desire to work in aerospace, and accepted a full-time position with the LAC. Concerning his projection for his career in ten years, Drew said, “it's too early to say. I don't really know. I'm still very early career engineer, so who knows. Things might change and I might want to go the management route. Right now I do like the technical, but I would like to lead my own projects.” Drew noted that if he ever left engineering, he potentially would explore finance. He is currently pursuing a graduate degree in engineering.

Ray. Ray started his co-op experience with the ESF having already had prior work-related experience in information technology/engineering. He described his reasoning to co-op with the ESF by saying, “I had an interest in aerospace growing up, so I wanted to try to nail a co-op there, and luckily ESF made it really easy to do that.” He worked on-site at the Large Aerospace Company (LAC) facility after spending an initial period at the Academic Design Center. Ray described his work as “pretty cool,” and said he returned to ESF for a second co-op because he was positioned to work on “higher caliber work versus having to start from the bottom again.” In his second co-op, Ray decided that working in stress analysis would not be a long term fit, so he chose to explore different opportunities for his third co-op to open additional full-time opportunities.

When searching for full-time employment, Ray sought out full-time positions with small companies and roles that would allow him to interact with multiple people as part of his work assignment; both of those features are characteristics that he valued after completing his co-ops with the ESF and another company. After graduation, he accepted a position as a software developer where he supports manufacturing in a broad sense, and not strictly within aerospace. In the next ten years, Ray sees himself remaining in a technical or engineering role, although he was careful to note, “It definitely could change. I'm definitely one to change my perspectives pretty frequently just trying to adapt as best to a situation. And where I am... in my career. So, I could end up anywhere. But as far as I can tell I'll still be doing some sort of technical work.”

Summary

The eight participants in this study represent multiple industries and voiced varying reasons for selecting their co-op as well as subsequent full-time work. This variation provides the reader with multiple perspectives as they consider the findings of this study. Moreover, the detailed discussion of the development, purpose, and layout of the Academic to Industry Developmental Program, Academic Design Center, and Co-op Development Program provides contextual understanding of the environment that influenced participants’ career decision-making. The description of the context and characteristics of the participant profiles should be considered when reviewing the findings discussed in Chapter 5.

Chapter 5
Findings

As outlined in Chapter 3, analysis was primarily guided by predetermined codes via three focal constructs of Social Cognitive Career Theory: learning experiences, outcome expectations, and career actions. Findings are organized and presented by research question and discussed in the context of the casual links proposed in Social Cognitive Career Theory. The chapter concludes with a summary discussion noting prominent themes and a summary table of themes coinciding with the three research questions.

Research Question One: Why did engineering graduates participate in co-op rotations in the CDP?

Participants expressed a range of reasons for participating in the Co-op Development Program for a single rotation or multiple rotations. Data analysis resulted in three themes: 1) *Interest Driven Exploration,* 2) *Characteristics of the Workplace*, and 3) *Convenience*. Figure 5.1 highlights the categories that comprise each theme. Table 5.1 illustrates how multiple participants' perspectives contributed to the development of each theme—providing a visual representation of how themes are represented across interview participants. It also displays how often a participant mentioned elements that were associated with a specific theme. As noted in Chapter 3, mentions were measured as distinctive complete thoughts within a category.

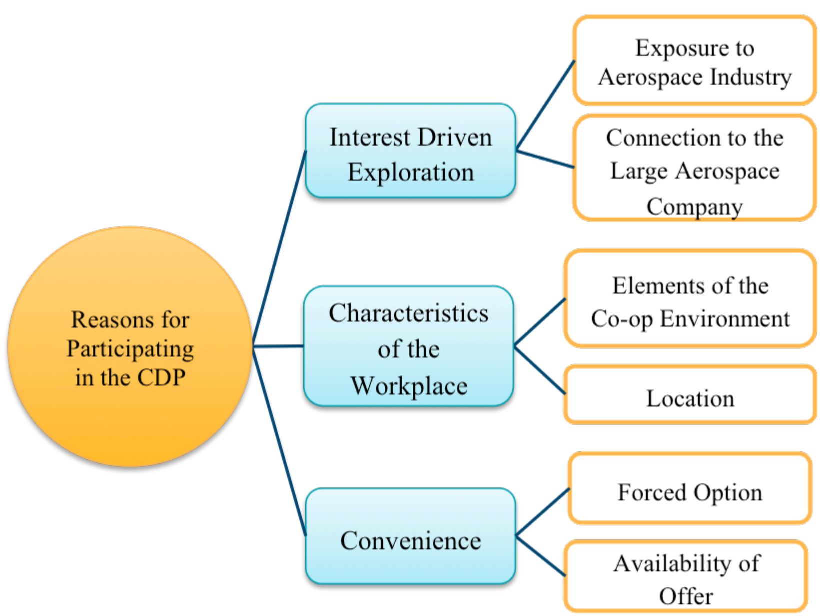

Figure 5.1. Visual diagram to represent themes that denote reasons for participating

Table 5.1.

Number of mentions per interview participant for Research Question 1 Themes

	Research Question One (Reason for Participating)		
Participant	Interest Driven Exploration	Characteristics of the Workplace	Convenience
Chris	2-3 mentions	1 mention	No mention
Chloe	4+ mentions	2-3 mentions	1 mention
Carter	1 mention	No mention	No mention
Cobb*	2-3 mentions	4+ mentions	No mention
Abigail	1 mention	No mention	No mention
Jack*	1 mention	1 mention	4+ mentions
Drew*	1 mention	2-3 mentions	1 mention
Ray*	4+ mentions	1 mention	2-3 mentions
*Participated in 2 co-ops with ESF			
Shading denotes number of distinct mentions (coded at the level of the complete thought)			
	4+ mentions		
	2-3 mentions		
	1 mention		
	No mention		

Theme 1: Interest Driven Exploration. As shown in Table 5.1, a commonality among all interview participants for their reason to participate in the Co-op Development Program was an interest in working in the aerospace industry. Participants' interests were framed in relation to both short- and long-term goals. Some participants expressed the desire to work full-time in the industry, and others discussed the desire to "test out" their curiosities about working in aerospace through a short-term co-op commitment.

Two categories contributed to this *Interest Driven Exploration* theme: exposure to the aerospace industry and connection to the Large Aerospace Company. Some participants targeted full-time work at LAC specifically, and other participants aimed to position themselves for future opportunities at similar types of companies.

Exposure to aerospace industry. Considering that the participants' institution did not have an aerospace engineering department, it is not surprising that two participants discussed exposure to the aerospace industry as a reason for participating in the co-op. For example, Ray, a returning co-op student, noted a reason for completing a second round of co-op with ESF to understand long-term fit in the industry. Additionally, participants cited childhood interests in aerospace and the opportunity to explore areas outside their disciplines as reasons for participating. Though these participants did not initially seek out the co-op because of its connection to LAC, they did acknowledge that the ESF/LAC partnership was appealing as well. Both participants used a more exploratory and time-considerate tone when describing choosing the CDP to explore their interests in the industry. Ray expressed:

> I think the main reason for [ESF] was aerospace is very appealing, I think, to a lot of students, especially being a mechanical engineering student. Anything with aerospace is not only something that seems cool to put on the résumé but just a pretty unique experience that's hard to get outside of the co-op experience.

Chloe extended this notion beyond mechanical engineering students when she shared that she chose the CDP because it was "something different and something really interesting that [she] had never considering being in [her] field [of civil engineering]…"

Connection to the large aerospace company. This category captures participants' interest in working for LAC or for a company with a similar profile as a reason for participating in the CDP. This category differs from the previously discussed category because it highlights participants' preferences for working for specific companies, a narrower view than the industry level previously discussed. All participants reflected some level of interest in the connection to LAC as a reason for participation. Several participants described their decision to co-op at ESF as the first step toward their long-term goal of working in the aerospace industry. When asked why he chose to work for ESF, Chris shared, "because I knew I wanted to go work for a big, well-known company. I didn't get a job directly with a big, well-known company, but I knew [ESF] was like a stepping stone in that direction." Jack expressed a similar logic when describing his process of choosing to co-op at [ESF]: "it was a good way to try to get my foot into the door into working for a company like LAC."

All participants in the study identified the connection to LAC as appealing, and each noted LAC's reputation or the consideration of the ESF co-op as a career jumpstart as reason to participate in the CDP.

Summary. The theme *Interest Driven Exploration* highlights preconceptions participants held as engineering students about working in the aerospace industry. Prior to working at ESF or LAC as a co-op, participants held beliefs about what LAC might offer (short- and long-term) in relation to their career goals. Participants also sought to gain exposure to the aerospace industry; the connection to LAC, specifically, was a secondary consideration. These categories converge to the theme *Interest Driven Exploration*, as both point to participants' initial interests as a motivator for exploring the aerospace industry in some capacity.

Theme 2: Characteristics of the Workplace. The theme *Characteristics of the Workplace* encompasses participants' evaluations of specific features of the co-op as decision points to work at ESF. Participants based their evaluations on information they received during their co-op search or on their experiences with ESF during their first co-op rotation. As shown in Figure 1, the theme was comprised of two categories: elements of the co-op environment, and location. One participant additionally expressed that working with LAC would lead to a higher salary when compared to other positions in her field. Noted in Table 5.1, five participants expressed *Characteristics of the Workplace* as a part of their decision process for joining the CDP.

Elements of the co-op environment. Six participants expressed reasons for participating that reflect elements of the co-op environment. Participants expressed types of work assignments, workplace climate, and anticipated company benefits as reasons to participate. Both first time and second cycle co-op participants expressed a desire to work at ESF because of the types of projects they would complete. Two first time participants noted their desire to gain "real world design experience" as a reason to co-op at ESF. Returning co-ops discussed a desire to continue work on specific projects from their first co-op rotation. Ray expressed:

> Overall, I think that was kind of a reason why I wanted to go back just [be]cause I knew I was already doing some pretty cool stuff and that if I was to return to LAC I could jump straight into that higher caliber work versus having to start from the bottom again which a lot of the guys I know had to do.

Although project work led some participants to return to ESF, others decided not to return because of the work assignments. Chris chose to work directly with LAC for his remaining co-ops because LAC offered "cool" projects in contrast to the ESF. Abigail and Carter opted not to return for a second co-op experience with the ESF (or LAC) because their interests did not align with their work assignments during their first co-ops. A distinct aspect of interest in this theme versus interest previously discussed in the *Interest Driven Exploration* theme is that the interest highlighted in these remarks relate directly to elements of the co-op environment, not overall interest in LAC or in the aerospace industry. The link between interests and elements of the co-op environment is further discussed in the context of research question three—linking learning experiences to beliefs about engineering work.

Location. Participants additionally referred to the location of the co-op as a reason for participating in the CDP. Three participants valued the close proximity of the workplace and the opportunity to work at multiple locations (i.e., on site at LAC manufacturing facility or at the Academic Design Center at the downtown city center). Location also served as a reason not to participate, as one student discussed not returning to ESF for a second co-op to explore a different geographical region since he had grown up in the city where the co-op occurred. Another participant shared that not having to "uproot" and make long daily commutes to nearby cities was an attractive reason to participate. In addition to proximity, participants valued the options to work either downtown or on site at a manufacturing facility. Cobb summarizes this view when sharing his appreciation for having a choice of where to work and expressed that to work on "the 13th floor office" and have the opportunity was "just a totally new experience for a college kid."

Summary. Theme two, *Characteristics of the Workplace*, captures how participants used information they received during their co-op search and prior ESF co-op experience to evaluate specific features of interest of the ESF and LAC. Participants looked beyond their interests in the aerospace industry—considering the specific types of work assignments, location, and workplace climate—to decide whether to participate in the CDP. The first category (elements of the co-op environment) captures internal features of the co-op, and the second category (location) captures an external feature.

Theme 3: Convenience. The final theme for research question one, *Convenience,* encompasses participants' statements about limited opportunities during their job search, the likelihood of obtaining an offer through the number of opportunities available, and the ease of returning for a second rotation in the Co-op Development Program. This theme developed from two categories: Forced Option and Availability of Offer. Four of eight participants discussed elements captured by this theme (see Table 5.1).

Forced option. Some participants had a single offer from ESF and by nature of the mandatory co-op program at the university, took what was immediately available. Data in this category highlight the acceptance of a co-op offer with little to no consideration of a second option. As a first time co-op student, Drew was unable to be very selective in his decision and admitted, “I took whatever I could possibly get.” Jack, who had faced challenges in his first co-op job search, expressed a similar idea when considering ESF for his second co-op. Because of his prior experiences, his tolerance for taking a chance was lowered, and he opted to have a guaranteed option over a potential opportunity. In his discussion, he noted features of the university co-op system that impacted his decision to participate in the CDP:

> Actually, [ESF] was the only interview I got…I really struggled to get interviews. My first 3 co-op cycles in college, they were the only ones that offered me an interview and I went on interviews, I applied but nothing hit. Really, [I’d] either take ESF job in round A, the first co-op cycle, or roll the dice in another co-op cycle where potentially other people on that wait list that I mentioned (where if other people were [ESF’s] second round pick, they could come in and take my position) and I'm waiting for the Large Aerospace Company offer that may magically turn up, but to me, a guaranteed on something that I wasn't necessarily familiar with. I didn’t necessarily know the company too well was worth rolling the dice for a better job.

Availability of offer. Other participants expressed the notion of convenience via the availability of the ESF co-op offer. A distinct aspect of this category is that participants may have had more than one option, but the accessibility of the offer made it an attractive option. Chloe expressed her gratitude for ESF managers providing access to the co-op because she did not believe she was a typical candidate for the position:

> It is hard to get in with a civil engineering degree, for example. Well I don't know hard, but it might be harder than from mechanical or aerospace [engineering]. That was my thought process when I was interviewing and I thought, "Wow, this would be great." I can actually get in. And they’re saying in the interview, it’s totally fine with them. Civil engineering doesn't really matter. A lot of skills you acquire on the job.

Ray described his decision to participate within the context of the number of available positions advertised by ESF in relation to other companies offering aerospace related co-op assignments:

> [Be]cause there were other opportunities, other co-op programs through the Large Mid-Atlantic Private University that were, in some way, related to aerospace but the Engineering Service Firm was just hiring so many of us, they were making it a lot easier to land a spot. [be]cause trying to get a co-op position with someone else where they

might have one to three openings versus ESF which, my first time around, they hired over a dozen of us. So, that was a lot easier to go through them.

Summary. Participants' reasons for selecting the Co-op Development Program because of convenience highlight the impact of external factors on their decision process. In some instances, participants had limited co-op offers and accepted a guaranteed opportunity as opposed to waiting for another option. Other participants joined because the co-op was more accessible with respect to the number of job openings, and management opened co-op roles to applicants across all engineering disciplines. Together, the two categories highlight accessibility and availability as measures for convenience when describing reasons for participating in the CDP.

Research Question Two: What learning experiences did engineering graduates encounter during co-op rotations in the CDP?

Four themes were identified following data analysis addressing research question two: 1) *Directing Self through Discovery*, 2) *Building Professional Connections*, 3) *Sharing Knowledge with Peers*, and 4) *Receiving Guidance*. Figure 5.2 highlights the categories that contributed to each theme, and Table 5.2 illustrates how multiple participants' perspectives contributed to the development of each theme—providing a visual representation of how themes are represented across interview participants. It also displays how often a participant mentioned elements that were associated with a specific theme. As noted in Chapter 3, mentions were measured as distinctive complete thoughts within a category.

Guided by Social Cognitive Career Theory, learning experiences were viewed as activities in the Co-op Development Program related to the goal of working in engineering full-time. Participants identified a range of activities as learning experiences that were grouped and summarized to develop each theme. Learning experiences were defined through the views of participants and considered "processes" (rather than outcomes) that aligned with Lent et al.'s definition of learning experiences. When a participant identified a learning outcome, they were asked to describe the process through which they developed that outcome. Based on participants' descriptions, learning experiences involved acquiring and/or developing knowledge, skills, abilities and ideas about full-time work in industry during the CDP.

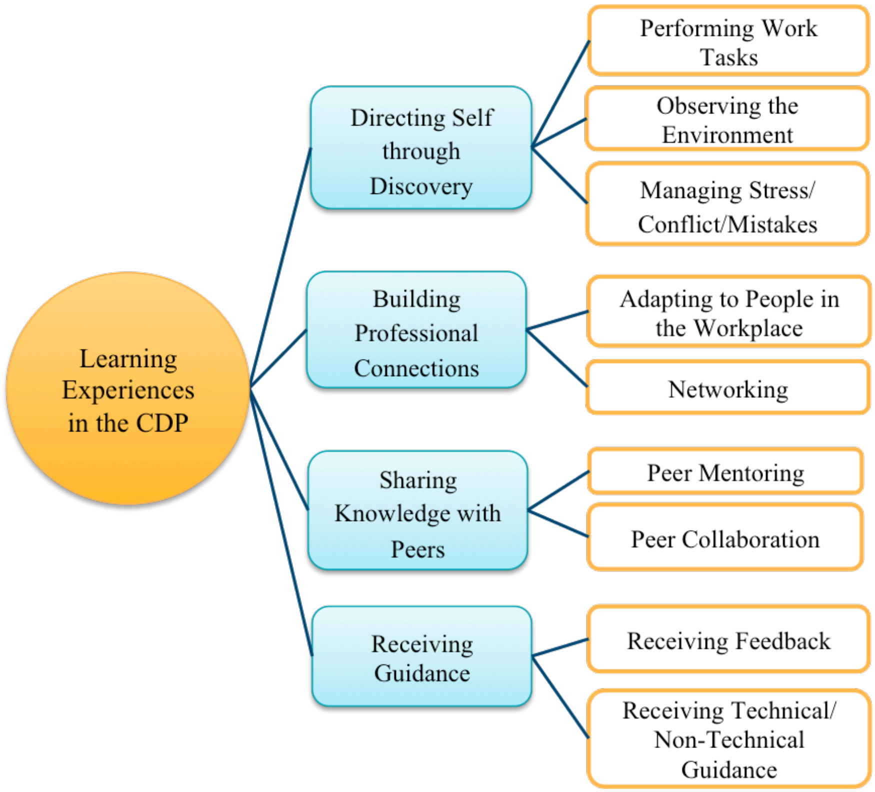

Figure 5.2. Visual diagram to represent themes that denote learning experience

Table 5.2.

Number of mentions per interview participant for Research Question 2 Themes

	Research Question Two (Learning Experiences)			
Participant	Directing Self through Discovery	Building Professional Connections	Sharing Peer Knowledge	Receiving guidance
Chris				
Chloe				
Carter				
Cobb*				
Abigail				
Jack*				
Drew*				
Ray*				
*Participated in 2 co-ops with ESF				
Shading denotes number of distinct mentions (coded at the level of the complete thought)				
	4+ mentions			
	2-3 mentions			
	1 mention			
	No mention			

Theme 1: Directing Self through Discovery. Seven participants described learning experiences in the CDP aligned with the theme *Directing Self Through Discovery*. The theme highlights experiences in which participants employed a sense of agency to complete work tasks. Participants described activities that grouped into three conceptual categories: performing work tasks; observing the environment; managing stress, conflict, and mistakes. Table 5.3 maps these conceptual categories onto concrete learning experiences (i.e., activities) discussed during the interviews. Each concrete learning experience appears in only one conceptual category.

Table 5.3

Mapping of Conceptual Categories with Concrete Learning Experiences

Conceptual Categories	**Concrete Learning Experiences**
Performing work tasks	• Contributing meaningful work • Reworking assignments • Presenting solutions • Performing work tasks • Asking questions • Self teaching • Searching for answers
Observing the environment	• Noticing interactions between engineering professionals • Acknowledging the facility layout
Managing stress/conflict/mistakes	• Breaking the rules • Dealing with fear • Taking a misstep • Taking on responsibility • Working under pressure

Performing work tasks. Participants' perceptions related to performing work tasks were captured via two sub categories: exploring independently, and completing work assignments. Participants described learning experiences where they proactively guided their own inquiry by asking thoughtful questions, searching multiple resources for answers, and teaching oneself. Chloe offers an example of these experiences as she discussed closing her knowledge gap in composite materials during the Co-op Development Program:

> Asking tons of questions to everyone involved. Going through all the documents possible and just reading through them and trying to understand what to do. … We had no clue. I believe mechanical engineers were in exactly the same boat. You don't really study

> composites in college. I think we do more now in some colleges more than others. But it was definitely new... If I don't know something, I have to ask someone who knows it.

Participants also referenced activities necessary for performing work. They placed value on experiences that allowed them to develop skills they could use in the future as well as experiences that generated a meaningful contribution. For instance, Abigail discussed the value of presenting solutions during her co-op as she was able to use those skills when she returned to her university. Ray highlights the intersection of exploring independently and completing work tasks when he emphasized the value of two co-op experiences:

> I'd say the most meaningful experience I had through both co-ops was, at the end of my second co-op, was pretty much a culmination of all the work I had been doing. So, first co-op I got exposed to stress analysis and some of the tools LAC uses, second co-op I was actively using them, writing reports. And by the end of my second co-op, I had produced a section of the repair manual. Seems pretty minor, but I got to put my name on the analysis for a couple of brackets. So, if it does ever get damaged, they'll have to refer to my work, so I think that was the biggest thing is I know that someone out there will have to use the work I've done someday. Versus a lot of the stuff that I did in my first co-op or... While it is work that needs to be done, I know most of it is just due to the size of the corporation. And this is just work that someone has to do 'cause it needed to be done, but no one is ever really gonna need to refer to it. So, first co-op, a lot of the stuff I did I felt like it was necessary but it wasn't as important as the second one, where I know someone will eventually look at what I did...Not for just reviewing it but someone will actively need to use the stuff I've written.

Through multiple activities, Ray gained an appreciation for his individual contribution to the larger scope of the work at LAC. This category captures participants' descriptions of how they approached completing work tasks, the independent nature of the work tasks, and the contribution that resulted from their work in the CDP. Through searching for answers independently or recognizing their contributions as meaningful, participants identified performing work tasks as activities that afforded them the opportunity to engage in self discovery.

Observing the environment. Participants also described learning experiences that involved observing the environment. This category captures how participants absorbed information from watching the facility run and professionals interact. Several participants spoke about how simply being in the manufacturing facility or in the office environment generated memorable experiences. Abigail described how her observation of the number of females in the work environment was a learning experience. She was able to compare the number of females she had seen in the university setting to the number she saw in the work environment:

> I actually thought that in my classes and stuff at [Large Mid-Atlantic Private University], I wouldn't say there was a lot of females, but there was a few of us. I think I saw less when I actually got into working. I think that, that was a little bit more shocking. I felt like there was not a lot, but a decent amount, you could say. Then actually getting into work I think in my first co-op I was the only female in my office. I think it was a little shocking to see how little or how many females there actually were, which was a small number.

Other participants similarly noted learning more about LAC through observation. Jack noted several realizations he gathered from observing the environment. He shared, “LAC was not just a skyscraper. It's a series of buildings. They have a hangar and the engineers work right next to the hangar.” By taking notice to the facility layout, Jack began to form beliefs about how people interact and function in the engineering workplace. Ray noted a similar observation when discussing his decision to work for a different industry full-time. He stated that “seeing how the engineering leads, how their interactions with the managers are, and what their daily work load is like… I just wanted to see what else is out there…” Ray observed engineers’ day-to-day interactions and determined that he should explore a different opportunity. The idea of translating observations in the workplace to beliefs about fit in a related full-time career is further discussed in context of research question three—linking learning experiences to beliefs about engineering work.

Managing stress/conflict/mistakes. Participants also discussed *Directing Self Through Discovery* as experiences that required them to experience stress, navigate conflict, and acknowledge mistakes made during their co-op work assignment. Participants described activities in which they felt fear, took a misstep, took on additional responsibility, and worked under pressure. Cobb highlighted a moment of internal conflict that aroused an emotional response when completing a work task:

> I did one little side project where I did analysis of some of the materials they were going to try to use for a future aircraft. It was a little analysis spreadsheet thing and you could see that 90% of the test samples had failed, and I was thinking to myself, "Oh man, I don't want to fly on this aircraft any time soon till I figure out how to get this done." At that level it definitely opened it up to survivability, the whole worry and responsibility. Like I'm building this part and it's going to fly and in this case it's going to carry soldiers into battle and it needs to be good. If you mess up, then it will trace back to you.

In a moment of self-discovery, Cobb learned to place a high value on his work after learning the broader implications of work in the industry. Participants also identified initial moments of balancing multiple projects as exercises of managing stress and conversations with supervisors about unmet expectations as opportunities of learning how to navigate conflict.

Summary. Nearly every participant in this study discussed some type of self-directed learning experience when reflecting on his or her time as a co-op in the CDP. Participants discussed performing work tasks, observing the environment, and managing conflict/stress as moments that fostered self-discovery. In each category, participants noted working or making a decision independently, which fostered a moment of self-reflective learning. In exercising self-agency, participants actively created and guided themselves through unique learning experiences and were able to experience the results of their decisions.

Theme 2: Building Professional Connections.

The theme *Building Professional Connections* describes participants' descriptions of learning experiences that involved interacting directly with engineering professionals. Participants described these interactions as moments in which they learned how to fit in the environment or as moments whereby those relationships allowed them to build future connection opportunities. This theme does not include isolated participants' interactions with professionals for the exchange of technical or work related information, but instead encompasses the relationship-building element between professionals and co-op students. These interactions highlight the recurring nature of professional interactions and the time needed to pursue these relationships. The theme emerged from two categories: Adapting to People in the Workplace (i.e., acting as a team member, adapting to different personalities) and Networking (i.e., making an impression and personal sharing). As noted in Table 5.2, half of the participants recognized the need to build professional connections to gain industry insight and network for full-time roles.

Adapting to people in the workplace. When discussing their co-op experiences, CDP participants called attention to the need to adapt to different personalities in the workplace as well as understand underlying tension experienced in some interactions. Carter highlighted the activity of learning to work with others and the ways he progressed through these interactions in both the office and manufacturing setting:

> The process and having to learn and meet everyone at the design center and then going to [the manufacturing facility] and meeting everyone there. It definitely teaches you to adapt to different people and bring that into other work environments. How does it teach you to adapt? You just see what works and what doesn't. You see if you're starting to build relationships, or if you're having good communication with another person right away. Just non-verbal cues, verbal cues, and you adjust yourself accordingly to create a copacetic work environment. Some people don't care as much, but you look to gain that acceptance as you go on. I would say I'm more like a pleaser. When I come in I try to overwork to please everyone around me to show that I'm devoted to what I'm doing. That's something I think I did probably with [ESF].

Jack also voiced his experiences in adapting to engineering professionals as a similar process; he added, however, that not all of his interactions were ideal. He spoke of feelings of hostility or competitiveness that he believed influenced his exchanges with professionals. While at the manufacturing site, Jack discussed the valuable access of having engineers in close proximity and vocalized his viewpoint of the challenges he faced when building relationships with LAC engineers:

> The one thing about that though was we were the new guys. I feel like we weren't necessarily accepted into their cult yet just because they were older engineers. Every one of them seems to be over 50 or over 60 and it was a sense of, "We are here to take your job." At the end of the day, they're right, but there was definitely some hostility, so they would help us out but you could tell they weren't necessarily giving us all the information. They were definitely holding out so maybe their design could be better or something along those lines, so if you really wanted the full information, you ended up going to this one LAC direct hire who was there who was the lead, and maybe he felt

> comfortable that a new hire wasn't going to take the lead position. But either way you would go, you would interact with them. Work or chat, things like that, but at the end of the day, we didn't necessarily feel 100% included in LAC culture even though we were there and it definitely made an impact.

Networking. In addition to adapting to work within the corporate culture, participants discussed networking as an act of building professional connections. The distinct aspect of this category is that it focuses on specific moments that generated relationships during which participants built future connection opportunities. Drew identified a learning experience as networking when he took the initiative to take on project work outside of his assigned workgroup to build relationships with engineers that could lead to full-time employment. Another participant discussed networking from the perspective of building professional connections via small talk, story-telling, and personal sharing. Jack discussed the importance of leveraging his personality to build connections with hiring managers and supervisors:

> I know far and away that I was not the best engineer. No question… but I used to be able to hang out and go into [the Program Manager's] office and have a conversation with him for 10, 15 minutes and we both walk out laughing. I knew that I had a great interaction with…the three individuals that you need to get a job.

Through the CDP, participants established connections with full-time engineers as a means to expand their professional networks and, in some cases, to be considered for full-time employment with LAC or ESF.

Summary. The theme *Building Professional Connections* captures participants' discussions that highlight relationship-building interactions between engineering professionals and co-op participants. Participants articulated that adapting to people in the workplace (e.g., acting as a team member within a group of engineering professionals) and networking by making an impression and connecting on a personal level were processes that helped to establish relationships with engineers in the workplace. By actively engaging with engineering professionals, participants came to value the importance of making connections in the Co-op Development Program as well as the future workplace.

Theme 3: Sharing Knowledge with Peers. Another theme identified during data analysis is *Sharing Knowledge with Peers*. Participants identified experiences of interacting with their peers (i.e., other co-op students) to discuss their work and complete work tasks through shared knowledge. The first category, peer mentoring, captures activities that involve a more experienced participant training or guiding a less experienced participant. The second category, peer collaboration, includes activities of peers working together and sharing perspectives to complete work tasks regardless of the level of experience. Four participants expressed the value added to their experiences by having peers in similar circumstances or having access to a more experienced peer whom they could ask for help.

Peer mentoring. Several participants discussed experiences during which peers provided the technical knowledge they needed to complete work tasks and how peers were able to connect them with the proper resources and people to support their work. One participant, Abigail, explained the role that a returning co-op student played in sharing knowledge:

> The person we actually communicated with the most was another ESF co-op who had worked for ESF previously as a co-op. He was in his second term for ESF, and so he had been working with LAC people and at LAC facility for his first co-op as well. He just was continuing his previous work, and we were helping him out. He was actually both of our "go-to person" [i.e., a problem solver, helpful resource] to work through things. He had a really good handle on how LAC operated and what we should do and how to push us to work harder. I thought that was good.

Participants also shared the perspective of serving as a peer mentor. Drew described his experience in the context of helping a group of 7-10 co-op students learn design-based software:

> … I was helping a lot of them learn the [design software]. I grew into this, I guess, mentor where I was helping each one of them out and learn the software and learn the ins and outs of the program, and what's expected of you kind of thing.

In sharing his knowledge, Drew was able to gain additional experience using the software while advancing the knowledge of peers. Carter similarly discussed the mutual benefit of peer mentoring when he noted that his communication skills improved when he successfully trained a peer he considered much smarter than himself.

Peer collaboration. In addition to peers sharing knowledge across experience levels, participants also discussed working in groups with peers and working together as first time co-op students to solve problems and discuss trouble spots, stimulating closer connections with peers that in some cases led to long-term friendships. Such discussions were not structured by program managers but primarily occurred informally and were student driven. Abigail highlighted the casual, yet valuable, environment the CDP fostered allowing peers to share their knowledge:

> A lot of us knew each other before we ever had the co-op. I thought that, that was good. We had lunch together everyday, and we got to talk about our work and what each other were doing and stuff. I think that, that was really good. It gets you talking about and critically thinking about the work that you're doing. When you get to talk to someone else who's in a similar boat to you, working on different projects and stuff, they get you thinking about different ways to look at situations or they may give you ideas of how to improve something. I thought a lot of interaction with them made me better at my job, I felt. I thought that was good.

Participants also described working with their peers to quicken work tasks as well and to brainstorm potential ways to approach a problem when they could not identify how to start work on an assignment.

Summary. *Sharing Knowledge with Peers* surfaced as a theme that describes learning experiences in which peers initiated learning amongst themselves. Through peer mentoring, participants shared knowledge across experience levels and provided and/or accepted guidance to complete work tasks. Via peer collaboration, peers worked together and shared perspectives to complete work assignments. The commonality between both categories is the engagement of peers in the problem solving process for support, idea sharing, and gathering technical knowledge.

Theme 4: Receiving Guidance. The final theme for research question two is *Receiving Guidance*. Similar to *Building Professional Connections*, this theme describes participants' interactions with engineering professionals during the CDP. The distinction is that *Receiving Guidance* involves interactions focused on the receipt of information (i.e., participants' received feedback or guidance on technical or non-technical work related experiences), whereas the former category focused on the relationship-building element between professionals and co-op students. In their dialogue, participants discussed how they developed meaning from the information they received from engineering professionals with no reference to building a relationship with the professional. All co-op participants offered examples of experiences of receiving advice on career next steps, having their work performance critiqued, or receiving one-on-one technical instruction.

Receiving feedback. This category includes participants' descriptions of receiving feedback following a high stakes presentation or completing a major project. Three participants discussed these moments as learning experiences and reflected on how those experiences led to a learning outcome. A distinct aspect of this category is that it is linked to a specific event, not general or unsolicited feedback of day-to-day performance. Several participants identified experiences that involved receiving feedback for a job well done following an accomplishment. No participant described an event in which they received feedback indicating they did a poor job. Although participants may have self-selected to share positive examples of their experience, data do show that participants were open to sharing negative experiences when reporting missteps/mistakes as discussed in the *Directing Self through Discovery* theme. Rather, in this theme participants described learning experiences in which upper management provided encouraging feedback on their performance. Chloe, for example, spoke of an experience in which senior managers at LAC acknowledged her work:

> And they also did recognize our work which was really cool. No one expected that…I mean we got a mug. But we did get called out in the meeting. In an LAC staff meeting we got called in and they actually said, "Hey thank you guys for your help." I think it was actually, I already forget, but I believe he was a manager or someone from [Corporate] because we were working for an [Corporate] team in [Corporate Location]. Like our team was helping with that. They actually stood up and said, "thank you everyone, thank you ESF co-ops." We got a mug and stuff, and we got a handshake. (laughs) It was awesome. For a co-op, I thought it was wonderful.

Cobb also described an experience of receiving feedback following a presentation to upper management. Prior to Cobb's presentation, LAC managers had made complaints about the ESF working group because LAC and ESF were having a dispute about design parameters. Eventually, a meeting with LAC and ESF stakeholders was held to settle the disagreement, and Cobb was selected to represent the ESF working group in the discussion. Cobb described the opportunity as a valuable learning experience that provided him with the opportunity to receive direct feedback from members of the management team:

> I just talked through the process that we did and LAC people talked through their process and it all went to the section manager. At the end of it he finally came up with, "No, the ESF guys are doing this right, my people are doing it wrong. You're checking

> against the wrong thing that ESF is making." That was just an amazing experience. He didn't dismiss me as a kid coming in here and he was a veteran, he was a 30 or so, almost ready to retire veteran of LAC. For him to take all the facts, not completely dismiss it, say, "Hey, yeah, the ESF guys, you co-op guys, you guys are doing good. Keep going, this is what we want you to do. I just need to talk to my guys, that they need to get on the right page."… that's when I knew I had really made an engineering career.

Both Cobb and Chloe described experiences of having their work performance evaluated by engineering professionals after a major assignment as learning experiences. Chloe experienced a moment of unexpected recognition and learned that her work was valued, and Cobb alluded how receiving feedback on his performance strengthened his beliefs about working as an engineer full-time.

Receiving technical/non-technical guidance. In addition to participants' discussions of receiving feedback following memorable high stakes performances, the second category contributing to the theme *Receiving Guidance* encompasses participants' discussions of receiving guidance related to routine or daily activities. Seven participants noted receiving training on software, troubleshooting technical issues, as well as career advice as activities in this category. Notably, participants cited receiving guidance more often from engineering professionals in their working groups at ESF and LAC and less frequently from their direct supervisors. Drew illustrates this finding when discussing the guidance he received during his co-op:

> Well, I worked with everyone in my group. I guess there was a group of... 1, 2, 3 ... Let's just say that I dealt with a group of primarily five people. There was my lead who I interacted with on a daily basis. He was basically the one who was assigning tasks to me and I would be asking questions, but the person that I worked with primarily is another engineer who basically taught me everything I need to know about aircraft design and processes and certain kinds of tools. Everything that I would need to know in order to do the job. There would be like best practices for design, what to do/what not to do, kind of thing.

In addition to technical guidance, participants described receiving valuable career advice that helped them consider future pathways. Ray notes this while also calling attention to the relationship between experience (i.e., time in the workplace) and the type of guidance he received from a co-op supervisor at LAC:

> As we were leaving, he was there to help us boost our resume, tell us just some clear advice on what we should be thinking about, what we should be trying to do. So, there's definitely some mentoring, especially towards the end as you're wrapping up your second co-op. First co-op, though, in terms of mentoring there's not as much, [be]cause I guess as a majority of that co-op they're just trying to teach you what you need to be doing. [Be]cause there's so much to learn from just acronyms that LAC uses to LAC standards, there's a ton of information that they're more worried about making you learn than actually helping you on a personal level [be]cause that comes second I think.

While Ray suggests that feedback is linked to mentoring and occurred late in his co-op program, other participants described receiving guidance during their first co-op with ESF. Undoubtedly, guidance will vary across engineering professionals and will vary in length and depth; however, these data suggest that participants recognize opportunities to receive guidance and use that information in their decision making as a learning experience.

Summary. Theme four encompassed learning experiences that allowed participants to process information about their performance and/or receive guidance from engineering professionals. The two categories focus on participants' ability to self-reflect on their performance and include processing feedback encountered after high-stakes events, routine work assignments, or career next steps. To engage in self-reflection, participants processed their own performance in conjunction with the feedback of others to establish beliefs about their abilities to perform the task or the expected outcomes of performing similar tasks in the future.

Managers' versus Participants' Perceptions of Learning Experiences. To triangulate these findings within the broader context of the CDP, I compared these learning experiences highlighted by participants to managers' perceptions of learning experiences (summarized in Figure 5.3 from Young et al., 2016). This comparison highlights intended learning experiences (manager's perspectives) versus actualized learning experiences (participants' perspectives) and provides context to support the in-depth description of the case study. Similarities across the two perspectives provide evidence suggesting that participants encountered the intended experiences set forth by managers. Beyond that, however, the identification of experiences outside of the managers' perspective highlight why it is important to take into account students' perspectives in exploring how CDP learning experiences influence career decision-making during and post co-op. For this discussion, participants' experiences are described at the category level to note the details of the learning experiences.

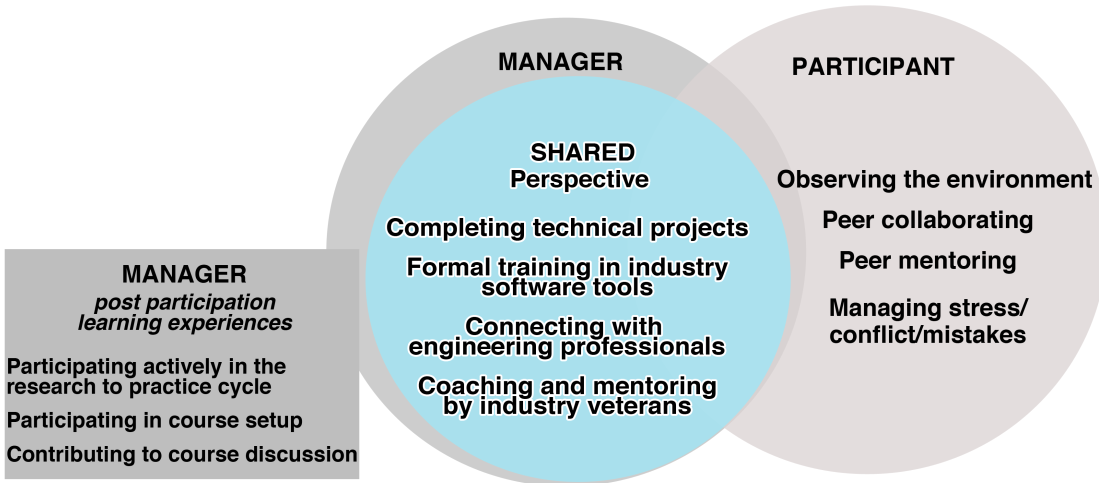

Figure 5.3. Learning experiences identified by CDP managers, participants, and the level of similarities and differences across the two perspectives

Managers identified learning experiences occurring across two time points: during co-op experiences and post co-op learning experiences; students primarily identified experiences that occurred during the CDP and did not discuss post co-op learning experiences in a similar manner as the managers. Notably, participants were not asked to detail post co-op learning experiences since the focus of this case study was on the CDP and its industrial context. Also, on-site co-op experiences have not been well defined in co-op literature (Gilmartin, Antonio, Brunhaver, Chen, & Sheppard, forthcoming; Ricks, 1993). Still, some participants did refer to experiences in the university setting post co-op. For instance, one participant referenced returning to school with advanced Microsoft Excel skills and noted utilizing those skills in group project work. Another participant discussed selecting a communications minor when returning to the university, which she identified as a personal growth opportunity to further develop skills she identified as essential during her co-op experience. These examples highlight the application of learning outcomes from the co-op experience in the university setting; however, these limited instances of participants' post participation learning experiences do not provide sufficient evidence to suggest that the managers' perspectives of such activities were experienced by participants.

The most inner circle of Figure 5.3 highlights similarities in participants' and manager's views and indicates that all learning experiences identified by managers indeed were identified by participants as well. Managers identified completing technical projects as a learning experience, which parallels to participants' discussions of performing work tasks (see theme one of research question two for the extended student perspective). Additionally, managers' descriptions of formal training in industry software tools aligned with participants' discussions of participating in training sessions as well as training peers (see theme 2). Next, both groups identified connecting with engineering professionals as learning experiences. Students described moments of receiving technical/non-technical guidance, adapting to people in the workplace, and networking (discussed in theme four of research question two); those findings paralleled the managers' perspectives of co-op students connecting with engineering professionals. Lastly, participants revealed experiences that aligned with managers' identification of coaching and mentoring by industry veterans as learning experiences. Participants discussed receiving advice on career next steps, experiencing work performance critiques from top managers, and receiving one on one technical. While managers described the coaching and mentoring experience as intentional and formally structured activities, participants primarily perceived coaching and mentoring sessions as informal and naturally occurring.

Differences in perspectives were highlighted as participants discussed learning experiences in a more nuanced way—they pointed to learning experiences that were not mentioned by managers to emerge. Participants emphasized sharing knowledge with peers via collaboration and mentoring as well as observing the environment and managing stress/conflict/mistakes as learning experiences as all influencing their career decision-making. It is possible that managers assume such experiences inherently occur as a byproduct of completing project work. However, since multiple participants discussed the experiences, findings signal opportunities for managers to gauge the current state of the CDP and evaluate opportunities to leverage and support those additional experiences more intentionally.

Together, both the manager and participant perspectives articulate learning experiences during CDP and highlight the unique contribution of this study to provide operationalized definitions of co-op learning experiences. Triangulating participants' reflections with manager's perspectives provides additional context for readers to gauge the transferability of this study to similarly structured student work programs and, in practice, allow managers to evaluate the execution of program activities.

Research Question Three: In what ways do engineering graduates believe their learning experiences in the CDP influenced their outcome expectations (i.e., beliefs about pursuing engineering industry positions full-time) and subsequent thinking about their career?

Four themes were identified following data analysis for research question three: 1) *Defined Spectrum of Engineering Work,* 2) *Prepared to Pursue Full-time Work,* 3) *Validated Industry Pathway,* and 4) *Redirected Industry Pathway.* Figure 5.4 highlights the categories that contributed to each theme, and Table 5.4 illustrates how multiple participants' perspectives contributed to the development of each theme—providing a visual representation of how themes are represented across interview participants. It also displays how often a participant mentioned elements that were associated with a specific theme. As noted in Chapter 3, mentions were measured as distinctive complete thoughts within a category.

Themes discussed in this section illustrate the impact of learning experiences (as identified in research question two) on participants' outcome expectations (i.e., their beliefs about working in an engineering industry position full-time following graduation) and their subsequent career related thinking. Situated in Social Cognitive Career Theory, data analysis focused on identifying links between learning experiences and outcome expectations and their contribution to the development of career interests, goals, and action.

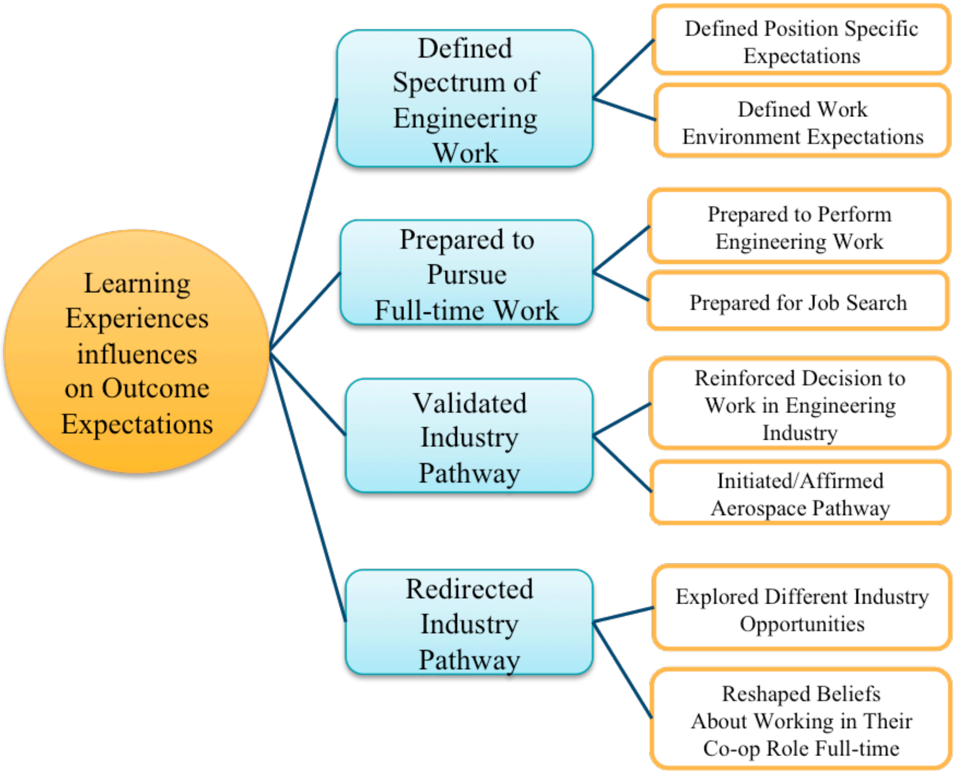

Figure 5.4. Visual diagram to represent themes that denote the relationship between learning experiences, outcome expectations, and subsequent career thinking

Table 5.4

Number of mentions per interview participant, Research Question 3 themes

	Defined Spectrum of Engineering Work	Prepared to Pursue Full-time work	Validated Industry Pathway	Redirected Industry Pathway
Chris				
Chloe				
Carter				
Cobb*				
Abigail				
Jack*				
Drew*				
Ray*				
*Participated in 2 co-ops with ESF				
Shading denotes number of distinct mentions (coded at the level of the complete thought)				
	4+ mentions			
	2-3 mentions			
	1 mention			
	No mention			

Theme 1: Defined Spectrum of Engineering Work. The theme *Defined Spectrum of Engineering Work* describes participants' views of how their experiences adjusted their definitions of engineering during and following participation in the CDP. In doing so, participants made connections between their learning experiences and their expectations of work as a full-time engineer. Participants' perceptions formed two categories: defined position-specific expectations, and defined work environment expectations. Discussions span from work expectations as a design engineer, as a full-time employee at LAC or ESF, and work expectations of the engineering field broadly. All participants mentioned at least one instance of how their experiences in the CDP influenced their perceptions of engineering.

Defined position specific expectations. This category describes participants' beliefs about the role and responsibilities of specific types of engineering positions. As co-ops, participants held stress analyst or design engineer titles. From their experiences, seven participants formed expectations about associated outcomes of holding full-time roles and their individual preferences to perform specific job responsibilities. These findings situate within the theme of *Defined Spectrum of Engineering Work* because participants' understanding of engineering work expanded or was challenged during and following the CDP experience. Consequently, as they learned about the specific responsibilities of a position, participants established beliefs about the type of work they would pursue in the future (i.e., they adjusted their subsequent career thinking based on the position-specific outcome expectations).

In reference to having their understanding challenged, several participants emphasized the lack of "*engineering*" that was involved in their work assignments. Participants contrasted their views of engineering with the work they were assigned, and others bluntly dismissed the work as non-engineering. Carter shared that the environment felt like a "sweat shop for mechanical design work, whereas in an engineering company you may hire drafters to just do purely CAD. That's essentially what they had us doing, and you don't really get an exposure to the engineering process." Drew also referenced his role to have more of a drafting focus than engineering and described his work as "button pushing." Drew challenged the definition of design engineering when he offers a comparative description of "true engineering work":

> For my first co-op [with ESF] there was really... it was just copy and paste, and it was just model conversions, so it was the same repetitious thing over and over and over again. You learn how to do it one way, and you just rinse and repeat and you just keeping doing

> and doing and doing again. For the wire install [during my second ESF co-op], that was more engineering oriented, but it was still drafting work per say. The engineering work that I describe as true engineering work that's not drafting is that you're actually taking apart and you are designing it to include some feature, without some feature, stiffening it or designing it in some way and actually using the knowledge that you gained in school, let's say for instance like mechanics of materials or any kind of manufacturing knowledge that you might have. Using all that to create something, or to design something.

These findings highlight CDP participants' perceptions of engineering work prior to entering the co-op, and the labels they impose on work they feel was incorrectly described as engineering despite having an engineering job title. After two co-ops with ESF, Drew completed a third co-op with LAC directly and eventually accepted a full-time position with LAC with a design engineer title but had different responsibilities than in his ESF co-op. Carter left the industry completely and even rejected an opportunity to discuss a second co-op directly with LAC. He noted, "just having a bad experience I was like, 'You know what? Let me just try to do something else. I don't want to deal with it,'" and opted to not return for a second co-op rotation. He ultimately left the aerospace industry entirely following graduation. Notably, additional factors beyond those discussed in this analysis influenced his decisions to avoid design engineering work full-time; still, the CDP experience was influential as it helped shift his focus from design engineer positions following his initial ESF experience.

Not all participants, however, described their positions as "non-engineering" work. Five participants did not challenge the work but instead chose to expand their definitions of engineering to include the responsibilities included within their co-op work assignments. For example, Jack recognized, in hindsight, the necessity of tedious forms of engineering work, and Cobb discussed having clearer knowledge of the work expectations of a full-time design engineer. Like participants whose views were challenged, they developed beliefs about their future in a similar full-time position. Abigail (a design engineer co-op) and Ray (a two-time stress analyst co-op) noted gaining valuable engineering skills but decided that the position did not align with their longer-term interests. Ray believed that the technical knowledge he gained while at ESF was so specialized that it could only be used if he pursued a career in stress analysis at LAC, which he decided was not a good fit. Abigail described design engineering to be too much desk work, noting her desire to work in the "nitty-gritty in the manufacturing plant."

For both groups, learning experiences that defined position-specific expectations also impacted subsequent career thinking. Chris illustrates this logic when asked to discuss how his ESF co-op influenced his expectations about working in an engineering position after graduation:

> I thought I wanted to be a designer, and ESF gave me a little view into what the design world was like and I realized that wasn't what I wanted to be but I knew I still wanted to be in the aerospace industry. It's either or, you're either design or stress, so I knew I wanted to be the "or" so I got into the stress world. I wouldn't have done that if I hadn't of seen what the design world was like through ESF.

Through learning experiences in the CDP, participants developed beliefs about the roles and responsibilities of design engineers and stress analysts and challenged or expanded their beliefs. Some chose to compare their views of engineering with the work they encountered, and others did not question whether the work was engineering or non-engineering. A consistency across all participants was that their position-specific experiences shaped their subsequent career thinking. With the exception of one participant, all participants in this category believed they should consider a different position in their first full-time roles.

Defined work environment expectations. The second category in this theme summarizes perceptions of the engineering work environment via a system's perspective. The distinction of this category is the development of beliefs about how the workplace functions as a whole and the generalizations of those beliefs to the engineering field broadly as opposed to position-specific beliefs (i.e., design engineer, stress analyst). Four participants discussed a range of work environment expectations including company culture, increased earning potential, and gender representation.

As noted in research question two, Abigail discussed observing only a few female engineers in her co-op work environment. She later linked how the observation shaped her beliefs about the gender makeup of the field following her co-op:

> I think I didn't really understand how many men would be in the field… I think there was 2 other female engineers in that department that I worked in. I think that was always surprising. I think it took a little bit of time to get used to… I think that, that was something that changed my expectation, what I was getting myself into, almost. I think it prepared me a little bit more for what was to come next and what was to come when I finally graduated and got into, whatever field I decided.

Abigail's realization of the small number of women engineers exemplifies the impact that a single experience may have on defining a student's views. Students might extrapolate from and apply what they learned in a single experience to all engineering industry work scenarios. Her realization about the gender makeup did not discourage her from joining the field, however, as she noted that there are even fewer females in her current field.

In addition to considering the makeup of the workforce, participants noted operational components of the work environment. For example, Ray developed beliefs about what it meant to work for a large engineering company during his co-op.

> I'd say the biggest asset was surprisingly just not related to the work or engineering really. It was more just about the corporate structure and the way that LAC works, and just being exposed to a company of that scale was a really beneficial experience…it's pretty invaluable to see the way those companies work and it gives you just an overall better philosophy on life…

Ray continued his discussion by noting his experiences with navigating "red tape" and experiencing slow project timelines. He concludes by noting the necessity of the high level of teamwork and coordination required to accomplish tasks in a large company like LAC. Ray later referenced such experiences when stating that he intentionally targeted smaller companies during his full-time job search to gain a different perspective.

Participants' experiences in the CDP fostered opportunities to examine how the workplace functions as whole. As such, participants developed beliefs about the engineering field as well as company specific expectations. Separate from position-specific expectations, generalizations about the engineering workplace influenced participants' views of full-time work.

Summary. As depicted by the theme *Defined Spectrum of Engineering Work*, participants expressed how learning experiences encountered during the CDP influenced their expectations of engineering work at several levels. Participants developed beliefs about the roles of design engineers and stress analysts, general engineering work tasks, and characteristics of the engineering work environment. These definitions, in turn, shaped participants' interests and goals following their co-ops and contributed to their choice actions to remain in engineering industry following graduation.

Theme 2: Prepared to Pursue Full-time Work. The theme *Prepared to Pursue Full-time Work* also emerged from data analysis, as participants' beliefs about their preparedness to work in industry full-time solidified following their co-op experience at ESF. Participants discussed developing needed skills for full-time work, gaining confidence in their abilities to perform in the workplace, and emerging insights to apply to their full-time job search. Two categories, represented across six participants, emerged in the analysis of participants' narratives: prepared to perform engineering work, and prepared for the job search.

Prepared to Perform Engineering Work. When asked to reflect on how their experiences shaped their beliefs about working in engineering full-time, participants expressed a new or heightened understanding of their abilities to perform in an engineering role. Participants reflected on how learning experiences as a co-op student served as a training ground that prepared them for full-time work. Five participants highlighted this relationship. Cobb referred to juggling multiple time sensitive projects as "opportunities for students to become professionals if they could crack it." For Cobb, being able to handle the pressure of work tasks as a co-op student was evidence of his readiness to complete projects successfully as a full-time engineer. Chloe similarly discussed feeling prepared following her co-op as she described the value of co-ops broadly and the unique opportunity she received at ESF:

> First of all, I think that co-ops are awesome because I, as a civil engineer, never knew that I would be interested in aerospace. I had a hunch, and that was it. I would've been too scared to just switch. I would've been too scared to apply, you know, graduate [and] just out of the blue apply to an aerospace engineering job. I had no idea that I could do that. Doing this co-op did show that, 'Yes I can do this. I can work really hard and actually do this. And I have a chance of getting a job there.' That was a great feeling.

Both Chloe and Cobb sought out full-time positions with LAC following their co-op experiences. Chloe completed a second co-op with LAC and accepted a job offer with LAC during her senior year. Although Cobb did not complete a co-op with LAC, he was interested in working with LAC full-time. Unfortunately, Cobb was unable to realize his goal because of an LAC hiring freeze and accepted a full-time role with the ESF as a first step for his post-graduation employment.

Participants also recognized their preparation for full-time work by noting how their communication and leadership skills developed during their co-op as well as understanding the necessity of these skills for success in the workplace. Cobb referenced the noticeable growth he experienced in his communication skills and how his full-time work was affected:

> If I did not have the professional development that ESF provided, I definitely would have struggled early career-wise. The ESF time and the face-to-face customer interaction, the email interaction, the etiquette interaction, all led me to a better and faster transition to the professional working world. If I was still the college kid coming off with an attitude or whatever, it definitely would have been a rougher start and especially in the interview process.

Both Chris and Carter expressed the value of communication skills as a vital component of a young engineers' career readiness for a full-time position in industry. Chris referenced his increased comfort in talking with people from different backgrounds in professional settings following his co-op at ESF. Carter echoed this comment by saying that "everybody learns and receives differently," and noted the importance of adjusting to different personalities and learning to send emails and communicate effectively in meetings during his co-op. He also noted that "not everybody has the same engineering mentality or engineering process" and that his co-op reinforced this idea and provided insights into the level of communication needed for a successful full-time career.

Prepared for job search. Participants also shared that they believed their co-op at ESF prepared them for a more pointed job search. Six participants discussed how their learning experiences in the CDP shed light on job market expectations, provided advanced knowledge of the job search process, and shaped the types of positions they explored. Ray shared that his experiences in the co-op helped him target his job search:

> [Be]cause I really don't [know] what I would've been like or what I would've been thinking upon graduating without having any actual engineering experience. [Be]cause looking for a job, I would have no idea of the kind of industry or job I wanted to go into. So co-ops definitely helped me, not nail it exactly what I wanted to do, but come pretty close to finding an industry I wanted to work in.

Cobb shared that he was more informed during his search because he knew what to expect after completing work assignments and building professional connections at ESF:

> The ESF knowledge of, 'Hey, this is what a design engineer does and from networking and knowing people at LAC.' Like, 'Hey, what is your role? What's your everyday?'

> Definitely provided a lot of experience, what to expect from the job market and expect from individual jobs that were out there.

Additional participants discussed preferences for the type of employer and work assignments they would look for in full-time industry positions based on their experiences during the CDP. In some cases, identifying poor fit with some work tasks helped participants understand and articulate their needs. Drew expressed a disinterest in working for a large contracting firm because he believed they got "unfavorable" work, and Ray expressed his desire to work on non-proprietary work to support a healthy work-life balance. In this way, participants entered their job search with specific criteria that aligned with their interests in working in particular kinds of environments.

Participants translated the knowledge and accomplishments gained during their co-op assignments to job search criteria. Participants believed they had a better understanding of the field and work expectations, which proved to be valuable to participants when considering next steps post-graduation.

Summary. Six participants mentioned beliefs related to feeling prepared to pursue full-time work following their co-op experience at ESF. Participants developed or heightened their understanding of their abilities to perform in an engineering role and identified career ready skills and relevant knowledge to target their job search. Such understanding allowed participants to believe that they were prepared to pursue full-time work. Chloe and Cobb connected their beliefs to their goals of working with LAC full-time, and Chris, Carter, Drew and Ray discussed shifts in their beliefs. Carter opted not to return to ESF for a second co-op, Ray decided the aerospace industry was no longer the best fit, and Drew and Chris opted for roles more aligned with their interest at the LAC. This finding suggests that each participant processed learning experiences in the CDP uniquely—each developed a set of interests, goals, and actions that defined their own path to industry.

Theme 3: Validated Industry Pathway. The theme *Validated Industry Pathway* captures moments when participants believed that CDP learning experiences confirmed their engineering and/or aerospace industry focused career plans for post-graduation employment. Since all participants chose to remain in industry, participants expressed that learning experiences in the CDP influenced their beliefs about pursuing an engineering industry position via two conceptual categories: 1) reinforced decision to work in the engineering industry, and 2) initiated or affirmed aerospace pathway. Five participants' narratives contributed to the development of this theme.

Reinforced decision to work in engineering industry. Two participants explicitly stated that the CDP provided an experience that they believed reinforced their decision to work in the engineering field. This category is distinct because it is not restricted to the aerospace industry but considers engineering positions across any industry. Considering that all participants in this study chose the industry pathway, this category may be highlighting a characteristic of the sample (i.e., participants made an early commitment to work in industry). Therefore, results mostly focus on finding industry fit versus making the decision to enter industry. Still, Chris illustrates the role the CDP may play in directing participants to the engineering industry pathway:

> I would say [that] ESF gave me that little window into the engineering world and it didn't get me all the way into it, but it showed me how much there is out there to learn and... Also, most of what I learned in school wasn't as directly applicable to work and I also didn't learn as fast in school as I do at work, so that's what pushed me into the industry because that's where I learned the fastest and that's where the most information was, so I went there instead of going back to school or anything like that.

Despite not finding a precise career fit during the CDP, Chris did realize that if he worked in industry he would be able to learn in an environment that best fit his needs. His experience in the CDP provided evidence that pursuing the industry pathway most aligned with his interests and goals. In a similar way, Abigail expressed that the co-op provided reassurance about her decision to pursue the engineering field. She noted that she knew she was going to work in engineering at the start of her co-op, but added, "I would say it definitely told me that I was doing the right thing, that engineering was where my mind was. It just validated that I was in the right field for me."

Chris's and Abigail's discussions highlight the role that co-op experiences play in confirming decisions to work in the field at large. The second category in this theme captures how participants believed their CDP experience validated their industry pathway by shaping their career beliefs related to working in the aerospace industry specifically.

Initiated/Affirmed aerospace pathway. Participants who entered the co-op with thoughts of working in aerospace believed their co-op experience confirmed their desire to work in the industry, while others described developing a new desire to pursue the aerospace industry during or following their co-op. The experience ultimately served as a testing ground for some and a step along the way for others. Notably, this finding parallels with reasons for participating as discussed in research question one. Chloe and Chris illustrate the two approaches. Chris voices his (pre ESF) desire to work in aerospace in light of other industries:

> I was very positive that's where I wanted to be. It wasn't the only place I would go though, there were other possibilities, but I only heavily searched in the aerospace field because that was the most interesting to me. My co-op with ESF didn't change that at all (that’s how I went in) and I came out even more so knowing that I wanted to be in the aerospace industry.

Although Chris said the CDP did not affect his goals to work in aerospace, he acknowledged the role that his experience had in reaffirming his interests. Chloe, on the other hand, notes how her experience in the CDP initiated her interest in the aerospace field—a somewhat unusual route for her as a civil engineer: “ ... I definitely wanted to apply to aerospace jobs after doing that first co-op. I think after doing the first three weeks in ESF, I decided "yep this is it."' (laughs) Civil engineering is too boring.”

While Chris and Chloe started with different levels of interest in working in the aerospace, both (via initiation or reaffirmation of interests) desired to work in the aerospace industry following the CDP. Consequently, they both established career goals and executed career actions to remain in the field. Both Chris and Chloe completed co-ops working directly for LAC and are now employed at LAC full-time. Notably, three additional participants discussed having their interests reaffirmed through their co-op. However, only one of these participants continued work in the aerospace industry full-time. This finding suggests that although their interests in the aerospace industry at large were affirmed, their decisions to pursue work in the industry was influenced by additional factors. This finding is further explored in Chapter 6.

Summary. The theme *Validated Industry Pathway* captures participants’ beliefs about pursuing the industry pathway following the CDP. Participants expressed that CDP learning experiences reinforced their decisions to pursue the industry pathway as well as initiated or reaffirmed a desire to work in the aerospace industry following graduation. The two categories culminate to form the theme because each highlights participants’ perceptions about work in industry full-time. Because the two participants who confirmed their interests in the engineering industry pathway (category one) also cited having their interests in the aerospace industry reaffirmed (category two), the categories converge to represent validation of participants' beliefs to pursue the industry pathway. Over half of the participants in this study discovered or affirmed their desire to pursue a role in the aerospace industry full-time; however, not all remained in the industry full-time. This finding suggests that even with validation of their interests, participants' industry pathways were redirected for other reasons.

Theme 4: Redirected Industry Pathway. The theme *Redirected Industry Pathway* captures moments when participants cited a pivot or shift in the specific type of industry role they would pursue following graduation because of their engagement in the CDP. Six participants expressed elements of this theme, and participants identified two ways in which they were redirected: 1) participants shifted their interests to a different type of role within the aerospace industry, and 2) participants explored different types of industries during their job search. Four of the eight participants accepted roles in the aerospace industry, one accepted an aerospace related role for a defense company, and three did not enter the aerospace industry following graduation. Of the five participants who remained in the aerospace industry, Chris, Chloe, and Drew completed additional co-ops with LAC directly and continued in similar roles full-time at LAC after graduating. Cobb and Jack completed additional co-ops with ESF and continued in similar full-time roles at ESF after graduating.

Explored different industry opportunities. As previously discussed, most participants' interests in aerospace was initiated or reaffirmed during the CDP. Participants additionally noted that following their co-op they would also explore full-time opportunities in other industries in addition to aerospace. Notably, their exploration did not always signal dissatisfaction with aerospace. For some participants, it shifted from being first choice to one of several options they would consider post graduation. Four participants noted exploring different pathways following their participation in the CDP. In discussing his full-time role, Ray discussed his journey to a different industry:

> After my second time, I figured that I have a good enough understanding of what it's like to be a stress analyst for LAC. Just for not only doing some of the work, but seeing how the engineering leads, how their interactions with the managers are and what their daily work load is like. I had a good enough understanding that... [its not that] I didn't like it. I

just wanted to see what else is out there. When I found manufacturing, it seems like a better fit.

Ray explored a different pathway following his position, and though not out of disinterest, he believed that he would be better suited in his current role. For Ray, Cobb, and Abigail, post-graduation plans remained flexible, allowing them to seek out opportunities in different industries. Findings suggest that the co-op did not completely funnel students to the aerospace industry, but it allowed them to consider aerospace while also exploring different industry opportunities.

Reshaped beliefs about working in their co-op role full-time. This category focuses on participants' beliefs about redirecting their full-time role based on position-specific expectations. As participants developed expectations about the roles and responsibilities of specific roles (see the *Defined Spectrum of Engineering Work* theme), they experienced a mismatch between interests and opportunities and redirected their pathways to different roles within aerospace or chose a different industry and employer.

When discussing redirection, Jack expressed his dislikes for his ESF co-op project because it had an electrical focus. He shared that working on the project at ESF helped him recognize his longer-term interests, as it steered him toward projects with a focus on mechanical structures. Chris also expressed a shift in focus based on his dislike of design work. As the following demonstrates, Chris described the moment he shifted away from pursuing a design-engineering role full-time:

> At ESF, it was the design side of things. I saw how much of just button pushing that was, and I knew I could have gotten more technical with it, but I also figured out that wasn't quite the direction I wanted to go. That was eye opening because I thought I wanted to be a designer, so that changed my expectations of what a designer was and also pushed me in the direction of being a stress analyst, which is what I turned out to be at LAC... [During the ESF co-op,] there was no one thing that was like, yup, I don't want to be here. It was just a general this could be more exciting if I got to really delve into, but I don't get to, I just get to push buttons.

The three participants who left the aerospace industry believed there was a mismatch between their interests and what they viewed as available opportunities at the ESF or LAC. Abigail, Carter, and Ray each cited hindrances of a design engineer's work environment. They reported feeling isolated, bored, disconnected from people, and distanced from the tangible work product during their co-op. Abigail cited a moment of redirection as her biggest takeaway from her co-op:

> I really wanted a field opportunity. I think ESF didn't necessarily offer a lot of opportunities like that. I think that's where I was. I didn't get field opportunities in my first two co-ops, so I knew I only had one more chance and I really wanted to get that side of things. Then LAC too, they did offer some field opportunities, but it just seemed to be things that I wasn't necessarily qualified for, or things that didn't necessarily apply to my major, what I was specifically looking for. I think that, that's what came out of my co-op. … I just don't think ESF or LAC really offered the specific opportunity that I was looking for.

Although Abigail, Carter, and Ray left the industry, each expressed some fondness of the aerospace industry, and one noted they might return to the aerospace industry at some point in their full-time career.

Summary. The theme *Redirected Industry Pathway* captures moments when participants cited a pivot or shift in the specific type of industry role they would pursue following graduation. Participants redirected their pathways to full-time industry positions by changing roles within the aerospace industry or exploring different industries during their job search. Findings suggest that following a co-op, students who identify a mismatch of interests and opportunity will redirect their goals based on their perceived lack of fit within a specific role within a company as opposed to their perceived fit within the industry.

Conclusion

Table 5.5 summarizes themes for each research question. The most prevalent theme among participants related to reasons for participating in the Co-op Development Program (research question one) was *Interest Driven Exploration*, and *Convenience* was the least prevalent theme. For research question two (learning experiences identified in the CDP), *Receiving Guidance* and *Directing Self Through Discovery* were most common across participants' narratives, and the other two themes were equally common across participants. *Defined Spectrum of Engineering Work* was the most prevalent theme for research question three, which sought to link learning experiences to outcome expectations, and *Validated Industry*

Pathway was the least prevalent theme. Across all of the research questions, at least half of the participants were represented within each theme.

Table 5.5

Summary of themes for each research question

RQ1: Reason for Participating	**Interest Driven Exploration**	*Participants desired to work in the aerospace industry prior to starting the co-op at ESF.*
		• Reasons were framed in relation to both short term and long term goals.
		  o Some participants expressed the desire to work full-time in the industry.
		  o Some discussed the desire to "test out" their curiosities about working in aerospace through a short-term co-op commitment.

	Characteristics of the Workplace	*Participants evaluated specific features of the co-op as decision points to work at ESF.* • Participants based their evaluation on information they received during their co-op search or on their experiences with the ESF during their first co-op rotation. • Participants looked beyond their interest in the aerospace industry—considering types of work assignments, location, and the people and climate of the workplace—to decide whether to participate in the CDP.
	Convenience	*Participants faced limited opportunities or preferred the accessibility of the ESF co-op.* • Some participants had a single offer from ESF. • Other participants joined because the co-op was more accessible with respect to the number of job openings and accessibility of the offer for a returning co-op.
RQ2: Learning Experiences in the CDP	**Directing Self through Discovery**	*Experiences required participants to employ a sense of agency to complete work tasks.* • *Activities:* asking thoughtful questions, searching multiple resources for answers, and teaching oneself, observing the environment, managing stress and conflict, navigate mistakes, and completing co-op work assignments
	Building Professional Connections	*Experiences involved interacting directly with engineering professionals.* • Participants learned their fit in the environment and established relationships that allowed them to build future connection opportunities. • *Activities*: adapting to people, making an impression, networking, and acting as a team member
	Sharing Knowledge with Peers	*Experiences involved participants interacting with their peers (i.e., other co-op students) to discuss their work and complete work tasks.* • *Activities:* working with peers, sharing perspectives, receiving peer guidance, training a peer, and mentoring peers
	Receiving Guidance	*Experiences involved participants Receiving information gained from exchanging information with engineering professionals, i.e., participants' received feedback or guidance on technical or non-technical work related experiences.* • *Activities*: receiving advice on career next steps, experiencing work performance critiques, and receiving one on one technical teaching
RQ3: Learning Experiences influence on Outcome Expectations and Subsequent Thinking	**Defined Spectrum of Engineering Work**	*Beliefs about how learning experiences adjusted a participant's definition of engineering roles and the workplace during and/or following the CDP.* • Discussions span from work expectations of specific engineering positions, as a full-time employee at LAC or ESF, and work expectations of an engineer broadly.
	Prepared to Pursue Full-time Work	*Beliefs about preparedness to work in industry full-time following their co-op at ESF.* • Participants developed or heightened understanding of their abilities to perform in an engineering role, identified career ready skills, and gained knowledge relevant for targeting their job search.
	Validated Industry Pathway	*Beliefs that CDP learning experiences fostered engineering and/or aerospace industry focused career plans following graduation.* • Participants developed an interest in working in aerospace, established preferences for their future workplace; confirmed a desire (held prior to CDP) to work in aerospace, or validated their choice of engineering as a career field.

	Redirected Industry Pathway	*Beliefs that led to a pivot or shift in the specific type of industry role a participant would pursue following graduation.*
		• Participants were redirected in two ways:
		  o Shifted their interests to a different type of role within the aerospace industry.
		  o Explored industry pathways beyond aerospace/

Chapter 6
Discussion

The findings of this study contribute to the literature by 1) providing empirical data to strengthen the current body of literature on co-op learning experiences and career related outcome expectations 2) establishing analytic generalizability of Social Cognitive Career Theory (SCCT) to the study of engineering co-op students' work experiences. In this chapter, I review themes that emerged during data analysis that make unique contributions to the current state of the literature and I discuss how findings align with Social Cognitive Career Theory.

Empirical data to strengthen the current body of literature related to learning experiences and outcome expectations

Aligned with Yin's (2009) recommendation to develop an initial proposition from the guiding framework and revisit it throughout data analysis, the evolution of the proposition throughout the study extends evidence of the applicability of Social Cognitive Career Theory to understand how co-op experiences influence the early career beliefs of engineers. The following final proposition emerged following analyses:

- Participating in co-ops provide informational sources that influence career related self-efficacy and outcome expectations, thus impacting engineering graduates' interests, goals, and actions to pursue specific industry paths.

The proposition evolved based on: 1) participants' descriptions and perceptions of their learning experiences (i.e., themes discussed in Chapter 5), and 2) the reciprocal and iterative nature of learning experiences, self-efficacy, outcome expectations, and career choice. As other researchers have examined and validated the use of the SCCT framework with early career engineers (e.g., Brunhaver, 2015; Winters, 2012), my study contributes within the context of cooperative education by highlighting the decisions of early career professionals within a specific co-op experience (research questions one and three). I also identify sources of career related self-efficacy and outcome expectations (research question two) and add specificity to co-op-to-career outcome expectations (research question three).

Learning experiences. The concrete learning experiences described by participants and the conceptual themes that summarize co-op participants' learning experiences are unique contributions of this study. As discussed in Chapter 5, participants identified a range of activities as learning experiences that were categorized and summarized in four themes: *1) Directing Self* *through Discovery, 2) Sharing Knowledge with Peers, 3) Building Professional Connections,* and *4) Receiving Guidance.* As described in Chapter 2, current SCCT related literature prominently describes learning experiences as four informational sources that inform an individual's self-efficacy and outcome expectation beliefs: 1) past performance accomplishments, 2) verbal (social) persuasion, 3) vicarious learning, and 4) physiological and affective states. Definitions for each source appear in Chapter 2 (Table 2.1). Although foundational to the framework, few researchers (e.g., Anderson & Betz, 2001; Schaub & Tokar, 2005) have operationalized learning experiences (Betz, 2007). Because learning experiences are said to contribute to "dynamic self-beliefs that are linked to particular performance domains and activities" (Lent et al., 2005, p. 104), the four proposed informational sources must be translated to specific contexts and activities to measure their presence and influence on self-beliefs.

My study identified four conceptual themes that describe participants' learning experiences within the Co-op Development Program. As described in Chapter 5, activities identified across the themes align with the limited co-op literature that articulates learning experiences (Raelin, Bailey, Hamann, Pendleton, et al., 2014). For this discussion, however, I highlight how the identified co-op learning experiences relate to the four informational sources individually and jointly to support development of one's career related self-beliefs. As shown in Table 6.1, each theme described activities that aligned with at least one informational source described by Bandura (1977).

Table 6.1

Mapping of Themes to Informational Sources of Self-efficacy and Outcome Expectations

		Theme from my study			
		Directing Self Through Discovery	Building Professional Connections	Sharing Knowledge with Peers	Receiving Guidance
Informational Source from Bandura (1977)	Past Performance Accomplishments	X		X	
	Verbal Persuasion		X	X	X
	Physiological/Affective States	X			X
	Vicarious Learning	X			

Past performance accomplishments. Past performance accomplishments occur when a learner's self-perceived personal mastery and failure experiences serve as a reference to his or her ability to perform current or future tasks (i.e., the learner recalls the outcome of previous work experiences). As first suggested by Fletcher (1990) and revisited by Raelin, Bailey, Hamann, Pendleton, et al. (2014), the entire co-op experience can be viewed as a performance accomplishment because “students need to use skills, abilities, and coping strategies to perform tasks (p.4).” In doing so, co-op participants experience success, failures, and improved skills while performing work related activities throughout their co-op experiences. While it can be argued that all activities reflect performance accomplishment in some way, this study identified specific activities that describe co-op related past performance accomplishments. Data align with existing literature that has shown that past performance accomplishments have a more influential impact on self-efficacy than other sources (Bandura, 1977; Lent, 2005; Maddux, 1995).

Two themes, *Directing Self Through Discovery* and *Sharing Knowledge with Peers,* include activities that provided participants with direct evidence of their successes and failures as well as their mastery of a subject during the Co-op Development Program. These activities involved working on project assignments independently and working as part of a peer group. Training and mentoring peers provided participants with repeated opportunities to evaluate their mastery of a task through teaching and sharing specific subject matter with another individual. Similarly, Tschannen-Moran and McMaster (2009) identified planning and practice sessions with peers as mastery experiences for pre-service teachers undergoing professional development. Additionally, completing individual work assignments, asking thoughtful questions, teaching oneself, and searching multiple resources for answers were activities that provided participants with direct evidence of their mastery of a technical topic based on their abilities to complete a task independently. Participants described working through difficult and time sensitive assignments that allowed them to experience mastery by working through the challenges. Based on Bandura’s (1977) postulation that continued successful experiences increase self-efficacy and decrease self-debilitating behaviors, such experiences can provide additional confidence to participants about their abilities to translate their co-op knowledge gains to similar activities they encounter during full-time positions, thereby allowing individuals to perform similarly well in related situations (Usher & Pajares, 2008).

The co-op environment provides students with direct access to experiences that show their abilities to succeed or fail at elements of professional engineering work. In this study, the co-op environment required students to acknowledge what information they did and did not know, devise a plan for learning, and complete their assigned tasks. Overall, participants identified six experiences that generate past performance accomplishments that contributed to the development of their beliefs about pursuing engineering industry roles full-time. Coll, Zegwaard, and Lay (2001) support this notion by suggesting that problem solving, working in teams, and gaining communication skills increase career related self-efficacy. Especially when approaching new tasks, a participant will experience a variety of mastery experiences that will lead to an iterative process of developing and establishing self-beliefs about the ability to perform engineering work tasks and the resulting outcome expectations about what it means to work in engineering full-time. While students may encounter continuous opportunities for past personal accomplishments during their co-op experiences, their limited work history in the professional environment often requires them to rely on additional informational sources while developing their beliefs about performing engineering work, which often takes shape as a reliance on the feedback of full-time professionals or more experienced co-op students.

Verbal (social) persuasion. Participants described several activities that reflect verbal persuasion across three themes: *Building Professional Connections, Receiving Guidance*, and *Sharing Knowledge with Peers*. Participants were encouraged or discouraged to participate in particular co-op activities via supervisor feedback and evaluations, guidance from peers and engineering professionals, peer discussions, one-on-one teaching, and networking. Participants primarily experienced encouraging forms of persuasion, although a few instances of discouragement were identified. Discouragement largely occurred when supervisors voiced disapproval of a specific behavior (e.g., a supervisor told a student to stop using certain language over email communication).

The activities identified by participants in this study reflect elements of verbal persuasion as described by Bandura (1977). Supervisor feedback and evaluation served as realistic assessments that provided students with needed reassurance to continue or adjust their work approaches. Peer discussions involved flattery and objective feedback that encouraged participants to continue work on their assigned projects. Such forms of encouragement provided participants with an additional information source to affirm they had the skills to complete project work as well as the ability to perform work in an engineering industry environment. In addition to feedback-based activities, participants discussed receiving encouragement through direct instruction, such as from one-on-one teaching and networking experiences. Particularly during their first co-op cycle with the ESF, participants described increases in their career related self-efficacy after speaking with engineering professionals about technical work approaches and career next steps. The prominence of these comments with first cycle co-op participants in this study aligns with DeLorenzo's (2000) suggestion that students experiencing their first co-op might be more impressionable via verbal persuasion because they lack prior performance accomplishments to contribute to self-efficacy. Again, this finding highlights the relationship between knowledge gained from prior co-op rotations and learning experiences. The direct teaching, feedback, evaluation, and flattery translated as encouragement have been identified as elements of mentoring that engineering students encounter in the academic setting (Pembridge & Paretti, 2012; Smith, 2015) as well as in the workplace (Gibson & Angel, 1995; Zey, 1984). In this way, findings suggest that verbal persuasion can be construed as workplace mentoring by co-op participants, which Gibson and Angel (1995) and Raelin, Bailey, Hamann, Pendleton, et al. (2014) noted as a determinant in helping students maximize their co-op experience. Findings of this study, in light of current literature, suggest that participants translated instruction and guidance from peers and professionals into vital informational sources that supported beliefs about working in engineering industry full-time.

The sources of encouragement and discouragement are noteworthy as it relates to the findings of this study. The impact of verbal persuasion on one's self-belief is dependent on the individual's confidence in the persuader (i.e., the persuader's credibility and knowledge level (Bandura, 1977)). Within the co-op context, DeLorenzo (1998) asserted that stakeholders internal and external to the co-op work environment provide both encouragement and discouragement. For this study, co-op peers and supervisors were identified as sources of verbal persuasion. Participants identified full-time engineers with knowledge of their project work, engineers who were willing to support their personal career development, and peers with prior co-op experience at the ESF as sources of encouragement. No participant talked explicitly about encouragement they received from resources external to the co-op worksite (e.g., co-op practitioners, faculty, or family). However, a few participants did refer to the overall co-op system and culture at the university, with one participant acknowledging supportive programming provided by university co-op administrators. This finding suggests that stakeholders external to the co-op environment could serve lesser roles while students are participating in the co-op, a finding supported by Raelin, Bailey, Hamann, Pendleton, et al.

(2014) who identified that students rely less on support from university resources as well as friends and family when compared to non-co-op students. Even so, because researchers have discussed the influence of family and other external stakeholders on early career decision-making (e.g.,Winters et al., 2014), more research is needed to understand the full extent of external stakeholders' impact on co-op participants.

Vicarious learning. Participants' discussions of observing the environment identified in the theme of *Directing Self Through Discovery* can be attributed to vicarious learning, which occurs when the learner partakes in observation of other people's behavior and its consequences for them. The observer does not overtly perform the behavior during the exposure period but decides if the behavior should be modeled or imitated in his or her own response when in similar situations (Bandura, 1977; Maddux, 1995). In my study, participants discussed related learning experiences primarily as observations of engineering professionals in the work environment, not as acts of modeling or imitation. As discussed in Chapter 5, participants described observing how engineers perform work, nuances of the LAC manufacturing and Academic Design Center (ADC), and the composition of the workforce. Few researchers have explored the role of vicarious learning in relation to co-op experiences or more broadly in student work experiences. Raelin, Bailey, Hamann, Pendleton, et al. (2014) and DeLorenzo (1998) categorized successful peer models and opportunities to imitate and observe work in real-time as vicarious learning during co-op, but the limited empirical evidence of vicarious learning experiences in the co-op work environment suggests further exploration to confirm these findings.

An additional finding related to the timing in which participants identified observations during their co-op experiences is better supported, however. Participants most often described observing their environment either at the beginning of their co-op assignment or while being introduced to a new project well into their co-op. As new members of the working community, participants took time to understand how things operated as well as the role of existing members (i.e., co-ops peers and full-time professionals). This finding reflects elements of the concept of community of practice (Wenger, 1998), which has been extended to the engineering industry context (Wenger, McDermott, & Snyder, 2002). That is, from the outset of joining the engineering industry community, participants held more of an observational role to understand how the community operates. As interactions with experienced members of the community increased and participants' knowledge grew, their roles expanded to become more active and contributory. Zegwaard and Coll (2011) offer support for the link between observational learning and the community of practice for co-op students. They argue that students' exposure to the workplace supports socialization to the community, which in turn helps students' career decision-making processes. Findings from this study bolster this claim by documenting findings that show co-op students participating in observational activities that shaped their beliefs about the engineering industry environment.

Physiological and affective states. Two themes, *Directing Self Through Discovery* and *Receiving Peer Guidance*, include activities that described changes in participants' affective state (e.g., arousal, anxiety, vulnerability). Bandura (1977) contends that self-efficacy is lowered or heightened based upon the learner's self-evaluation of his or her state. Depending on their judgment, a learner establishes beliefs about personal competency that may lead to facilitating or debilitating their performance (e.g., avoidance behaviors in stressful situations).

In this study, participants described moments during the Co-op Development Program that had an emotional impact and aroused feelings of stress, conflict, and increased responsibility. Participants discussed these changes when describing activities that involved navigating mistakes, experiencing work critiques, managing multiple projects, and making an impression. Such findings align at a high level with measures that have been used in previous studies of college students. Williams and Subich (2006) associated anxiety, uneasiness, nervousness, and uptightness with Holland's six personality types to measure learning experiences, and Raelin, Bailey, Hamann, Pendleton, et al. (2014) includes measures of handling pressure, expressing sensitivity, and managing politics to explore work self-efficacy. Moreover, the activities identified by participants reflect the effect of being in the engineering workplace versus a classroom environment. As suggested by Bates, Thompson, and Bates (2013), students in work integrated learning programs may (possibly for the first time) encounter office politics and manage multiple priorities between school, work, and home; therefore, changes in co-op students' physiological and affective states are likely to occur as they learn how to navigate their new roles and responsibilities.

Additionally, this study highlights how participants evaluated and translated their affective states into beliefs about subsequent co-op performance and career related actions. Considering that changes in affective states may facilitate or debilitate an individual during skill development (Bandura, 1977), participants' discussions in this study focused on facilitating performance. No participant translated changes in affective states as a trigger to discontinue engineering study or not return to the engineering industry career path. The co-op presented learning experiences that challenged participants and pushed them to manage experiences of stress/conflict, which ultimately served to increase their self-efficacies. Such experiences have been described to support persistence (Bandura, 1977; Bates et al., 2013).

Interrelatedness of sources. It is important to note that significant overlap of informational sources can occur in a single learning experience (Bandura, 1977). Additionally, since individuals will vary in how they define the end of one learning experience and the start of another, informational sources are even more likely to play an interdependent role in influencing self-efficacy. In my study, this idea can be highlighted across several identified activities (e.g., networking, navigating mistakes, experiencing work critiques, and peer discussions). For instance, supervisor feedback can involve elements of verbal persuasion and lead to changes in physiological and affective states. When first interacting with a full-time employee, a co-op student may feel nervous because of the new connection (i.e., experiencing changes in their physiological and affective states). At the same time, through meeting with the employee, the student may receive encouragement or discouragement via career related advice (i.e., experiencing verbal persuasion). In this example, a single networking experience generates two informational sources that can contribute to self-efficacy. To provide clarity in discussing this study's findings, activities were discussed in relation to their most prominent informational source. I determined the prominent information source by referring to interview transcripts to understand the full context of participant descriptions, and leveraging descriptions of the four informational sources utilized by previous researchers (Schaub & Tokar, 2005; Williams & Subich, 2006). The evidence of overlapping informational sources warrants further investigation to define more precisely the contributions to self-efficacy and to design interventions to maximize the development of an individual's self-efficacy.

Outcome Expectations

Participants identified outcome expectations developed during and following their participation in the CDP and the effect of those beliefs on their subsequent career thinking. Throughout their discussions, participants highlighted several postulates of SCCT: 1) the predictive role of learning experiences in shaping outcome expectations, 2) the mediated role of self-efficacy in an individual's outcome expectations, 3) the interrelated relationship of outcome expectations to interests, choice goals, and choice actions. Most participants discussed outcome expectations while simultaneously discussing their subsequent career related thinking.

Outcome expectations refer to an individual's beliefs about what occurs following certain behaviors (e.g., 'if I try doing this, what will happen?' (Bandura, 1986, p. 392)) and may develop through observations or direct learning experiences (Lent et al., 2005, p. 104). In my study, co-op students developed beliefs about engineering work, preparation for the workplace, and fit within the engineering workplace. Findings highlight links between learning experiences and outcome expectations and their contribution to the development of career thinking (i.e., interests, goals, and action). As discussed in Chapter 5, findings were categorized and summarized into four themes: 1) *Defined Spectrum of Engineering Work*, 2) *Prepared to Pursue Full-time Work*, 3) *Validated Industry Pathway*, and 4) *Redirected Industry Pathway*. Themes articulate the type of outcome expectations that were developed and capture both the mediated and predictive role of outcome expectations in the SCCT framework.

The theme *Defined Spectrum of Engineering Work* provides evidence to suggest that co-op experiences affect participants' beliefs about engineering work. During and following engagement in the CDP, some participants noted developing an expanded view of engineering work, while others believed some work was incorrectly characterized as engineering. Considering that some students often do not know what to expect of the engineering profession and can be uncertain about what it means to work in engineering as late as senior year (Matusovich et al., 2009), these findings indicate the informative role that co-op experiences play in shaping students' beliefs about engineering work. Through the CDP, participants' views of engineering work were expanded or challenged, leading them to establish beliefs about the practice of engineering in industry and make decisions based on that information. For example, Abigail's logic included that if she worked full-time as a design engineer for LAC or ESF, she would be working from a desk with limited fieldwork opportunities. In the same thought, she expressed how she shifted her goals to work in a more focused manufacturing role. Abigail's thought process highlights the expected outcomes of work as an engineer and highlights the interrelatedness of outcome expectations, interests and goals. Findings indicate that co-op programs serve as learning experiences for students to develop beliefs about what it means to work (or not work) as an engineer in industry, an idea supported by Reisberg et al. (2012).

Participants' beliefs captured in the theme *Prepared to Pursue Full-time Work* shed light on the mediating role of self-efficacy in shaping an individual's outcome expectations. Through their co-op exposure, participants developed confidence about the job search and about performing engineering work full-time. Discussions related to increased preparedness to pursue a job search revealed elements of career decision-making self-efficacy (Hackett & Betz, 1981; Taylor & Betz, 1983), and discussions of preparedness for work as an engineer aligned with work and occupational self-efficacy (Raelin, Bailey, Hamann, Pendleton, et al., 2014; Schyns & von Collani, 2002).

As previously discussed, co-op learning experiences act as informational sources that impact career related self-efficacy. Themes identified in research question three suggest the mediated role of self-efficacy in an individual's outcome expectations is present in the data. For example as it relates to the *Prepared for Full-time Work* theme, Chloe discussed that because she had established relationships through her co-op, she felt more prepared to apply to the LAC—not because she felt like they could give her a job, but because engineers believed in her. Chloe's career decision-making self-efficacy increased based on the encouragement she had received from LAC employees during her co-op. In turn, she believed that if she applied, she would have a real chance at successfully gaining a full-time position at the LAC. In another example, Cobb's description captured in the *Validating Industry Pathway* theme suggests the impact of work self-efficacy on outcome expectations of full-time engineering work:

> That was definitely a meaningful moment, that's when I knew I had really made an engineering career. I was able to present data correctly, I was able to talk to these professionals, I was able to keep my cool about it. Still I'm a kid at [that] point, I want[ed] to lash out but that was absolutely the most meaningful experience the 2nd time around. That manager eventually offered me a job to come back and work in his department.

Cobb translated his ability to engage with professionals and present information in a high stakes situation as evidence that he would be successful in a full-time engineering position. Therefore, he developed an expectation of what work would entail as well as what behaviors would lead to success. Both examples highlight the mediating role of self-efficacy in shaping an individual's outcome expectations. That is, the co-op provided students with an opportunity to perform a task, evaluate their performance, establish confidence levels, and consequently develop beliefs about what performing similar or dissimilar behaviors would produce in a full-time engineering industry position. Previous researchers have captured parallel abilities of self-evaluation when developing measures of work self-efficacy (Raelin, Bailey, Hamann, Pendleton, et al., 2014; Schyns & von Collani, 2002). *Defined Spectrum of Engineering Work* and *Prepared to Pursue Full-time Work* provide evidence suggesting that co-op experiences influence beliefs about engineering work and preparation for the workplace via career decision-making and work self-efficacy. Discussions of challenged and expanded views of engineering roles as well as increased preparedness offer evidence to illustrate the role of co-ops in forming expectations related to following specific industry pathways.

Validated Industry Pathway and *Redirected Industry Pathway* reflect participants' beliefs about fitting in the engineering workplace and subsequent career choices. As discussed in detail in Chapter 5, participants shared that learning experiences in the CDP initiated, affirmed, or confirmed their beliefs about pursuing an engineering industry role. Participants discussed expectations in relation to their beliefs about what it meant to work full-time for either ESF or LAC, in the aerospace industry, or in specific types of workplaces.

The implications of these findings are noteworthy, as researchers have noted the ability of a single experience to influence engineering students' career options (Lichtenstein et al., 2009). In this study, the CDP provided experiences that helped participants gain career clarity and heightened career self-efficacy. As such, participants developed beliefs and, in turn, acted on their beliefs for their first professional role post-graduation. I am careful to qualify that the CDP was not the sole influence on any participants' career actions, as both individual characteristics and environmental factors also played a role in career decision-making, as posited by SCCT. However, findings do highlight the formative role of co-ops and align with existing findings that have shown that participation in co-op experiences predict plans for engineering work (Sheppard et al., 2010). Lastly, as all participants in this study self-described their current full-time roles as an engineering position, findings show that at least within the early career range (1-5 years in the workforce), participants' beliefs hold true and map to their current choice actions of working in engineering.

The parallel of findings of this study in relation to outcome expectations show support that SCCT appropriately postulates the progression of learning experiences, to self-beliefs, to action for engineering co-op participants. Still, researchers must be careful to examine context-specific elements that drive the development of self-agency in career decision-making, as suggested by the model. Even more so, the link between learning experiences, outcome expectations, and subsequent thinking (research question three) illustrates the formative nature of the co-op experience. Co-op experiences have traditionally been considered exploratory in nature (Linn et al., 2004), although recent research has cited links between students' work experiences and their preferences for engineering employment post-graduation (Sheppard et al., 2010). Findings from this study suggest that participants viewed their co-ops as a highly informative experience in their early career decision-making through multiple references to acquired skills, outcomes, and expectations. As discussed in Chapter 5, all participants described their ESF co-op to have either validated or redirected their career paths. Co-op experiences in the CDP served as the link from exploration to formation for many participants, as the experiences encountered during their co-op helped bring clarity by establishing self-efficacy and outcome expectations about engineering industry work. These findings show the level of impact that a co-op experience has on an individual's decision to persist on a specific industry career path and highlights the definitive nature of the CDP.

While findings highlight the definitive nature of the CDP on participants' post graduation career decision-making, the program manager described the CDP as an opportunity for participants to de-select the field. That is, the CDP manager's position of promoting that students will opt-out (prior to joining full-time) could be reconsidered in light of research question three findings. As participants chose to opt-in various industry pathways, managers could reconsider positioning the CDP from a 'weed-out' program to an exploratory experience—potentially making the program more welcoming to students at various interest levels. In summary, findings of this study strengthen prior assertions that co-ops inform engineering post-graduation career plans and more importantly establishes *how* post-graduation plans are affected by a co-op experience

Additional Discussion

In addition to providing empirical data to strengthen the current body of literature on co-op learning experiences and career related outcome expectations and expanding the literature as it relates to learning experiences and outcome expectations, several additional findings deserve discussion. Participants identified reasons for co-op participation that align with co-op outcomes and benefits and do not reflect propositions of SCCT. Additionally, environmental elements notably impacted career decisions in conjunction with co-op experiences. Also, other notable patterns in the data are discussed as evidence to establish analytic generalizability of Social Cognitive Career Theory (SCCT) to the study of engineering co-op students' work experiences.

Reasons for Co-op Participation. As discussed in Chapter 5, participants identified three themes related to reasons for participating in the co-op: *Interest Driven Exploration, Characteristics of the Workplace*, and *Convenience*. Notably, participants discussed reasons for participating in relation to prior interests and contextual factors. These findings do not directly align with the SCCT framework, as very few participants provided reasons related to person inputs, background contextual affordances, or performance domains and attainments—the framework posited that those constructs impact access and exposure to learning experiences (Lent et al., 1994). Instead, participants' responses more closely align with the co-op literature that summarizes co-op outcomes and benefits. Primarily through the *Interest Driven Exploration* theme, participants highlighted notions of selecting the co-op to explore career interests so that they could gain work experience related to their goals of working in engineering full-time, explore their career identity, or gain career clarity (Brown, 1984; Weston, 1986; Zegwaard & Coll, 2011).

There is little supportive literature to explain *Convenience* or *Characteristics of the Workplace* as reasons for participating in the CDP. One plausible explanation for the *Convenience* is the mandatory nature of co-ops at the Large Mid-Atlantic Private University. Participants felt they would prefer to accept the position than to miss an opportunity, and the proximity of the university to CDP worksites assisted with logistics and costs. Managers also leveraged the close proximity of the university and the worksites to conduct some interviews on site, allowing some participants to consider *Characteristics of the Workplace* in their decision to co-op in the CDP. Because research has determined that the quality of a co-op experience is a determinant of post-co-op outcomes (Pittenger, 1993), early exposure to characteristics of the workplace may indicate the potential quality of an experience and may affect participants' decisions to select a co-op experience. Ultimately, this study showed that precursors to learning experiences as posited in SCCT did not directly explain reasons for participation. Because participants' reasoning influences learning experience selection, researchers should be sure to consider prior interests, knowledge of the workplace, and non-co-op related elements that impact convenience as factors that influence participation.

Notably, because participants discussed reasons for participating in the co-op in a reflective mode, their responses could be a function of the positive outcomes following their co-op experiences. Findings might be different if they were captured before the start of the co-op. Still, findings provide future researchers with a starting basis for understanding why students chose to participate in co-op experiences within the context of the SCCT framework.

Other patterns to note related to Social Cognitive Career Theory. Though not directly explored via the interview protocol, findings offered evidence that suggest alignment with additional relationships posited by Social Cognitive Career Theory (displayed in Figure 6.1). The SCCT framework served as an up-front explanation of participants' decisions before and after the Co-op Development Program (CDP), provided a "ready made hypotheses" for the proposed relationships between learning experiences, outcome expectations, and subsequent career thinking, and supported further conceptual exploration (Creswell, 2009).

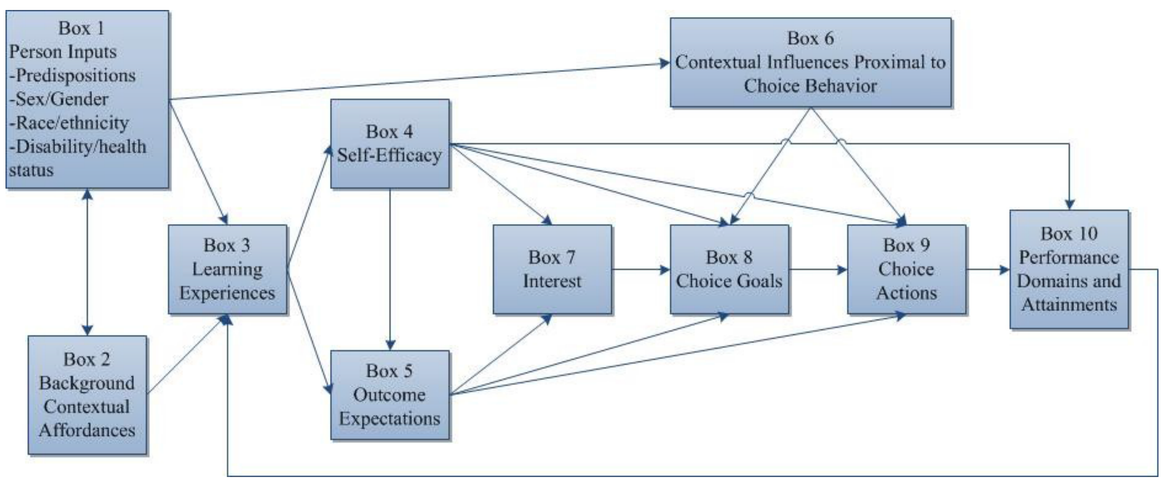

Figure 6.1. Social Cognitive Career Theory (Lent et al., 1999).

Data from this study highlighted the moderating role of person inputs (box 1) and background contextual affordances (box 2) on career related self-beliefs. Moreover, the role of learning experiences (box 3) as sources of self-efficacy (box 4) and outcome expectations (box 5) was evident in the data, and the link between self-efficacy and outcome expectations repeatedly became apparent even though it was not directly investigated. The relationship between outcome expectations, interests, choice goals, and choice actions (box 8 and box 9) proved to be interrelated and not as distinct as illustrated in Figure 6.1. Also, proximal contextual influences (box 6) moderated the translation of interest to choices. Finally, although performance domains and attainments (box 10) were not largely present in the dataset, the posited link to learning experiences was supported. As focal constructs of the study, multiple points of evidence for learning experiences and outcome expectations comprise the themes discussed in Chapter 5. Although less prominent, findings demonstrating the indirect influences of person inputs, background contextual affordances, and performance domains and attainments on career choices provide additional evidence of alignment with SCCT.

Person inputs and Background Contextual Affordances. Aligned with SCCT, neither person inputs nor background contextual affordances directly influenced career choices, although each moderated influences on career choices. Person inputs shaped learning experiences and outcome expectations for one participant, and background contextual affordances influenced another participant's interests over time.

Regarding person inputs, Abigail discussed being a female in relation to developing career expectations during her co-op experience; Chloe did not. Abigail noted observing a low number of female engineering professionals in her co-op work environment. Though she initially described the experience as shocking, she felt more prepared because she learned what to expect in future co-ops and full-time work environments. In this instance, Abigail's perspective as a female led to a unique learning experience, which shaped her expectations about full-time work. While such an experience aligns with well-documented research about female engineers' unique experiences and beliefs about the workplace (Amelink & Creamer, 2010; Fouad, Fitzpatrick, & Liu, 2011; Lichtenstein, Chen, Smith, & Maldonado, 2014; Trenor et al., 2008) as well as the complexity of engineering gender identities (Hatmaker, 2013), Chloe did not similarly share how being a female impacted her learning experiences. Therefore, data in this study suggest that person inputs produce varying levels of influence on career decision-making, although more intentional sampling should test these ideas more comprehensively. While person inputs may have a differential effect, these findings highlight the complexities of female identity and identify formation in the engineering environment as both participants may have become socialized within the engineering culture to minimize discussion about their experiences from a gendered[1] point of view (Faulkner, 2000; Jorgenson, 2002; Tonso, 2007).

In addition to gender, examining participants' racial/ethnic background in relation to their industry destination uncovered a notable finding. None of the minority participants continued

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[1] The personal profile questionnaire used in this study asked students to self-identify their *sex* and included options to select 'other' or 'prefer not to answer.' As the term *gender* is more prominently used in the research literature, it is used throughout the discussion section to situate findings related to *sex*.

full-time work with either the host company or within the aerospace industry. That is, the two participants who identified as multi-racial, in addition to one participant who preferred not to answer, opted to work in the oil and gas and manufacturing industries, respectively. It is important to note that participants were not asked to speak about their race in relation to their co-op experiences or career decisions; the three participants expressed that their departures from the aerospace industry was a result of having different interests or higher salary opportunities in other industries. Still, because of the well-researched findings related to race, engineering career exposure, and career destinations (e.g., Beasley, 2011; Hackett & Byars, 1996; Lichtenstein et al., 2014; Sheppard et al., 2010), it is a finding worthy of further investigation to understand if a notable pattern exists within the CDP and co-ops more broadly. Additionally, as studies leveraging SCCT have found race to impact the exposure and experiences of minority engineering students and full-time engineers (Evans & Herr, 1994; Hackett & Byars, 1996; Trenor et al., 2008), this finding aligns with the SCCT framework that suggests race plays a moderating role in career actions. Since participants noted their interests and starting salary (a proximal contextual influence) as drivers, these data could reflect the dominant role that some constructs have over others. Alternatively, this finding could point to potential intersections of race, learning experiences, and choice actions during and following cooperative education. Ultimately, the finding shows partial alignment with SCCT by highlighting person inputs and contextual influences as well as the link between the two constructs. Although more evidence is needed to validate findings, this study helps establish foundations for further research on both constructs as it relates to students' work experiences since gender and racial identity were not focus areas of this study.

Similar to person inputs, participants also described background contextual affordances as moderating influences. As hypothesized by SCCT, no participant directly pointed to a background contextual affordance as a direct cause for his or her career action. Yet, as not hypothesized in SCCT, participants discussed background contextual affordances to influence their interests. For example, Cobb described his parent's fifteen-year career in the Air Force to have sparked his interest in aerospace, which led him to establish choice goals and execute choice actions of taking aerospace related curriculum as an undergraduate and seeking out a co-op in the aerospace industry. This sequence of interests, goals, and actions occurred prior to the start of the CDP. When discussing his experiences during the CDP, however, Cobb did not directly connect his background contextual affordances to his choice actions to work in an engineering industry position full-time. This finding highlights the iterative nature of the SCCT framework. That is, a participant may describe a background contextual affordance to establish an interest that influences a learning experience (in this case, learning what engineers do in the Air Force), which in turn may shape additional interests and goals of working in a specific engineering industry. Ultimately, those interests led Cobb to a co-op and a full-time position in the aerospace industry. From this perspective, the data in this study highlight the iterative nature of career decisions and the cyclic nature of the SCCT framework, as identified by Lent (2005), Winters (2012), and Carrico (2013).

Considering the scope of this study was primarily focused on experiences during the Co-op Development Program, person inputs and background contextual affordances provide context for understanding participants' reasons for participating (addressing research question one) and also serve as an additional source of influence on career decision-making. Because neither construct was investigated purposefully, these findings serve as conservative estimates of influence; future work is needed to understand the comprehensive influences of these constructs in the model. Overall, the moderating influence of person inputs and background contextual affordances on career choice provides support for the alignment between SCCT and these findings.

Performance domains and attainments. The data in this study highlighted the hypothesized feedback loop between performance domains and attainments and learning experiences (Bandura, 1986). Evidence of the relationship was primarily seen through participants' references to prior co-op experiences. Prior co-ops afforded participants the opportunity to develop skills and accomplish project outcomes that contributed to their self-efficacy and outcome expectations as they entered the ESF co-op learning experience (see Lent (2005), which discusses how experiences lead to skill development and outcomes). Participants who returned to ESF or LAC for an additional co-op rotation discussed how insights gained from their first co-op influenced their desire to return and directly impacted their experiences during their second rotation. For instance, Ray talked about being able to "jump straight into [the] higher caliber work versus having to start from the bottom again." He also spoke about using the return experience to explore long-term fit with a full-time role as a stress analyst for the LAC. Ray's experience demonstrates the relationship of performance attainments and their impacts on subsequent learning experiences; the skills Ray acquired during his first co-op rotation supported learning experiences that increased his self-efficacy and established outcome expectations about full-time work at the LAC, therefore influencing his decision to explore his career interests with ESF. These data points show that the amount of exposure to the workplace affects how students perceive learning experiences. Moreover, the finding suggests that different kinds of learning happen in subsequent co-op rotations and illustrates a range of learning that can occur over multiple co-ops.

Although some participants redirected their career paths following the ESF co-op experience, they discussed being able to leverage the skills acquired during the co-op as well as their expectations about engineering work in a similar way in either their job search or in a different co-op environment. Both Abigail and Carter spoke about the critical communication skills they acquired during their ESF co-op experience and also discussed that they learned that design work was isolating or boring, and therefore a poor fit for their long-term interests. Both described acquiring important skills, but they opted not to return based on beliefs that there was a mismatch between their interests and the ESF learning experience.

Considering both returning and non-returning co-op students, these findings illustrate the ways that individuals use performance domain and attainments as feedback information for future learning experiences varies across individuals. Participants' beliefs about their abilities and the relationship between expectations, interests, goals, and actions impact how performance domain and attainments impact future work experiences via the feedback loop. Thus, for this study, as suggested by Lent (2005), successful performance domain and attainments (e.g., acquired skills and project completions) did not always lead to an individual persisting in the aerospace industry career path. Participants' interests and goals of having a higher salary and engaging in fieldwork as well as recognizing their disinterest for design work led to their departures from the industry. Such a finding provides additional evidence of the cyclic and iterative nature of the SCCT framework and the complexities of explaining career decision-making.

In summary, although performance domain and attainments were not initially within the scope of my study, the prevalence of the construct in the dataset provide additional evidence for the fit of SCCT to my study context. The construct primarily was evident through participants' references to how prior co-op experiences generate opportunities to develop skills and accomplish project outcomes that contributed to the development of their self-efficacy and outcome expectations. Additionally, participants' discussions of performance domains and attainments helped uncover the formative role of co-ops in engineering early career decision-making. Because the construct was not investigated purposefully, future work is needed to reaffirm these findings and better understand the influences of the construct and its links to learning experiences in the co-op environment.

Proximal Contextual Influences. While SCCT places an emphasis on individual characteristics and self-agency, the environmental context in which career decisions occur should not be overlooked (Lent, 2005). Captured via background contextual affordances (previously discussed) and proximal contextual influences in SCCT, social, cultural, and environmental factors influence choice goals and choice actions. In my study, participants' career choices were impacted at two time points: decision to co-op, and the decision to work full-time. Participants described the state of the job market as important influencers, which included salary offers, competitiveness, and availability, which were all proximal contextual influences.

The co-op literature and findings previously discussed in my study indicate that students anticipate increased marketability and salary advantages from co-op participation (Grosjean, 2004). Also, while debated in the literature, co-ops have been shown to lead to higher starting salaries for engineering students (e.g., Blair et al., 2004). Coupled with the higher expected salary of engineering majors relative to other bachelor's level degree programs (Carnevale, Rose, & Cheah, 2011; Carnevale, Strohl, & Melton, 2011), engineering students most likely enter their job search expecting a specific salary range. Thus, when a low salary offer or a hiring freeze prevented the realization of job market expectations for participants in my study, they were forced to reevaluate their career next steps. Even though participants had established interests and goals of remaining with the host employer, in the aerospace industry, or in a geographic region, the job market required them to revisit or redirect their career choices. This finding aligns with Lent's (2005) discussion noting that unforeseen events cause individuals to reevaluate and perhaps reestablish their self-efficacy and outcome expectations. This unanticipated situation may lead individuals to alter their approaches, change interested, or prioritize goals that do not directly reflect their interests (Lent, 2005). For example, Carter initially decided he did not want to return to either host company for a co-op because of his lack of interest. At the time of graduation, he prioritized salary, so he applied to jobs across all industries, including aerospace.

Because he received few offers and those he received had low salary offers that would not offset his student loans, he decided to leave the area and work in a temporary job before acquiring a full-time offer in the oil and gas industry. Carter's experience illustrates the role of proximal contextual factors in moderating one's goals and actions. He altered his goals by revisiting the aerospace industry in his full-time search, and because of barriers, completely altered his pathway. His story, along with others, highlight the influential role environmental factors play in shaping career actions. As other participants navigated a challenging job market, the complexities and iterations of career decision-making were again brought to light. This finding suggests that although findings of my study highlight individual experiences and development of self-beliefs as it relates to the CDP, external factors and the broader context must be acknowledged when interpreting results.

Summary

The empirical data of this study strengthen the analytic generalizability of Social Cognitive Career Theory (SCCT) to the study of engineering co-op students' work experiences. Evidence for focal constructs was present, and data highlighted the role of non-focal constructs in career decision-making. Although this study primarily focused on learning experiences and outcome expectations, it is notable that participants highlighted the role of person inputs, background contextual affordances, performance domains and attainments, as well as proximal contextual influences in their decision-making. Additionally, reasons for participation were identified that did not directly align with the framework, thus establishing new categories for future researchers to consider when applying the SCCT framework to the study of co-ops.

In applying SCCT to this study, I provide empirical data to strengthen the current body of literature on co-op learning experiences and career related outcome expectations. The themes that emerged during data analysis offer explanation to the causal link between learning experiences and outcome expectations (commonly referred to as the "black box of co-op"), which is an idea that has persisted as a needed contribution in student work experience literature (Gilmartin et al., forthcoming; Ricks, 1993). This study connects the much-supported outcomes of co-op with the learning experiences that create the outcomes. By offering concrete co-op learning experiences and mapping them to informational sources of self-efficacy and outcome expectations, this study created operationalized definitions that can be used to establish interventions and serve as the basis for future co-op design recommendations. Additionally, identifying reasons for participation that expand beyond the postulated precursors to learning experiences contributes to the literature and sheds new insights on opportunities to assist in career counseling and recruiting for university and industry stakeholders. Ultimately, these findings suggest that co-ops play an informative role in students' early career decisions, and specific elements of the cooperative experience shape students' views of potential employment opportunities. By better understanding how students' participation in the CDP impacted outcome expectations and subsequent career thinking, interventions to better prepare students to make career decisions and pursue engineering roles can be initiated. Such interventions support the ultimate goal of understanding how a student-centered university-industry partnership can support workforce development.

Chapter 7
Conclusion

Chapter 7 summarizes the findings of the dissertation, describes implications of the results for industry and university stakeholders as well as researchers, and suggests future research that can stem from this study. The chapter also discusses the study's limitations so that readers recognize the caveats within which to contextualize the results.

Summary

Persistent calls to the field of engineering education to help develop diverse, well-prepared engineers for the STEM workforce have fostered collaborations across multiple kinds of stakeholders. As stakeholders focus efforts on supporting student persistence at several critical junctures, there has been a renewed interest in leveraging university-industry partnerships to support the school-to-workforce transition for engineering graduates. With unfilled jobs and the push for developing a tech-savvy workforce, innovative approaches to supporting and preparing students to enter the workforce have become even more necessary. University and industry stakeholders in engineering have agreed that collaborating to share expertise and implement programs is a vital component for addressing workforce needs, and thus it is important to understand how such partnerships generate experiences that contribute to students' eventual workforce entry. A more nuanced view of university-industry partnerships from the perspectives of student participants will provide data to engineering educators and professionals to support the design and potentially the allocation of resources for such partnerships. Since university-industry partnership configurations vary considerably, this study focuses on a specific partnership that involves a university, two industry partners, and a co-op program (i.e., the Co-op Development Program).

The purpose of this qualitative single case study was to understand how experiences in the Co-op Development Program (CDP) influence student participants' subsequent career decision-making with respect to pursuing engineering industry positions. Several career development theories posit that co-op education experiences mediate beliefs about career attainment, and current literature provides some evidence of the impact of co-op experiences on career related outcomes. Most prior research has focused on quantitative outcomes (e.g., time to graduation, salary offer, and post co-op GPA). Other researchers who have focused on co-op experiences have not unpacked specific developmental experiences or explored participants' reflections on how such experiences influenced their career choices. By taking a qualitative approach with an intentional focus on understanding experiences, mediating beliefs, and career actions via the use of Social Cognitive Career Theory (SCCT), this study examines the role that cooperative education experiences play in how students view and act on the potential employment opportunities that university and industry partners anticipate. The results of this study contribute to the literature by: 1) providing empirical data to strengthen the current body of literature around learning experiences and outcome expectations (two understudied constructs of Social Cognitive Career Theory), 2) validating the posited link from learning experiences and cognitive beliefs of self-efficacy and outcome expectations to career choices, and 3) establishing analytic generalizability of SCCT for studying engineering co-op students work experiences.

This study addressed the following overarching question: "How did learning experiences during co-op rotations in the CDP shape the career decisions of engineering participants immediately following graduation?" As discussed in detail in Chapter 5, this question was addressed by focusing on three sub questions to clarify reasons for participation, specific learning experiences, and uncover the influences of the CDP learning experiences on beliefs and subsequent thinking about pursing an engineering industry position full-time. Analysis of participant interviews revealed three themes related to reasons for participation*: Interest Driven Exploration, Characteristics of the Workplace,* and *Convenience*. All participants voiced a desire to work in the aerospace industry to explore short-term interests or to accomplish longer-term career entry goals. Participants also voiced reasons to participate that related to specific features of the co-op opportunity as well as the accessibility of the co-op offer. Research question two addressed types of learning experiences that occurred in the CDP. Four major themes emerged during the analysis: *Directing Self through Discovery, Building Professional Connections, Sharing Knowledge with Peers,* and *Receiving Guidance*. Participants most frequently discussed experiences that required them to employ a sense of self-agency to complete work tasks (e.g., guiding themselves through uncertainty, observations of the environments, and interactions with engineering professionals to build relationships or advance project work). Finally, research question three linked learning experiences to outcome expectations and subsequent career thinking via four themes: *Defined Spectrum of Engineering Work, Prepared to Pursue Full-time Work, Validated Industry Pathway,* and *Redirected Industry Pathway.* Participants connected their learning experiences to their beliefs about what work looks like as a full-time engineer, their abilities to perform in an engineering role, and perceptions of fit across different engineering roles and workplaces.

Findings from this study give voice to students who engage in university-industry partnerships. As stakeholders from universities and industry continue to develop innovative models that link postsecondary education to workforce development, this research can help guide efforts in organizing those experiences so that they can be more student-centered; findings can be leveraged to discern how students can be supported and guided through the partnering experience. Stakeholders have new empirical evidence that can be leveraged in the redesign of existing and development of future partnerships geared toward students.

Implications and Future Work

Findings from this study have several implications for various kinds of stakeholders. Although I recognize that findings from this qualitative study are most applicable to the case under investigation, readers should consider the context, rich descriptions, and participant characteristics when considering the transferability of findings to different contexts. As outlined in detail in Chapter 4, the CDP was a multi-partner arrangement that involved a private university with a mandatory co-op program, a large well-established aerospace company, and an engineering services firm.

When considering implications, readers should remember that these students are co-op oriented and expect to complete at least one job cycle prior to graduation. Also, students were exposed to work environments and engineering professionals from two companies (i.e., ESF and LAC)—both within the aerospace industry. Although results are not generalizable to all co-op settings, findings offer evidence of the analytic generalizability of the SCCT framework to the study of engineering co-op students. Therefore, implications should be considered with the idea that student work experiences involving comparable activities and environments may similarly shape the career decisions of engineering graduates immediately following graduation.

Implications for Practice/Policy

Co-op Development Program Managers

Findings from this study offer several implications for CDP managers as well as student work program managers broadly. In this discussion, I consider "practices" as non-mandatory recommendations that are based on data and adaptable to a targeted group's needs, and "policies" as formalized practices that are required to ensure systematic and widespread adoption. Practice and policy implications in the context of CDP stakeholders are viewed as interchangeable since shifting industry resources and emerging technology drive industry's workforce development priorities, therefore impacting the need and timeliness of formalized practices.

An implication for practice/policy is the consideration of timing of an experience for co-op students since the study provides evidence of the different forms of learning experiences that can be enabled from one co-op rotation to the next. Findings illustrate that students completing their first co-op rotation referenced verbal persuasion (encouragement) from engineering professionals more frequently and noted relying more on past personal accomplishments during their second co-op. Students with work experience prior to starting the CDP relied more heavily on their past performance accomplishments as an informational source for building career related self-efficacy and outcome expectations during the CDP. As program managers have identified that finding the right level of complexity of co-op assignments balanced with student interest and ability is a "bit of an art" (Ciechon, 2013), these findings provide a starting point for understanding how interests and beliefs about pursuing a full-time role in the engineering industry are informed across various co-op rotations. Program managers might be more attentive of students' past experiences during the interview process as well as when assigning projects and supervisors during co-op student onboarding to make more informed co-op work assignments. Because different forms of learning experiences occur across co-op rotations, managers can provide timely workplace mentoring for less experienced co-ops, and scale up project work that will require students to build on their prior accomplishments for returning students.

Another implication for practice/policy is that CDP managers can initiate efforts to maximize the role of ESF and LAC staff in supporting students' career decision to enter an engineering industry position. Several findings offer evidence to industry partners that their staff are influential: 1) participants stated that engineering professionals beyond their supervisors were influential for their decision making by providing technical expertise and mentoring; 2) participants noted that observing professionals in the workplace informed their outcome expectations (especially in the early period of a co-op experience); 3) participants relied more on workplace relationships when seeking career guidance than external resources. Opportunities to maximize staff interactions with co-op students should be considered. CDP managers also should consider that professionals beyond the supervisor have influence on student intentions and may want to incorporate other on-site engineering professionals into mentoring in a more intentional way. For instance, management may offer voluntary co-op mentor training for its staff or host an open house/welcome event for co-op participants to meet professionals and visit different locations in the facility to foster early connections.

Another implication for practice/policy is that findings can directly inform strategic approaches to revamp recruitment and onboarding processes for co-op students. Participants cited several reasons for participating (i.e., *Interest Driven Exploration, Characteristics of the Workplace,* and *Convenience*) that would allow managers to anticipate students' expectations and make needed improvements prior to the next recruiting cycle. For instance, realizing that students seek out positions based on their short- or long-term interests, managers can more directly explore applicants' interest during an interview to better gauge overall fit as well as connect a co-op student with a project, mentor, or location that aligns with their initial interest. Improving the job match may lead to more positive perceptions of self-efficacy and outcome expectations for the student that, in turn, contribute to increased opportunities for persistence to full-time work in the industry. Also, managers can use identified reasons for participating as a starting point to survey current co-op students and extend the ability to anticipate student expectations and fit. Finally, recruiters can leverage the data as a formative assessment to gauge if participants' reasons for joining align with CDP offerings and branding. In doing so, recruiters can better determine the student/assignment fit and address any branding issues (e.g., students who expect to work on hands-on projects should be informed of the desk-based design work that is often assigned).

An additional implication from this research is that managers will now have an in-depth sense of the types of experiences students perceive as supportive of their success. Because participants identified learning experiences outside of the managers' high-level perspectives, managers are now aware of the extent to which peer knowledge sharing occurs. With this knowledge, managers can be strategic about facilitating meetings and encouraging group activities. Additionally, as participants discussed managing stress/conflict/mistakes as influential learning experiences, managers can consider how offering accessible mentors and safe spaces can support students through such experiences. Findings signal opportunities for managers to gauge the current state of the CDP and evaluate opportunities to leverage and support those additional experiences more intentionally.

A final implication for practice is that findings communicate to co-op program managers the potential gains of utilizing theory to inform the development and evaluation of co-op opportunities. Findings lay out how elements of career development theory can be contextualized to realize co-op programs goals and objectives. The operationalized learning experiences and their connection to self-efficacy and outcome expectations illustrate the applicability of SCCT to understand the role of co-op programs in engineering student career decision-making. This study serves as evidence of how co-op programs can leverage established frameworks of career development as the foundation for creating work experiences that purposefully support student transitions to post graduation work. In doing so, evaluation of the program's effectiveness can then identify concrete measures to clarify how outcomes are developed—clarifying best practices and growth opportunities for industry partners seeking to utilize student work experience can improve their competitive advantage.

University Academic and Career Advisors

Findings also offer implications for university staff who prepare students for co-op student experiences and support students as they return to the university from co-ops. Staff may reference findings of this study to provide industry (or company specific) recommendations in their advising. For example, they may cite the concrete learning experiences as well as students' career related outcome expectations to advise students on job placement, career outcomes, and fit in the aerospace industry where there are structures similar to host companies in this study. By doing so, one implication for practice/policy is that university career and professional development staff and academic advisors can better specify details of co-op outcomes. Because co-op students are making decisions of where to work based on their perceived benefits, staff should provide students with up-to-date and detailed data identified in this study to assist students in aligning expectations prior to and post co-op. For instance, if a staff member identifies that a student enjoys working in the field, he or she can discuss the level of field opportunities experienced by former CDP participants. Also, staff can help students process post co-op experiences. For example, as students noted that single experiences defined their preferences for design engineering work, staff can target efforts to remind students of the expanded role of full-time engineering at the host company or suggest that students further investigate how design engineering positions may differ across companies and contexts.

University-Industry Partnership Stakeholders

(Industry Managers/Human Resource Professionals/Academic and Career Staff, Students)

Another implication for practice/policy is that multiple stakeholders can use findings as evidence to promote the role of university and industry partnerships in the student-to-workforce transition. With a clearer understanding of how specific experiences impact participants' career decisions, university and industry stakeholders can collaborate to design co-op and internship experiences that will generate high-impact opportunities for participants to test their career intentions, and in turn influence recruitment and retention for industry partners. Results from this unique case study can enable conversations to be better directed about how partnerships offer benefits to students, academics, and industry broadly. Since participants' beliefs held over time, at least for the first five years following graduation, providing data to the university-industry partnership community on how partnerships impact students' career intentions may clarify how university and industry may better work together to improve student preparedness for industry. Co-ops (and students' work experiences) are critical to workforce development because participants move from professional exploration to professional formation.

Implications for Researchers and Future Work

The themes identified in this study provide researchers with empirical data to strengthen the current body of literature on co-op learning experiences and career related outcome expectations. Findings specify constructs in Social Cognitive Career Theory for a co-op experience—in particular, articulating learning experiences within the context of the CDP and linking those experiences to beliefs about pursuing industry roles. As researchers continue to explore how students' work experiences impact both career related outcome expectations as well as career choices, researchers can use this single case study as an outline for expanding the approach to a multiple case study strategy. Taking the research design and applying it to multiple cases gives the opportunity for researchers to show direct replication, offsetting criticism, and skepticism that often is given to single case studies. Considering the findings of this study in connection with the current literature, there are several additional opportunities for future research.

This study used qualitative methods to develop concrete learning experiences fostered by the CDP. Future research could include a quantitative approach to survey a larger group of CDP participants to identify additional learning experiences and to understand the variance of learning experiences that occur during the CDP across participants. The survey could also investigate relationships between learning experiences and individual characteristics of participants (e.g., major, grade-point average) as well as examine relationships with workplace characteristics (e.g., project type, location, and time of rotation).

Additionally, the role of self-efficacy deserves further investigation. Although not the focus of this study, descriptions that align with various types of career related self-efficacy were present and persistent in the data (e.g., work self-efficacy and occupational self-efficacy). Work self-efficacy refers to an individual's belief that he or she can successfully master non-technical and social skills needed in a work environment (Raelin, Bailey, Hamann, Pendleton, et al., 2014), and occupational self-efficacy is related to performance across all job tasks in different work scenarios (Schyns & von Collani, 2002). Because work self-efficacy and occupational self-efficacy measure different elements of an individual's belief about performing in the workplace, future work should tease out the differences in the various forms of career related self-efficacy to understand how specific learning experiences contribute to the development each type.

Future work should include interviews with on-site engineering professionals (supervisors and others) as well as other participants to demonstrate coherence in the research findings. By including both perspectives, future researchers can perform triangulation — converging managers' and students' perspectives to offer consistent conclusions as well as reconciling contradictions in the two datasets—which strengthens the trustworthiness of the study. In doing so, a more complete view of student and engineering professionals interactions can be developed.

In addition, future work could include identifying CDP participants who opted for the non-industry pathway (e.g., graduate school or leaving the field entirely) to understand how experiences in the CDP influenced their career decision-making. Such findings can shed light on potential differences in how students perceive the influence of co-op learning experiences in relation to their career goals. Also, considering that none of the underrepresented minority students chose to remain with the host company or in the aerospace industry, future work should examine if that pattern exists within the CDP and co-ops more broadly. Additionally, current participants in the CDP should be interviewed to gauge if reflections change over time, which would be an investigation of whether time in one's career impacts graduates' post participation perspective. Lastly, future longitudinal data collection with these participants could provide ESF and LAC with a better understanding of retention within their companies and the aerospace industry largely.

Limitations

Several limitations should be considered when evaluating the findings and implications of this research. By focusing on a single case, data collection was restricted to a limited number of participants who participated in the CDP and graduated from a single university. Changing personnel at the ESF led to issues in obtaining all former CDP participants' contact information directly from gatekeepers, and so I identified participants via multiples means (e.g., LinkedIn messaging, data requests from university co-op personnel, and cold emails to ESF managers). The size of the sample was reduced significantly when potential participants chose not to respond to recruitment contacts or opted not to participate. Moreover, the single case study approach required me to scope the study to a participant pool that presented challenges when seeking to gain access to participants and other relevant data. Ultimately, interviews in this study were supplemented by incorporating the managers' perspective and additional program documents which created opportunities to "extend analysis and enhance insights into the single case study (Yin, 2009)."

However, as discussed by Yin, case studies aim to establish analytical generalization, and researchers should aim to generalize to theory (i.e., focusing experiences in relations to building blocks of theory and discussing findings in context of theoretical constructs). By doing so, this study's findings can be viewed as building a case for engineering graduates' co-op experiences and career decision-making as posited by SCCT—providing researchers with an example case to investigate new contexts.

Although limitations to the interview approach have been discussed in Chapter 3, it is worth noting that participants self-selected both into the CDP as well as for this study. It is possible that these participants' views of the experience could represent two extremes, either advocating for the program because of a positive experience or criticizing the program because of a negative experience. I was mindful to remind participants of my dissociation from industry partners, and I asked participants to discuss both positive and negative experiences as needed to minimize this limitation. In addition, participants sometimes talked "across" multiple co-op experiences. I worked to have participants focus specifically on the CDP and applied appropriate filters during data analysis, but the influence and impact of additional co-op experiences that were outside the scope of the case under investigation are likely present.

Additionally, the mandatory nature of the co-op program in this study impacts the transferability of findings related to reasons for participation. Data in my study do not mimic the trend in co-op related literature that often highlights the financial aspects of participating in co-ops (e.g., Linn, Howard, & Miller, 2004); i.e., participants did not discuss salary as a reason to participate in the CDP. I propose that because participants are co-op oriented and are required to co-op they have likely developed an expectation of additional salary earnings during the co-op and post graduation that was not unique to the CDP. Therefore, one should not assume that the absence of findings related to the financial benefits of the co-op program mean that participants did not acknowledge the financial aspects of the co-op experience.

By focusing on the co-op participants' perspectives, I was unable to triangulate their discussions about interactions with managers, supervisors, or other engineering professionals. No direct observations occurred for this study since study participants reflected on their experiences, and findings related to student-manager interactions are based solely on the co-op participant perspective. This limitation was addressed by considering the managers' perspectives of the program via a secondary source, but that perspective is detached from the specific examples pointed to by participants and instead is a "bird's eye view" of the co-op program. Despite this limitation, however, the intent of this study was to capture students' perspectives and understand how they processed their co-op experiences as they considered their next career steps. Moreover, the participants' perspectives in this study include a diversity of students across sex, racial/ethnic background, and even major, thereby offering several perspectives of how learning experiences in the CDP shaped beliefs about engineering work.

Finally, career decision-making is a complex phenomenon that involves consideration of self as well as environmental and social pressures. While SCCT was utilized to frame student career decision-making, not all constructs of the framework were explored explicitly in this study. However, data in this study do suggest a strong alignment with SCCT, as discussed in Chapter 6. The varied pathways of each participant illustrate that there is no "one size fits all" approach to career decision-making as multiple factors (both internal and external to the individual) influence decision making, and SCCT captures these aspects through broad constructs. One must be careful not to focus solely on self-beliefs but also to consider interests and contextual influences to provide the most accurate representation of SCCT in career decision-making.

Conclusion

The structure of the Co-op Development Program and the perspective of eight former CDP participants addressed how learning experiences shaped the career decisions of engineering participants immediately following graduation. Major contributions of this study include extending the analytic generalizability of Social Cognitive Career Theory, creating operationalized definitions of learning experiences embedded within that framework, and linking those experiences to how students' beliefs became shaped on their pathway to an early career within engineering industry. The themes identified in this study can help CDP managers and university stakeholders better support co-op participants and potentially allocate resources that will serve as the basis for future co-op design recommendations. Stakeholders may also use findings to promote the role of university and industry partnerships in supporting the student workforce transition. Future researchers may extend the study design across multiple cases and leverage recommendations for qualitative and quantitative investigations to address some of the limitations embedded within this research design and further contribute to the discussion of preparing students for professional work environments through university-industry partnerships.

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Appendix A: Interview Protocol

Introduction:

Thank you for participating in this study. As I have mentioned, I am interested in understanding influences on the career decision-making of engineering graduates. Because this is a single case study on the Co-op Development Program between ESF/LAC/Large Mid-Atlantic Private University, I am going be focused on understanding how your experiences in the Co-op Development Program (CDP) influenced your career decisions to pursue engineering industry positions

As I am trying to provide an in-depth explanation of the relationship between experiences in CDP and career actions, I may ask a lot of "why" and "could you elaborate" questions to ensure that I am understanding your experience.

I want to assure you that your responses will be kept anonymous and at this time if you would like to choose a pseudonym for your name you may do so. This name will be used to identify you in both verbal and written presentation of my findings.

I do plan to record the interview in order to transcribe your responses later. Is this ok? You may stop at the interview at any point if you feel it is necessary. Do you have any questions?

[Provide Verbal Consent & Identify Pseudonym]

Interview Questions:

RQ1. [Understanding Participant beliefs] Why did engineering graduates participate in co-op rotations in the CDP?

1. **Describe your decision process to participate in the co-op development program.**

   Probing Prompts:

   - Why did you participate in the co-op assignment with ESF at the Academic Design Center?
   - Did you consider participating in another co-op or work experience?
   - If so, why did you choose CDP?

RQ2 [Learning Experiences] What learning experiences did engineering graduates encounter during co-op rotations in the CDP?

2. **Tell me about your experiences in the CDP.**

   Probing Prompts:

   - : Can you share an example of your
     - interactions with engineering professionals
     - involvement with work assignments
     - experiences with other co-op participants
3. **What were the most meaningful experiences that you encountered?**

4. **What was it about these experiences that you think made them meaningful?**

RQ3. [Linking Learning Experiences to Outcome Expectations] In what ways do engineering graduates believe their experiences in the co-op rotations influenced their outcome expectations (i.e., beliefs about pursuing engineering industry positions full-time)?

5. **How did you decide to pursue (or not pursue) a career in engineering?**

6. **How did your experiences in the CDP influence your beliefs about working in an engineering industry position post degree?**

7. **What specific examples can you remember shaping your beliefs?**
   Probing Prompts:
   - interactions with engineering professionals
   - involvement with work assignments
   - experiences with other co-op participants

8. **How did X (above response) affect your beliefs about working in engineering industry post graduation?**

9. **If you performed well during your time in the CDP, what do you expect to happen after you completed your co-op rotation with respect to…**
   a. advancing your goal to enter a technical engineering career
   b. exploring other career opportunities
   c. having an attractive salary
   d. earning the respect of colleagues

[Linking Outcome Expectations to Career Actions] How do engineering graduates relate outcome expectations to their career actions immediately following graduation?

10. **How did you decide to pursue (or not pursue) a career in (X-industry/Y-occupation)?**

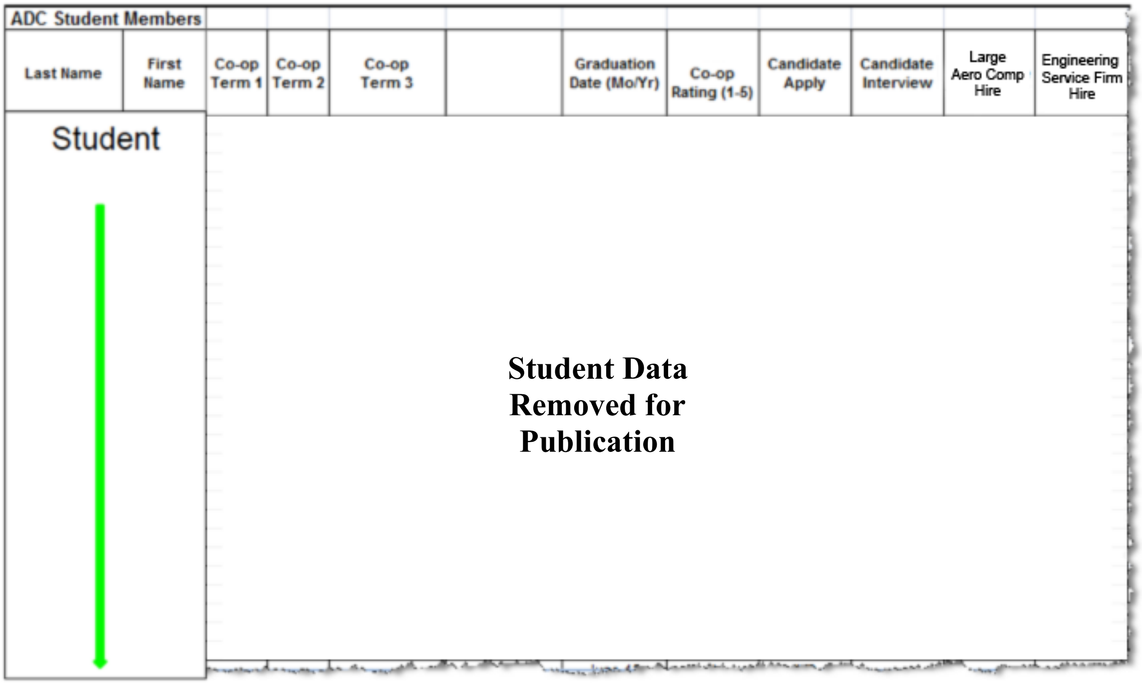
11. **How did you feel about pursuing an engineering role in industry after your co-op rotation?**

12. **Overall, how would you describe the influence CDP had on your decision to pursue (or not pursue) an engineering role in industry?**

13. **Is there anything else you would like to share?**

Thank you again for your participation. If you have any questions or think of anything else you want to share please feel free to contact me.

Appendix B: Skill Matrix Screenshot



ADC Student Members											
Last Name	First Name	Co-op Term 1	Co-op Term 2	Co-op Term 3		Graduation Date (Mo/Yr)	Co-op Rating (1-5)	Candidate Apply	Candidate Interview	Large Aero Comp Hire	Engineering Service Firm Hire
Student											

Student Data Removed for Publication

Appendix C: Personal Profile Questionnaire

Q30 The purpose of this questionnaire is to provide background information about participants in the Preparing Students for Professional Work Environments Through Academic-Industry Partnerships dissertation study. This study aims to understand how experiences in the Large Mid-Atlantic Private University University/LAC/ESF Incorporated Co-op Development Program (CDP) influence career decisions.

We anticipate this study will identify specific elements of participants' learning experiences within the co-op program that support or discourage entry into a full-time engineering position. The study will also produce a nuanced perspective of how student participation in cooperative education might be used to supplement public policy discussions that aim to grow a well-prepared and diverse STEM workforce in the US.

The survey will take about 7 minutes to complete.

Additional information about the study:

Responses in this questionnaire will be utilized to select participants for interviews.
If selected and you provide consent to participate, you will participate in an interview that will take up to 60 minutes.
Be assured, your responses are completely confidential; published results will include only summaries of multiple interviewee responses and aggregate data from the questionnaire will be included in published results regardless of your decision to participate in the interview.
A pseudonym will be used to ensure your name is not linked to data in published results.
The data will be stored electronically in a password protected, secure location.
Only the research team will have access to the raw data.
If you have any questions about the survey please contact Glenda Young at glenda87@vt.edu or 662-722-0201.

Thank you for taking time to complete the questionnaire.
Should you have any questions or concerns about the study's conduct or your rights as a research subject, you may contact the VT IRB Chair, Dr. David M. Moore at moored@vt.edu or (540) 231-4991.

Q4 Please respond about your voluntary participation in this study: Do you consent to have your responses used as part of this research project for publication and presentation to academic communities? At no point will your name be associated with the published results of this study.

¢Yes, I choose to participate in this study. I understand that my consent can be withdrawn or that I may withdraw from the study at any time.
¢ No, I choose not to participate in this study

Q32 Please respond about permission to utilize data from a Skill Matrix generated by ESF Incorporated. The Skill Matrix is a document created by ESF Incorporated to track student progress and retention in the Co-op Development Program. Variables include participants' technical training, graduation date, race, sex, academic classification, number of co-ops, performance assessments, decision to interview, reception of job offer, and decision to accept job offer. Data listed in the Skill Matrix will be used to describe characteristics of participants. This will be done at the aggregate level. The data may also be used to guide interview topics when appropriate. For instance, I may ask participants who completed multiple co-ops rotations to differentiate between those experiences in the interview. Please respond about use of Skill Matrix data in this study:

- ❍ Yes, I consent to use of my Skill Matrix data.
- ❍ No, I do not consent to the use of my Skill Matrix data.

Q6 Please fill out your first name, last name, email address, and phone number. This information will not be used in the content of this study. It will be used to to make selections for future interviews. No identifying data will be stored with your responses, that data will be replaced with a pseudonym.

First Name
Last Name
Email
Contact Phone Number

Q42 Please fill out your first name, last name, email address, and phone number. This information will not be used in the content of this study. It will be used to to make selections for future interviews and to connect the data from the questionnaire to data in the Skill Matrix. No identifying data will be stored with your responses, that data will be replaced with a pseudonym.

First Name
Last Name
Email
Contact Phone Number

Q8 What is your sex?

- ❍ Male
- ❍ Female
- ❍ Other
- ❍ Prefer not to answer

Q10 What is your racial/ethnic background?

- ❍ African American
- ❍ Asian/Pacific Islander
- ❍ Hispanic/Latino
- ❍ Native American
- ❍ White (non-Hispanic)
- ❍ Multi-racial
- ❍ None of the above categories
- ❍ Prefer not to answer

Q33 Please indicate the year you graduated from Large Mid-Atlantic Private University University:
- 2016
- 2015
- 2014
- 2013
- 2012
- 2011
- 2010
- 2009
- Before 2009

Q35 Please indicate which bachelor's degree you have earned. (If more than one major, select only one that most closely matches your professional interests.)
- Architectural Engineering
- Chemical Engineering
- Civil Engineering
- Computer Engineering
- Construction Management
- Cybersecurity
- Electrical Engineering
- Engineering
- Engineering Management
- Engineering Technology
- Entertainment Engineering
- Environmental Engineering
- Global Engineering
- Materials Science and Engineering
- Mechanical Engineering
- Nuclear Engineering
- Project Management
- Property Management
- Real Estate
- Systems Engineering
- Telecommunications Engineering
- Other
- Did not earn BS in engineering

Q17 What is the highest level of education you have completed?
- Bachelors Degree
- Masters Degree
- Doctoral Degree
- Professional Degree (JD, MD)

Q14 Number of co-ops completed while at Large Mid-Atlantic Private University University:
- ❍ 0
- ❍ 1
- ❍ 2
- ❍ 3
- ❍ 4
- ❍ 5
- ❍ More than 5

Q43 Number of co-ops completed as an employee of ESF Incorporated while at Large Mid-Atlantic Private University University:
- ❍ 0
- ❍ 1
- ❍ 2
- ❍ 3
- ❍ More than 3

Q31 Number of co-ops completed as an employee of LAC while at Large Mid-Atlantic Private University University:
- ❍ 0
- ❍ 1
- ❍ 2
- ❍ 3
- ❍ More than 3

Q36 Following your participation in ESF/LAC co-op rotation(s), which describes your experience? (Mark All that Apply)
- ❑ I was offered an interview with ESF for full-time employment
- ❑ I was offered and DECLINED an interview with ESF for employment
- ❑ I was offered and DECLINED full-time employment with ESF
- ❑ I was offered and ACCEPTED full-time employment with ESF
- ❑ None of the above describe my experience
- ❑ I was offered an interview with LAC for full-time employment
- ❑ I was offered and DECLINED an interview with LAC for employment
- ❑ I was offered and DECLINED full-time employment with LAC
- ❑ I was offered and ACCEPTED full-time employment with LAC

Q44 What is your current student status?
- ❍ Not enrolled in graduate study
- ❍ Full-time graduate study
- ❍ Part-time graduate study

Q26 What is your current employment status?
- ❍ Full-time
- ❍ Part-time
- ❍ Not currently employed

Q28 Is your current (or most recent) employed position the same as your first employed position after you earned your bachelor's degree in engineering?

- ❍ Current position is same as first employed position
- ❍ Current position is different from first employed position

Q22 Where are you currently (or most recently) employed?
- ❍ PRIVATE-FOR-PROFIT company, business or individual, for wages, salary or commissions
- ❍ PRIVATE-NOT-FOR-PROFIT, tax-exempt, or charitable organization
- ❍ Local GOVERNMENT employee (city, county, etc.)
- ❍ State GOVERNMENT employee
- ❍ Federal GOVERNMENT employee (does not include military active duty)
- ❍ MILITARY (active duty)
- ❍ SELF-EMPLOYED in own business, professional practice, or farm
- ❍ Working WITHOUT PAY in family business or farm
- ❍ Other (Explain below) ____________________

Q27 Would you describe your current and primary employed position (or most recent position if not currently employed) as:
- ❍ An engineering position
- ❍ A non-engineering position

Q18 In which industry are you currently (or most recently) employed?
- ❍ Agriculture, forestry, fishing and hunting, mining
- ❍ Armed Forces
- ❍ Arts, entertainment, recreation, food service
- ❍ Construction
- ❍ Finance, insurance, or real estate
- ❍ Health care or social assistance
- ❍ Higher Education
- ❍ Other educational services
- ❍ Information
- ❍ Management of companies or enterprises
- ❍ Manufacturing
- ❍ Publishing and communications
- ❍ Professional, scientific or technical services
- ❍ Transportation or warehousing
- ❍ Utilities
- ❍ Wholesale or retail trade
- ❍ Other

Q20 Which one of the following best describes your current (or most recent) primary job function?
- ❍ Business/finance
- ❍ Consultant
- ❍ Faculty/academic professional
- ❍ Human resources
- ❍ Information/technology/network support
- ❍ Management/administration/executive
- ❍ Marketing/sales
- ❍ Production/installation,delivery of services
- ❍ Supervisor of professional/technical/research personnel
- ❍ Research/development/testing
- ❍ Other

Q24 What is your current (or most recent) job title?

Q29 After earning your bachelor's degree in engineering, was your first employed position: (Mark one.)
- ❍ An engineering position
- ❍ A non-engineering position

Q33 What was your first employed position employment status?
- ❍ Full-time
- ❍ Part-time
- ❍ Other ____________________

Q35 Where was your first employed position (after earning your bachelor's degree in engineering) employed?
- ❍ PRIVATE-FOR-PROFIT company, business or individual, for wages, salary or commissions
- ❍ PRIVATE-NOT-FOR-PROFIT, tax-exempt, or charitable organization
- ❍ Local GOVERNMENT employee (city, county, etc.)
- ❍ State GOVERNMENT employee
- ❍ Federal GOVERNMENT employee
- ❍ SELF-EMPLOYED in own NOT INCORPORATED business, professional practice, or farm
- ❍ SELF-EMPLOYED in own INCORPORATED business, professional practice, or farm
- ❍ Working WITHOUT PAY in family business or farm
- ❍ Other ____________________

Q36 In which industry was your first employed position?
- ❍ Agriculture, forestry, fishing and hunting, mining
- ❍ Armed Forces
- ❍ Arts, entertainment, recreation, food service
- ❍ Construction
- ❍ Finance, insurance, or real estate
- ❍ Health care or social assistance
- ❍ Higher Education
- ❍ Other educational services
- ❍ Information
- ❍ Management of companies or enterprises
- ❍ Manufacturing
- ❍ Publishing and communications
- ❍ Professional, scientific or technical services
- ❍ Transportation or warehousing
- ❍ Utilities
- ❍ Wholesale or retail trade
- ❍ Other

Q37 Which one of the following best describes your first employed job function?
❍ Business/finance
❍ Consultant
❍ Faculty/academic professional
❍ Human resources
❍ Information/technology/network support
❍ Management/administration/executive
❍ Marketing/sales
❍ Production/installation/delivery of services
❍ Supervisor of professional/technical/research personnel
❍ Research/development/testing
❍ Other

Q30 Since earning your bachelor's degree in engineering, how would you describe your career path so far?
❍ Primarily pursuing engineering work/studies
❍ Primarily pursuing non-engineering work/studies
❍ Pursuing both engineering and non-engineering work/studies
❍ I do not see myself as having pursued a career path

Q13 This survey has asked about your employment history since earning your engineering bachelor's degree. Is there anything else you would like to share about yourself?

Q46 Would you be willingly to participate in future studies related to engineering career decisions?
❍ Yes, I am open to being contacted for future studies.
❍ No, I would not like to be contacted for future studies.